JAIDEV EDUCATION SOCIETY'S
J D COLLEGE OF ENGINEERING AND MANAGEMENT
KATOL ROAD, NAGPUR
Website: www.jdcoem.ac.in E-mail: info@jdcoem.ac.in
(An Autonomous Institute, with NAAC "A" Grade)
Affiliated to DBATU, RTMNU & MSBTE Mumbai
Department of Electrical Engineering
"Igniting minds to illuminate the world"
2024 -2027

VISION	MISSION
"To develop competent and committed Electrical Engineers to serve the society"	1. To impart quality education in the field of Electrical Engineering. 2. To be excellent learning center through research and industry interaction.

Teaching Scheme as per NEP
III Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC(T)	EE3T001	Measurement & Instrumentation	2	0	0	20	20	60	100	2
2		EE3T002	Network Analysis	2	1	0	20	20	60	100	3
3		EE3T003	Electrical Machine I	3	0	0	20	20	60	100	3
4	MDM	EE3M001	Computer Programming by Python	2	0	0	20	20	60	100	2
5	OE	EE3O001	OE-I	3	0	0	20	20	60	100	3
6	EEMC	EE3H001	Entrepreneurship Development	2	0	0	20	20	60	100	2
7	VEC	EE3V001	Universal Human Values-II	2	0	0	20	20	60	100	2
8	PCC(L)	EE3L004	Measurement & Instrumentation Lab	0	0	2	60	0	40	100	1
9	MDM(L)	EE3L006	Computer Programming by Python Lab	0	0	2	60	0	40	100	1
10	PCC(L)	EE3L005	Electrical Machine I Lab	0	0	2	60	0	40	100	1
11	CEP/FP	EE3F001	Comm Engg Proj/Field Project	0	0	4	60	0	40	100	2
			Total	**16**	**1**	**10**	**380**	**140**	**580**	**1100**	**22**

Member Secretary(Board of Studies, EE Dept)

Chairperson(Board of Studies, EE Dept)

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IV Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC(T)	EE4T001	Electrical Machine-II	3	0	0	20	20	60	100	3
2		EE4T002	Power Systems-I	2	0	0	20	20	60	100	2
3	MDM	EE4M002	Introduction to Data Science	2	0	0	20	20	60	100	2
4	OE	EE4O002	OE-II	3	0	0	20	20	60	100	3
5	AEC	EE4A002	Principles of Corporate Success	2	0	0	20	20	60	100	2
6	EEMC	EE4H002	Engineering Economics	2	0	0	20	20	60	100	2
7	VEC	EE4V002	Intellectual Property Rights	2	0	0	20	20	60	100	2
8	PCC(L)	EE4L003	Electrical Machine-II Lab	0	0	2	60	0	40	100	1
9		EE4L004	Power Systems-I Lab	0	0	2	60	0	40	100	1
10	VSEC(L)	EE4L005	Illumination and Electrification of Buildings	0	0	4	60	0	40	100	2
11		EE4N001	MOOC (NPTEL/SWAYAM)	0	0	0	40	0	60	100	2
			Total	**16**	**0**	**8**	**360**	**140**	**600**	**1100**	**22**

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Teaching Scheme

Branch code: EE

V Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC-EE	EE5T001	Power Electronics	3	0	0	20	20	60	100	3
2	PCC-EE	EE5T002	Control System I	3	0	0	20	20	60	100	3
3	PCC-EE	EE5T003	Power System II	3	0	0	20	20	60	100	3
4	PEC-EE	EE5E001	**Elective I**	3	0	0	20	20	60	100	3
5	PEC-EE	EE5E002	**Elective II**	3	0	0	20	20	60	100	3
6	OEC-EE	EE5O001	**Open Elective I**	4	0	0	20	20	60	100	4
7	PCC-EE	EE5L001	Power Electronics Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE5L002	Control System I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE5L003	Power System II Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE5P003	Mini Project/Seminar (Phase I)	0	0	2	30	0	20	50	1
11	MC	EE5T004	Consumer Affairs	2	0	0	10	15	25	50	Audit
			Total	**21**	**0**	**8**	**340**	**135**	**525**	**1000**	**23**

VI Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC-EE	EE6T001	Microprocessor and microcontroller	3	0	0	20	20	60	100	3
2	PCC-EE	EE6T002	Advance Control System	3	0	0	20	20	60	100	3
3	PEC-EE	EE6E003	**Elective III**	3	0	0	20	20	60	100	3
4	PEC-EE	EE6E004	**Elective IV**	3	0	0	20	20	60	100	3
5	OEC-EE	EE6O002	**Open Elective II**	4	0	0	20	20	60	100	4
6	PCC-EE	EE6L001	Microprocessor and microcontroller Lab	0	0	2	60	0	40	100	1
7	PCC-EE	EE6L003	Computer Aided Design Lab	0	0	2	60	0	40	100	1
8	PROJ-EE	EE6P004	Mini Project/Seminar(phase II)	0	0	2	30	0	20	50	1
9	PROJ-EE	EE6P005	Campus Recruitment Training(CRT)	0	0	2	50	0	0	50	1
10	PROJ-EE	EE6P006	Skill Development Courses	0	0	2	15	0	35	50	1
11	MC	EE6T003	Research Methodology	2	0	0	10	15	25	50	Audit
			Total	**15**	**0**	**10**	**305**	**95**	**400**	**800**	**21**

VII Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC-EE	EE7T001	Switch gear and protection	3	0	0	20	20	60	100	3
2	PCC-EE	EE7T002	High Voltage Engineering	3	0	0	20	20	60	100	3
3	PEC-EE	EE7E005	**Elective V**	3	0	0	20	20	60	100	3
4	OEC-EE	EE7O003	**Open Elective III**	4	0	0	20	20	60	100	4
5	PCC-EE	EE7L001	Switch gear and protection Lab	0	0	2	60	0	40	100	1
6	PCC-EE	EE7L002	Computer Applications in Electrical Engineering Lab	0	0	2	60	0	40	100	1
7	PROJ-EE	EE7P006	Project-I	0	0	10	75	0	75	150	5
8	MC	EE7T003	Intellectual Property Rights	2	0	0	10	15	25	50	Audit
			Total	**15**	**0**	**14**	**285**	**95**	**420**	**800**	**20**

VIII Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
	PEC-EE	EE8E006	Elective VI	3	0	0	20	20	60	100	3
	OEC-EE	EE8O004	Open Elective IV	4	0	0	20	20	60	100	4
1	PROJ-EE	EE8P007	Project-II	0	0	6	50	0	50	100	3
	PROJ-EE	EE8P009	MOOC	0	0	0	15	0	35	50	2
OR											
2	PROJ-EE	EE8P008	Internship(3 months)	0	0	0	0	0	0	300	10
	PROJ-EE	EE8P009	MOOC	0	0	0	15	0	35	50	2
			Total							**350**	**12**

EE Credits		124
First Year		35
Total Credits		**159**
EE Marks		4950
First Year Marks		1550
Total Marks		**6500**

Prof. A. V.Joshi
Member Secretary
Board of Studies, EE Dept

Dr.V.S.Dhok
Chairman
Board of Studies, EE Dept

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3T001	Measurement and Instrumentation	3	0 1	0 0	3 3

Prerequisites for the course	
1	Basic Electrical concepts studied up to second semester such as electromagnetic induction,emf,current,voltage,power,etc

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc19_ee44/preview
2	Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria & Sons

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the different types of instruments used in electrical measurements.
2	CO2	Understand the operating principles of various electrical measuring instruments.
3	CO3	Apply knowledge of variety of instruments available for required parameter and identify the appropriate one.
4	CO4	Analyze and classify different electrical measuring instruments on basis of type of electrical/ physical quantity to be measured
5	CO5	Evaluate different electrical measuring instruments
6	CO6	Test and solve various problems on electrical measuring instruments.

Syllabus:

Course Contents	
Unit I	General principles of measurements Measurement system measurement standards , characteristics - errors in measurement. Calibration of meters- significance of IS standards of Instruments. Classification of meters - operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operating, principles shunts and multipliers , extension of range. (8 Hours)
Unit II	Classification of resistance. Measurement of medium resistances , ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances, Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Loss of Charge Method, Direct Deflection Method. Measurement of earth resistance. (8Hours)
Unit III	AC bridges , Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge Anderson bridge, Owens Bridge for self inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge, Schering bridge for capacitance measurement. Wien's bridge frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. (8 Hours)
Unit IV	Measurement of Power & Energy Principle of Measurement of active, reactive and apparent power single and in poly phase circuits. Measurement of Energy in single and poly phase circuits. Electrodynamometer Wattcmeters, Construction, Working, Errors in wattmeter, Single phase Energy meter, Theory and operation, compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading. (8 Hours)
Unit V	Transducers Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezoelectric transducer, load cell, strain gauge, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system. (8 Hours)
Text Books	
1	Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, DhanpatRai .
2	Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria & Sons
3	Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012
Reference Books	
1	Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.
2	Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India
3	J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011
Useful links	
1	https://onlinecourses.nptel.ac.in/noc19_ee44/preview

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3T002	Network Analysis	2	1	0	3

Prerequisites for the course	
1	Basic Electrical concepts studied up to Second Semester in the subject BEEE such as current,voltage,power,etc

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ee07/preview
2	Sudhakar Shyammohan Tata Mc Graw Hill 2005, —Circuit and Network Analysis‖\

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember basic circuital law and simplify the network using reduction techniques
2	CO2	Understand the circuit using Kirchhoff's law and Network simplification theorems
3	CO3	Develop transient response, Steady state response, network functions
4	CO4	Analyze the maximum power transfer to the load, series resonant and parallel resonant circuit
5	CO5	Evaluate two-port network parameters , design attenuators and equalizers
6	CO6	Design one port network using Foster and Cauer Forms.

Syllabus:

Course Contents	
Unit I	Mesh And Nodal analysis: Dependent and Independent Sources, Active & Passive Elements, Source Transformation, Duality. Mesh analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy. Concept of super mesh, mutual inductance, coefficient of coupling, Dot convention, dot marking in coupled coils. Nodal analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy. Concept of super node. . (7 Hours)
Unit II	Network Theorems: Linearity theorem, Thevinin's theorem, Norton's theorem, Super position theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's theorems (Both AC & DC) (6 Hours)
Unit III	Time Domain Analysis of Circuits: Linear Differential Equations for Series RC, Parallel RC, Series RL, Parallel RL, Series RLC, Parallel RLC and Coupled Circuits- Complete Solution for step/impulse/sinusoid voltage/current inputs. Natural Response-Transient Response-Time Constant-Rise and Fall times-Concept of D.C. steady state and sinusoidal steady state-Frequency Response of simple circuits from steady state solution- (6 Hours)
Unit IV	Laplace Transform & Properties: Review of Laplace Transform & Properties Partial fractions, Concept of initial and final condition, Singularity functions, Waveforms synthesis, Steady state and transient

	state analysis of RL, RC, RLC network with and without initial conditions with Laplace transforms. Network Functions: Driving points and transfer functions, poles, zeros of transfer function, their properties. (6Hours)
Unit V	Two Port Networks : Two port networks, characterizations in terms of impedance, admittance, hybrid and transmission parameters, Conditions for symmetry and Reciprocal, inter relationships among parameter sets Reciprocity Theorem-Interconnection of Two port networks: Series, Parallel and Cascade connection. (6 Hours)
Text Books	
1	Mac.E Van Valkenburg, —Network Analysis‖
2	M. L. Soni, J. C. Gupta, —A Course in Electrical Circuits and Analysis‖
ReferenceBooks	
1	Franklin Fa-Kun. Kuo, —Network Analysis & Synthesis‖, John Wiley & Sons.
2	Joseph A. Edminister, Mahmood Maqvi, —Theory and Problems of Electric Circuits‖, Schaum's Outline Series
Usefullinks	
1	https://onlinecourses.nptel.ac.in/noc22_ee07/preview

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1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
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3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3T003	Electrical Machine I	3	0	0	3

Prerequisites for the course	
1	Basic Electrical concepts studied up to Second Semester such as electromagnetic induction ,emf,current,voltage,power,etc

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc20_ee60/preview
2	Electrical Machines: Ashfaq Hussain; Dhanpat Rai Publication

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Recall the basic laws and rules of electromagnetic induction, electric and magnetic circuits.
2	CO2	Understand constructional features, working principles of electrical machines and explain different types of starting & speed control methods of electric motors.
3	CO3	Apply knowledge to calculate the power loss, voltage regulation, efficiency of transformer and operating speed of electric motor and choose type of motor, its starting and speed control methods with respect to applications.
4	CO4	Analyse performance indices, vector diagrams of electrical machines and examine the need of parallel operation, O.C. & S.C. test, Polarity test on transformer, and blocked rotor test on induction motors.
5	CO5	Evaluate braking methods of DC, and induction motor.
6	CO6	Design motoring system able to give solutions for single phase, three phase and DC supply with respect to supply available and load requirements.

Syllabus:

Course Contents	
Unit I	Single Phase Transformer Transformer construction, classification, principle and operation of single phase transformer, Excitation phenomenon in transformers, Ideal and practical transformer, equivalent circuits, NO load and ON load operation, Phasor diagrams, Power and Energy Efficiency, Voltage regulation, Polarity test, Parallel operation, O.C. & S.C. test on single phase transformer, Effect of load on power factor, Applications-Auto transformers, Variable frequency transformer, Voltage and Current transformers, Welding transformers, Pulse transformer and applications. (8 Hours)
Unit II	Three Phase Transformer Constructional features, principle and operation of three phase transformer, Regulation, Efficiency, Three winding transformers and its equivalent circuit, Magnetizing current and harmonics, Winding identifications, Various connections with vector group, On load tap changing of transformers, O.C. & S.C. test on three phase transformer, Determination of equivalent circuit parameters calculation using O.C. & S.C. test, Parallel operation of three phase transformer, Scott Connection, Back to Back test, Type and routine tests. (8 Hours)
Unit III	DC Generator Construction, Magnetic structure, Principle and operation, Field and Armature systems, Field and Armature windings (Both Lap and Wave Types), EMF Equation,Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction, commutation, straight line commutation, inter-poles, compensating winding, Causes of bad commutation and remedies, Building of Emf in D.C. Shunt generator, Characteristics and Applications of Different types of D.C. Generators. DC Motor Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Applications of various types of D.C. Motors, Starting of DC Motors, Speed control of Series, Shunt and Compound motors, Power flow in DC machines, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses &Applications (9 Hours)
Unit IV	DC Motor Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Applications of various types of D.C. Motors, Starting of DC Motors, Speed control of Series, Shunt and Compound motors, Power flow in DC machines, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses &Applications (8Hours)
Unit V	Induction Motors Types of 3-phase induction motor and production of torque. Torque-slip characteristics, Torque-speed characteristics & Applications, NO load blocked rotor test, Losses & efficiency, Double cage motor, Operating characteristics & Influence of machine parameter on the performance of motor, Various methods of starting of 3 phase I.M, Methods of speed control of I.M., Braking Methods-Braking regenerative braking, Plugging, Dynamic braking, Crawling & cogging. Single Phase Induction Motor Construction, Double Field revolving theory of Single phase induction motor, Types of IM on the basis of self-starting methods: Split phase induction motor: Capacitor start inductor motor, Capacitor start capacitor run induction motor (two value capacitor method), Permanent split capacitor (PSC) motor; Shaded pole induction motor; Phasor diagrams, Losses and Efficiency, Load characteristics & Applications. (7Hours)
Text Books	
1	Electrical Machines: Dr. P.S. Bimbhra

2	A Text Book of Electrical Technology: B. L. Theraja (Vol. II)
Reference Books	
1	Performance & Design of A.C. Machine: M. G. Say
2	Electrical Machines and Transformers: Nasser Syed
Useful links	
1	https://onlinecourses.nptel.ac.in/noc20_ee60/preview

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3L005	Measurement and Instrumentation Lab	0	0	2	1

Prerequisites for the course	
1	Basic Electrical concepts studied up to Second Semester &Measurement and Instrumentation Theory concepts studying in current semester.

Prior Reading Material/useful links	
1	http://sl-coep.vlabs.ac.in/

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Choose correct instrument for measuring given electrical/ physical quantity.
2	CO2	Compare various methods and instruments available for measurement of single quantity.
3	CO3	Apply understanding about instrumentation concepts which can be applied to electrical measurements.
4	CO4	Analyse the testing and measuring set up for electrical systems
5	CO5	Evaluate efficiency of different instruments
6	CO6	Design circuit for measuring given quantity

Syllabus:

List of Experiments
• To measure low resistance by Kelvin's double bridge • To measure medium resistance by Wheatstone bridge • To measure self inductance by Hay's bridge • To measure capacitance by De Sauty Bridge • To calibrate a given single phase induction type energy meter. • To Study and Calibrate Three Phase Wattmeter. • To measure active and reactive power in three phase balanced load by one wattmeter method • To find the effect of various parameters on output of given LVDT • To Study the change in resistance of RTD probe depending on the process temperature and to Study the dynamic response of RTD probe. • To Study the change in EMF of a thermocouple in response to the process temperature. • To study impulse voltage generator • To study impulse current generator

Contributions for syllabus designing:

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1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3L006	Network Analysis Lab	0	0	2	1

Prerequisites for the course	
1	Basic Electrical concepts studied up to Second Semester & Network Theory concepts studying in current semester

Prior Reading Material/useful links	
1	http://vlabs.iitb.ac.in/vlabs-dev/labs/network_lab/labs/explist.php

CourseOutcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Define basic concepts and principles related to Circuit Analysis
2	CO2	Identify the super mesh & super nodal problems
3	CO3	Verifies principles of network
4	CO4	Solve two port network problems
5	CO5	To Analyze RLC Circuit

Syllabus:

List of Experiments
0) To Know your Lab 1) Introduction To Laboratory Equipment 2) To Study & Verify Superpostion theorem 3) To Study & Verify Thevinion‘s theorem 4) To Study & Verify Norton‘s theorem 5) To Study & Verify maximum power transfer theorem 6) To Study & Verify reciprocating theorem 7) Determination of transient response of current in RL & RC circuits with step voltage input 8) Analysis of RL/ RC and RLC circuits 9) Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values 10) Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.

Contributions for syllabus designing:

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1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
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3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3L007	Electrical Machine I Lab	0	0	2	1

Prerequisites for the course	
1	Basic Electrical concepts studied up to Second Semester &Electrical machine theory concepts studying in current semester.

Prior Reading Material/useful links	
1	https://em-coep.vlabs.ac.in/

Course Outcomes:

	Course outcome number	CO statement
1	CO1	The basic principle of transfer of electrical power, operation, construction of Single phase and Three phase transformers, their classification, connections and phasor diagrams.
2	CO2	The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of DC generators and motors.
3	CO3	The basic principle, construction, operation, Performance characteristics, steady state analysis, Speed control and applications of Single Phase and Three phase Induction motors.

Syllabus:

List of Experiments
• To verify turns ratio of Transformer. • To perform polarity test on Single Phase Transformer. • To determine equivalent circuit diagram of transformer through O.C & S.C Test. • To determine efficiency by direct loading test on Single Phase Transformer. • To verify V-I relationship & draw Phasor diagram of 1. Star-Star 2.Star-delta 3.delta-star • Delta-Delta connection of single-phase transformer. • To study the construction of field and armature of DC Machine. • To determine external characteristics of DC Generator. • To perform Load test on DC shunt motor. • To perform speed control of DC shunt motor using armature and field control method.

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
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Secretary	Chairman	Dean	Chairman
BOS	BOS	Academics	Acd.Council

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3M001	Electrical Engineering Mathematics	2	0	0	2

Prerequisites for the course	
1	Basic Mathematical concepts studied up to Second Semester such as Integration ,Fourier Transform etc.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/111105121
2	Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember properties of Laplace transform, Convolution Theorem, Fourier integral theorem, Parseval‟s identity , Cauchy's integral theorem , Cauchy's residue theorem
2	CO2	Describe properties of Laplace transform, Convolution Theorem, Fourier integral theorem , Parseval‟s identity , Cauchy's integral theorem , Cauchy's residue theorem .
3	CO3	Illustrate the examples using Laplace transform, Fourier Transform, Partial differential equation, Function of Complex Variables, Matrices.
4	CO4	Apply the knowledge of Laplace transform, Z-transform, function of complex variable, Advance partial differential equation.
5	CO5	Analyze the question on Laplace transform, Fourier Transform, Partial differential equation , Function of Complex Variables
6	CO6	Create a modal using Laplace transform, Fourier Transform, Partial differential equation, Function of Complex Variables, Matrices.

Syllabus:

Course Contents	
Unit I	Laplace transform: Definition , conditions for existence; Properties of Laplace transforms; Transforms of some special functions- periodic function, Heaviside-unit step function. (7Hours)
Unit II	Inverse Laplace transform :Introductory remarks ; Inverse transforms of some elementary functions ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of differential equations (7Hours)
Unit III	Z transform:Defination, Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method), Solutions of Difference Equations with Constant Coefficients by Z- transform.. (7Hours)
Unit IV	Advance Partial Differential equations :Introduction Partial differential equation, method of separation of variables, Application of partial differential equations .(Heat equation ,wave equation , Laplace Equation)

	(7Hours)
Unit V	Functions of Complex Variable: Analytic functions; Conjugate functions; Cauchy-Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form, Cauchy's integral theorem; Bilinear transform Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorem without proofs) (7Hours)
Unit VI	Numerical Methods: Solution of algebraic and transcendental equations using method of false position and Newton-Raphson method. Solution of system of linear equations, Gauss elimination method, Gauss- Seidal method, . Numerical solution of ordinary differential equations by Taylor's series method, Modified Euler's method, Runge-Kutta method. (7Hours)
Text Books	
1	Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2	A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
Reference Books	
1	Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2	A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
Useful links	
1	https://nptel.ac.in/courses/111105121

Contributions for syllabus designing:

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4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
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Secretary	Chairman	Dean	Chairman
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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3H001	Entrepreneurship Development	2	0	0	2

Prerequisites for the course	
1	Basics idea of Entrepreneurship derived from live examples of startups and innovation from various news channels, newspapers and social media.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc21_mg63/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Discover the creative / innovative side within her/him
2	CO2	Hone entrepreneurial and leadership skills within his/her personality.
3	CO3	Develop new ways of thinking and Learn the entire innovation cycle from Ideation to GoToMarket.
4	CO4	Study frameworks, strategies, techniques and business models for conceived ideas.
5	CO5	Develop skills for evaluating, articulating, refining, and pitching a new product or service.

Syllabus:

Course Contents	
Introduction to Innovation, Personal thinking preferences, 'Innovation' mind set, Everyday creativity and eliminating mental blocks, Introduction to Innovation, Creative thinking techniques, Innovation types, Idea management and approaches, Teaming techniques for creativity, Idea Conception, Idea Scoping, Self-Evaluation, Idea Brainstorming sessions, Idea Verification, Market Evaluation, Concept Evaluation, Idea Verification, Prototype Evaluation, Protection/Patent review, Innovation Case Study, Idea Presentations, Idea Incubation, Product and Market Plan, Product and Market Development, Innovation Case Studies, Idea Incubation and Product Launch, Marketing and selling, Post Launch Review	
Text Books	
1	Jeff Dyer, Hal Gregersen, Clayton M. Christensen, " The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators, Harvard Business Review Press, 2011.
Reference Books	
1	Paddy Miller, Thomas Wedell-Wedellsborg, "Innovation as Usual: How to Help Your People Bring Great Ideas to Life, Harvard Business Review Press, Kindle Edition.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_mg63/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE3V001	Universal Human Values -II	2	0	0	2

Prerequisites for the course	
1	Basic concepts of subject Universal Human Values -Istudied in Second Semester.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/109104068
2	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind.
2	CO2	They would have better critical ability.
3	CO3	They would also become sensitive to their commitment towards what they believe in (humane values. Humane relationships and humane society).
4	CO4	they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Syllabus:

Course Contents	
Unit I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course, recapitulation from Universal Human Values-I . Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations . Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking. (7 Hours)
Unit II	Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensureSanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate

	between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease (7 Hours)
Unit III	Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives (7 Hours)
Unit IV	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. (7 Hours)
Unit V	Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. (7 Hours)
Text Books	
1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
Reference Books	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
Useful links	
1	https://nptel.ac.in/courses/109104068

Contributions for syllabus designing:

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2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
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JAIDEV EDUCATION SOCIETY'S
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Department of Electrical Engineering
"Igniting minds to illuminate the world"

VISION	MISSION
"To develop competent and committed Electrical Engineers to serve the society"	1. To impart quality education in the field of Electrical Engineering. 2. To be excellent learning center through research and industry interaction.

Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4T001	Electrical Machine II	3	0	0	3

Prerequisites for the course	
1	Basic Electrical Engineering concepts like emf generation, active and reactive power etc.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc20_ee60/preview
2	Electrical Machine: Dr.P.K. Mukherjee and S. Chakravarti, DhanpatRai

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Define voltage regulation, load torque angle and MMF of windings.
2	CO2	Classify reactances under transient conditions and effects of variable excitation.
3	CO3	Apply the method of synchronous impedance and Potier triangle to find voltage regulation.
4	CO4	Develop phasor diagram of three phase synchronous machine.
5	CO5	Analyze the V curves and effects of excitation and load on motor operation
6	CO6	Compare various methods of cooling in synchronous machine.

Syllabus:

Course Contents	
Unit I	Synchronous Machines Construction, types, armature reaction, introduction to armature winding and field windings MMF of armature and field windings induced EMF, circuit model of synchronous machine, power angle characteristics, two axis theory, synchronous motor operation, characteristic curves, synchronous condenser, dynamics, Single phase synchronous motors. (8Hours)
Unit II	Steady State Operation of Three Phase Synchronous Machine Phasor diagram, voltage regulation using synchronous impedance and Potier triangle method, steady state performance of three phase synchronous machines, circle diagrams (8Hours)
Unit III	Synchronization Parallel operation, experimental determination of parameters (positive sequence reactance, negative sequence reactance, Zero sequence reactance), short circuit ratio, losses and efficiency (8Hours)
Unit IV	Synchronous Machines on Infinite Bus Phasor diagram, expression for torque, load torque angle, V curve and inverted V curve, effects of variable excitation and power input on generator operation and effect of variable excitation and load on motor operation, asynchronous generator.Transient Behavior, phase short circuit. Transient and sub- transient reactances and their measurement. Time constant and equivalent circuit diagram, hunting & damper windings (8Hours)
Unit V	Methods Of Cooling In Synchronous Machines Cooling system classification, Open ventilated, Air-to-water cooler, Air-to-air cooler, Radial flow ventilation system, Axial flow ventilation system, Circumferential Ventilation, Direct water cooling, Hydrogen cooling, their advantages and disadvantages. (8 Hours)
Text Books	
1	P. S. Bhimbra, “Electrical Machinery”
2	Electrical Machinery : Nagrath and Kothari, 3rd , Tata Mcgraw Hill
Reference Books	
1	JFitzgerald and Kingsley and Kusco , “Electrical Machinery” McGraw Hill
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ee06/preview

Contributions for syllabus designing:

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6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4T002	Power System I	3	0	0	3

Prerequisites for the course	
1	Basic Electrical Engineering concepts like emf generation, active and reactive power etc.

Prior Reading Material/useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105067/
2	AshfaqHussian - Power System Analysis. (Tata Mcgraw Hill).

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To define basic components of power system and remember the structure of power system
2	CO2	To understand the working of transmission and distribution system and relate the different parameters of transmission and distribution system
3	CO3	To do Modeling and representation of the system component used in power system
4	CO4	To Analyze the per unit system of power system
5	CO5	To select the proper parameter of power system and determine the value of inductance, capacitance, voltage regulation and efficiency of transmission line and explain the effect of sag and corona on transmission line.
6	CO6	To create the structure of power system with suitable components and improve the efficiency of power system

Syllabus:

Course Contents	
Unit I	General Structure of Electrical Power System Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview Single Line Diagram (SLD) Representation, Use of high voltage, idea about substation (indoor and outdoor), concept of real, reactive and complex power unit system, load and their characteristics, voltage and frequency dependence of loads, overhead v/s underground transmission (7 Hours)

Unit II	Inductance Definition Inductance due to internal flux of two wire single phase line of composite conductor line, Concept of GMD, Inductance of three phase line with equal & unequal spacing, vertical spacing. Capacitance: Concept of electric field, Potential difference between two points in space, Effect of earth's surface on electric field, Computation of capacitance of single phase, three phase transmission lines with & without symmetrical spacing for solid & composite conductors. (9 Hours)
Unit III	Representation of power system elements Representation of power system elements, models and parameters of generator, transformer and transmission lines, Transmission line parameters calculation (R,L,C), per unit system representation. Elementary distribution scheme: Feeders and distributors. Introduction to distribution automation (7 Hours)
Unit IV	Transmission Transmission: Types of conductors, Choice of conductor materials, Stranded copper & ACSR conductor, Current and Voltage relation: Representation of short, medium & long transmission lines, voltage regulation and efficiency of power transmission lines using equivalent pi and T representation. Representation using circle diagram with generalized constants. Ferrant effect, Skin Effect, Proximity Effect (7 Hours)
Unit V	Insulators ,Cables and Mechanical Design of Transmission Line Insulators and Cables Types: Classification of Insulators, Potential distribution over suspension insulator string, String efficiency, Numerical on string efficiency. CABLES: Construction, classification, insulation resistance, capacitance, Dielectric stress, economical size, Grading of cables, Numerical. Mechanical Design of Transmission Line: Effect of wind & ice coating on transmission line, sag due to equal & unequal supports, Corona: Phenomenon of corona, factors affecting the corona, Power loss & disadvantages of corona (9 Hours)
Text Books	
1	Nagrath& Kothari – Modern Power System Analysis.(Tata Mcgraw Hill).
Reference Books	
1	Stevension .W. D– Power System Analysis. (Tata Mcgraw Hill).
2	AshfaqHussian - Power System Analysis.(Tata Mcgraw Hill).
Useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105067/

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4T003	Control System I	3	0	0	3

Prerequisites for the course	
1	Concepts Laplace transform, z-transform etc. studied in subject Engineering Mathematics-III.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc19_de04/preview
2	D'AzzoHoupis, Logakusha, Huelsoman, "Linear System Analysis", McGraw Hill.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the basic concept of control system, types & effect of Feedback
2	CO2	To apply Block diagram and Signal flow graph technique
3	CO3	To apply knowledge for Time domain analysis.
4	CO4	To analyze the stability of a system & to construct Root Locus
5	CO5	To apply knowledge for Frequency domain analysis.
6	CO6	To construct state model of a system

Syllabus:

Course Contents	
Unit I	Introduction to Control Problem: Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time invariant systems, Feedback control, Open loop and closed loop systems, Benefits of feedback, Block dig and signal flow graph algebra,Characteristics of Feedback Control Systems: Effect of negative feedback compared to open loop system such as – sensitivity to parameter variation, speed of time response, bandwidth, disturbance rejection and linearizing effect, Effect of positive feedback (8 Hours)
Unit II	Time domain analysis Concept of transient response, Steady state response and time response, standard test signals, Time response of first order systems, Transfer function of second order system, Time response of second order system, Time response specifications of second order system, steady state error (ess) analysis, static error constants and system type, dominant poles, Relation between roots of characteristic equation, damping ratio and transient response, effect of proportional(P), Integral (I) and derivative (D) controllers on the time response

	concept of transportation lag. (8 Hours)
Unit III	Stability Concept of stability, Effect of pole zero location on stability, Routh- Hurwitz criterian. Root Locus Techniques: Concept and use of root locus, Magnitude and angle criteria, Construction of root loci, effect of addition and poles and zeros on root loci (8 Hours)
Unit IV	Frequency domain analysis of control systems Concept of frequency response and sinusoidal transfer function, resonant frequency, resonant peak, cut off frequency, bandwidth, correlation between time and frequency response. Frequency Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion gain and phase margin, Closed-loop frequency response. (7Hours)
Unit V	State Variable Analysis : Concept of state, state variables and state model, state model of linear systems, state model using physical variables, phase variables and canonical variables, state model from differential equations, block diagram and signal flow graph, transfer function from state model, stability of systems modeled in state variable form. (7Hours)
Text Books	
1	Benjamin C Kuo, “Automatic Control Systems”, Prentice Hall of India.
2	M. Gopal, “Control Systems- Principle of Design”, Fourth Edition, 2012, McGraw Hill.
Reference Books	
1	D’AzzoHoupis, Logakusha, Huelsoman, “Linear System Analysis”, McGraw Hill.
2	Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Pearson Education Inc
Useful links	
1	https://onlinecourses.nptel.ac.in/noc19_de04/preview

Contributions for syllabus designing:

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5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4L004	Electrical Machine II Lab	0	0	2	1

Prerequisites for the course	
1	Basic Electrical concepts studied up to Third Semester & Electrical machine-II theory concepts studying in current semester.

Prior Reading Material/useful links	
1	https://ems-iitr.vlabs.ac.in/

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Performance characteristics of synchronous machines using direct and indirect methods
2	CO2	Regulation of three phase alternator using the predetermination methods
3	CO3	Saliency nature of synchronous machine
4	CO4	Starting and Speed control of ac machines
5	CO5	Synchronization of two three phase alternators
6	CO6	Measurement of impedances and short circuit ratio of alternator

Syllabus:

List of Experiments
• Predetermination of regulation of three phase alternator using emf, mmf and Potier triangle method • To determine Xd and Xq of the salient pole type synchronous machine • To plot V curves and inverted V curves for three phase synchronous machine. • Study of prime mover and damper windings in synchronous motor • To measure the synchronous reactance of a synchronous generator by measured values of open circuit voltage and short circuit current • To study and measure positive, negative and zero sequence impedance of alternator. • To measure short circuit ratio of synchronous generator • To perform synchronization of two three phase alternators by • Synchroscope method • Three dark lamp method • Two bright one dark lamp method • To perform OC test on synchronous generator and determine full load regulation of a three phase synchronous generator by synchronous impedance method • To study synchronization of the alternator with infinite bus bar

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
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2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4L006	Control System I Lab	0	0	2	1

Prerequisites for the course	
1	Basic concepts of subject Control System studied in current semester.

Prior Reading Material/useful links	
1	https://www.iitk.ac.in/new/control-systems-laboratory

Course Outcomes:

Sr. No	Course outcome	CO statement
1	CO1	To remember the basic concept of control system, types & effect of Feedback
2	CO2	To apply Block diagram and Signal flow graph technique
3	CO3	To apply knowledge for Time domain analysis.
4	CO4	To analyze the stability of a system & to construct Root Locus
5	CO5	To apply knowledge for Frequency domain analysis.
6	CO6	To construct state model of a system

Syllabus:

List of Experiments

- Potentiometer error detector
- Time response of second order systems
- Characteristics of synchros
- A.C. position control system
- D.C. position control system
- Determination of step & impulse response for a first order unity feedback system
- Lag and lead compensation - magnitude and phase plot
- Stability analysis (Bode, Root locus, Nyquist) of linear time invariant system using MATLAB
- State space model for classical transfer function using MATLAB
- Study the effect of addition of poles to the forward path transfer function of a closed loop system
- Effect of P, PD, PI, PID controller on second order systems

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

Secretary	Chairman	Dean	Chairman
BOS	BOS	Academics	Acd.Council

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4L007	Electrical Estimation and Costing	0	0	4	2

Prerequisites for the course	
1	Basics Electrical concepts studied upto Higher secondary Classes.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember the importance of estimation, specification and earthing
2	CO2	Understand the schedule of materials with specifications and estimates for service mains
3	CO3	Apply the knowledge of wiring for residential buildings, Prepare the schedule of materials with specifications and estimates for lighting Installations.
4	CO4	Analyse the layout of machines with wiring plan for workshops. Prepare the schedule of materials with specifications and estimates for power insulation.
5	CO5	Evaluate the schedule of materials with specifications for Distribution lines and estimates for transformer centre.
6	CO6	Design the schedule of materials with specifications for transmission lines and substations.

Syllabus:

Course Contents	
Unit I	Meaning of estimation, purpose of estimating and the factors to be considered while preparing estimations, qualities of a good estimator, Meaning of specification, importance of specification and the factors to be considered. Meaning of standardization and its advantages. Meaning of overhead charges, stock incidental charges, contingencies, supervision charges, labour charges, Inspection/Inspectorate charges, transportation charges and miscellaneous charges. Meaning of tender/tender notice, quotation, comparative statement, purchase order and work order. Importance / purpose of IE Act and IE Rules. Meaning of earthing, touch potential and step potential, necessity of earthing, Points to be earthed, factors influencing earth resistance, methods of reducing earth resistance, standard values of earth resistance for various installations, method of selecting the size of earth conductor, types /methods of earthing, Pipe earthing-diagram, specifications of pipe earthing, Plate earthing-diagram and specifications of plate earthing. (9 Hours)
Unit II	Meaning of service mains, code of Practice for service mains, types of service mains- Over Head Service Mains -materials and specifications, UG Service Mains - materials and specifications, Standard wire size table, current ratings for Aluminium, copper conductors and selection of size of conduit pipe as per the size and number of wires. Load calculation, selection of size and type of conductor/UG cable, discrimination of size of protective devices, Quantity calculation, schedules of materials and estimates for single phase OH service connection, three phase OH service connection, single phase UG service connection and three phase UG service connection. (6 Hours)
Unit III	Interior Wiring types and their applications, factors to be considered while selecting the type of wiring system, materials required for Interior wiring and their specifications, Code of Practice for Lighting Installations, method of deciding the number of sub-circuits, calculating the quantity of wiring materials and accessories for the Interior Wiring, load calculations for a residential buildings, size of conductors, main switch, sub switches and protective devices. Draw wiring plan for AEH Installation, concept of horizontal run, vertical rise and vertical drop. Prepare the schedule of materials for providing lighting and heating circuits and their estimates. Procedure for converting lighting to AEH installation. (6 Hours)
Unit IV	Code of Practice for Power Installations, materials required for power circuit wiring and their specifications, Prepare the layout diagram of machines showing clearances as per IS standards, draw wiring plan of the Power circuit for workshops, Decide the type of wiring system, load calculations, determine the size of conductors, main switch, Isolators, sub switches and protective devices, Draw the SLD of Power Distribution Scheme showing grading/discrimination of ratings of protective devices, Prepare the schedule of materials with specifications for workshops and their estimates, Determine the rating of motor for IP set and the concept (**only**)of pump house wiring (6 Hours)
Unit V	Code of practice for Distribution Lines and Transformer centre, types of transformer centres - Pole mounted, plinth mounted, indoor and outdoor types. Determining the rating of Distribution Transformer. Write Specifications of the Distribution Transformer. Draw the SLD of a Transformer centre indicating the size of protective devices, Prepare the schedule of equipments /Materials with specifications for a 11KV/415V,100 KVA transformer centre and their estimates, 415 V LT line materials and specifications , method of calculating various LT line materials (**only**). Prepare the schedule of materials (**only**) for 3 phase 4 wire LT line, 11 KV HT Line-materials and their specifications, method of calculating

	various HT line materials and tapping structure, TOPO sheet and its use, Concept of combined estimates. Prepare the schedule of materials (**only**) for 11 KV single circuit HT line for Rural Electrification (6 Hours)
Text Books	
1	Electrical Design Estimating and Costing, K.B.Raina&K.Battacharya. Khanna Publications
2	Electrical Installation ,J.B.Gupta Estimating and Costing, S.K.Kataria and Sons
Reference Books	
1	Electrical Estimating and Costing N.Alagappan and Ekambaram. Tata McGraw Hill
Useful links	
1	https://onlinecourses.nptel.ac.in/noc19_ee35/preview

Contributions for syllabus designing:

Sr. No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Professor	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Professor	JDCOEM,Nagpur
3	Ms.P.P.Panchbhai	Asst.Professor	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

Secretary	Chairman	Dean	Chairman
BOS	BOS	Academics	Acd.Council

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
IV	EE4V002	Intellectual Property Rights	2	0	0	2

Prerequisites for the course	
1	To know Basic concepts regarding Idea, Innovation & research studied in subject Entrepreneurship Essentials

Prior Reading Material /useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105060/
2	GUBGMHVpwcTsPFvNNVdG5DKtpv6UwksAfzw5aULcGzgG

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	To provide an understanding of the law relating to Intellectual Property and Competition in India.
2	CO2	To understand the concept of Intellectual Property and Intellectual Property Rights with special reference to India.
3	CO3	To appreciate the significance of Intellectual Property in modern times, in the light of its international legal regime
4	CO4	To study the important Agreements, Treaties and Conventions relating to Intellectual Property Rights
5	CO5	To understand the intricacies of grant of Patent, Patentability, Licensing and Revocation at National and International levels.

Syllabus:

Course Contents	
Unit I	Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad Function of IPR. Public good, Incentive theory, different forms of IPR, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.
Unit II	Practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad .Introduction to competition Law, Anti-competitive agreements, Abuse of dominance, Regulation of combinations,
Unit III	International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. .
Unit IV	The relationship and Interaction between IPR and competition law The economics of US Anti trust law, IP and competition issues, Technology transfer agreements.

	The EU experience with IP and Competition Law
Unit V	Market allocation, Horizontal agreements, Vertical agreements, licensing issues. Indian Competition Act and IPR protection. Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.
Text Books	
1	Fundamentals ofIP for Engineers: K.Bansl & P.Bansal
2	Intellectual property right, Deborah, E. BoDcboux, Cengage leam'ng
Reference Books	
1	Electronic resource guide ERC published online by the American Society of Intellectual Property Rights Development Policy
2	Commission on Intellectual Property Rights, London September 2002
Useful links	
1	
2	

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4	Mr.P.V.Ambade	Asst.Professor	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Professor	JDCOEM,Nagpur
6	Mr.Rishabh Darwai	Systems Engineer	Infosys Systems ,Pvt.Ltd,Bengaluru

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5T001	Power Electronics	3	0	0	3

Prerequisites for the course	
1	Concepts of transistors & semiconductor physics studied in subject Electronic Devices & Circuits.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/108105066
2	Bimbhra.P. S- Power Electronics.(Khanna Publication).

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the principle of operation of various basic semiconductor devices
2	CO2	To understand the characteristics of various types of semiconductor device and its working as converters.
3	CO3	To make use of various semiconductor device for the converter's operation under various load types.
4	CO4	Examine the performance of various types of converters.
5	CO5	Compare various types of converters based on performance parameter.
6	CO6	To design the converters based on real time industrial applications.

Syllabus:

Course Contents	
Unit I	Power semiconductor devices & their characteristics SCR, triac, diac-construction, characteristics & applications, turning ON-OFF SCR, turn ON mechanism, different methods of turning ON-OFF SCR, series and parallel connections of SCRs, Protection of SCR gate circuit protection (6Hours)
Unit II	Turn on and turn off circuits for power semiconductor devices Introduction to GTO, power MOSFET & IGBT & their construction &characteristics. Triggering circuits and opt couplers and Pulse transformer Introduction to types of power electronic circuits: diode rectifiers, AC-DC converters, AC-AC converters, DC-DC converters, DC-AC converters (6Hours)
Unit III	Diode Rectifiers and AC-DC converters Diode Rectifiers: Single phase half wave, full wave rectifiers with R and RL load, Three phase bridge rectifier with R and RL load. Controlled Rectifiers: Principle of phase controlled rectification, single phase semi

	and full converter with R and RL load, power factor improvement in controlled rectifiers, three phase semi and full converter with R and RL load. (Only descriptive approach) (7Hours)
Unit IV	DC-AC converters Classification , series inverter, improved series inverter output voltage control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase bridge inverter. (6Hours)
Unit V	DC-DC converters Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper ckt, step-up chopper, step-down chopper (7Hours)
Unit VI	AC voltage controllers (AC-AC converters) Principle of on-off control, principle of phase control in single phase and three phase circuits, Cycloconverters: single phase cycloconverter operation, three phase cycloconverter operation. (7Hours)
Text Books	
1	Rashid M. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education).
Reference Books	
1	Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford).
Useful links	
1	https://nptel.ac.in/courses/108105066

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1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
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4	Mr. P. V. Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
6	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
7	Ms.Shreya Ramteke	Technical Recruiter	Collabera Pvt.Ltd. (Alumni batch JDCOEM,Nagpur)
8	Ms.Snehal Tembhurne	Business Development Executive	Byjus Pvt.Ltd. (Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5T002	Control System I	3	0	0	3

Prerequisites for the course	
1	Concepts Laplace transform, z-transform etc. studied in subject Engineering Mathematics-III.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc19_de04/preview
2	D'AzzoHoupis, Logakusha, Huelsoman, "Linear System Analysis", McGraw Hill.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the basic concept of control system, types & effect of Feedback
2	CO2	To apply Block diagram and Signal flow graph technique
3	CO3	To apply knowledge for Time domain analysis.
4	CO4	To analyze the stability of a system & to construct Root Locus
5	CO5	To apply knowledge for Frequency domain analysis.
6	CO6	To construct state model of a system

Syllabus:

Course Contents	
Unit I	Introduction to Control Problem: Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time invariant systems, Feedback control, Open loop and closed loop systems, Benefits of feedback, Block dig and signal flow graph algebra (7Hours)
Unit II	Characteristics of Feedback Control Systems: Effect of negative feedback compared to open loop system such as – sensitivity to parameter variation, speed of time response, bandwidth, disturbance rejection and linearizing effect, Effect of positive feedback (7Hours)
Unit III	Time domain analysis Concept of transient response, Steady state response and time response, standard test signals, Time response of first order systems, Transfer function of second order system, Time response of second order system, Time response specifications of second order system, steady state error (ess) analysis, static error constants and system type, dominant poles, Relation between roots of

	characteristic equation, damping ratio and transient response, effect of proportional(P), Integral (I) and derivative (D) controllers on the time response concept of transportation lag. (7Hours)
Unit IV	Stability Concept of stability, Effect of pole zero location on stability, Routh- Hurwitz criterian. Root Locus Techniques: Concept and use of root locus, Magnitude and angle criteria, Construction of root loci, effect of addition and poles and zeros on root loci (6Hours)
Unit V	Frequency domain analysis of control systems Concept of frequency response and sinusoidal transfer function, resonant frequency, resonant peak, cut off frequency, bandwidth, correlation between time and frequency response. Frequency Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion gain and phase margin, Closed-loop frequency response. (7Hours)
Unit VI	State Variable Analysis : Concept of state, state variables and state model, state model of linear systems, state model using physical variables, phase variables and canonical variables, state model from differential equations, block diagram and signal flow graph, transfer function from state model, stability of systems modeled in state variable form. (7Hours)
Text Books	
1	Benjamin C Kuo, “Automatic Control Systems”, Prentice Hall of India.
2	M. Gopal, “Control Systems- Principle of Design”, Fourth Edition, 2012, McGraw Hill.
Reference Books	
1	D’AzzoHoupis, Logakusha, Huelsoman, “Linear System Analysis”, McGraw Hill.
2	Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Pearson Education Inc
Useful links	
1	https://onlinecourses.nptel.ac.in/noc19_de04/preview

Contributions for syllabus designing:

Sr. No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
3	Ms.S.V.Jethani	Asst.Prof.	JDCOEM,Nagpur
4	Mr. P. V. Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
8	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
9	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5T003	Power System II	3	0	0	3

Prerequisites for the course	
1	Basic Electrical Engineering concepts like emf generation, active and reactive power etc & Power Systems-I basic concepts.

Prior Reading Material/useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105067/
2	AshfaqHussian - Power System Analysis. (Tata Mcgraw Hill).

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Define the different parameters of power system operation.
2	CO2	Illustrate the different parameters of power system operation and control.
3	CO3	To identify the different issues related to power systems
4	CO4	Analyze the different solution methods related to power system ..
5	CO5	Choose amongst the different analytical & numerical methods for power flow solutions.
6	CO6	Solve the different problems related to cost load flow, fault, reactive power and Stability constraints in the power systems

Syllabus:

Course Contents	
Unit I	Economic Operation of Power System Introduction, Distribution of Load between Units & within the Plant.Optimum Generation Scheduling considering Transmission Losses, Representation of Transmission Loss Using Loss Formula Co-Efficient, Derivation of Loss Formula Co-Efficient. (7Hours)
Unit II	Load Flow Studies Per Unit System, Y_{bus} formation Simple example of a load flow solution, Network model formulation, (Applications of iterative techniques like Gauss-Siedal method, and Newton-Raphson method, etc.). (7Hours)
Unit III	Symmetrical fault analysis: Sequence Components, Symmetrical Fault Analysis Without & With Pre-Fault Load Currents. Symmetrical Component Transformation, Three Phase Power in Unbalanced Circuit in Terms of Symmetrical Component Sequence Impedance

	of Generator Transformer & Transmission Line. (7Hours)
Unit IV	Unsymmetrical fault analysis: Unsymmetrical Fault Analysis: L-G, L-L-G-, L-L-L, LL-L-G, Open Conductors Fault Using Symmetrical Components (6Hours)
Unit V	Stability of Power System: Steady State Dynamic and Transient Stability Definition and Comparison Dynamics of Synchronous Machine Swing Equation Swing Equation for Single Machine Connected To Infinite Bus, Power Angle Equation. Steady State Stability Studies Transient Stability Studies: Swing Curve, Equal Area Criterion for Transient Stability Application of Equal Area Criterion for Different Disturbances. Solution of Swing Equation by Point-by-Point Method, Methods of Improving Transient Stability. (7Hours)
Unit VI	Load dispatch center functions Contingency analysis, preventive, emergency and restorative Control. power quality def., causes, affects, slandered and mitigation methods (7Hours)
Text Books	
1	Nagrath& Kothari – Modern Power System Analysis.(Tata Mcgraw Hill).
Reference Books	
1	Stevension .W. D– Power System Analysis. (Tata Mcgraw Hill).
2	AshfaqHussian - Power System Analysis.(Tata Mcgraw Hill).
Useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105067/

Contributions for syllabus designing:

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1	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
2	Ms.S.V.Jethani	Asst.Prof.	JDCOEM,Nagpur
3	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
8	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
9	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E001(A)	Elective I (Renewable Energy System)	3	0	0	3

Prerequisites for the course	
1	Concepts of transistors & semiconductor physics studied in first year & some basics of Renewable Energy.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/108102047
2	V. V. N. Kishore: Renewable Energy Engineering and Technology, TERI. 2006

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To define basic properties of different renewable sources of energy and technologies for their utilization.
2	CO2	Describe main elements of technical systems designed for utilization of renewable sources of energy
3	CO3	Interpret advantages and disadvantages of different renewable sources of energy
4	CO4	Undertake simple analysis of energy potential of renewable sources of energy
5	CO5	Interpret the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.
6	CO6	Discuss the economics of harnessing energy from renewable energy sources.

Syllabus:

Course Contents	
Unit I	Overview of conventional &renewable energy sources, need , potential & development of renewable energy sources, types of renewable energy sources ,types of renewable energy system, Global and Indian Energy Scenario, Energy for sustainable development, Physical principle of conversion of solar radiation into heat, Global climate change, CO2 reduction potential of renewable energy (7Hours)
Unit II	Solar Radiation & its Measurement: Solar constant, solar radiation on earth's surface, solar radiation measurement, estimation of average solar radiation, solar radiation on tilted surface. Introduction to solar collectors. Applications of Solar Energy: Solar water heating, Space cooling, Solar thermal heat conversion, Solar photovoltaic energy conversion, Solar pumping, Solar cooking , Online grid connected solar photovoltaic generation system.

	(7Hours)
Unit III	Wind Energy: Basic principles of wind energy conversion, Wind energy conversion system, Wind data& energy estimation, Site selection consideration, Basic component of wind energy conversion system (WECS), Classification of WEC system, Energy storage, Advantages and Disadvantages of (WECS), Application of wind energy. (7Hours)
Unit IV	Geothermal Energy: Geothermal fields, , Basic geothermal steam power plant, Binary fluid geothermal plant , Geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy.Applications of geothermal energy in India. (6Hours)
Unit V	Energy from Oceans : Oceans thermal electric conversion (OTEC) , Evaporators,Bio-fueling,Hybrid cycle,Site selection, Component of OTEC for power generation.Energy from Tides: Introduction, Basic principles of Tidal power, Component of Tidal Power Plant, Operation methods of utilization of Tidal Energy, Power in simple single basin Tidal system,Estimation of Energy & Power in double basin Tidal system , Advantages & limitations of Tidal Power Generation. (7Hours)
Unit VI	Other nonconventional Energy Sources: Brief intriduction to operating principles of small scale hydro electric power generation,Energy from Bio-Mass, Ethanol production, MHD power generation, Fuel cell, Energy from waste. (7Hours)
Text Books	
1	Non Conventional Energy Sources : G.D. Rai , Khanna publishers
Reference Books	
1	A. N. Mathur: Non-Conventional Resources of Energy. 2010 .
Useful links	
1	https://nptel.ac.in/courses/108102047

Contributions for syllabus designing:

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1	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
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5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
8	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
9	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E001(B)	Elective I (Electromagnetic Field)	3	0	0	3

	Prerequisites for the course
1	Basics of Electrical Engineering concepts studied in subject Fundamentals of Electrical Engineeering like mmf,flux,field intensity etc.

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/108102047

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember, Understand Scalars & vector analysis, vector and scalars conversion for different coordinate system.
2	CO2	Apply Gauss law, Divergence theorem to electric field intensity.
3	CO3	Apply Faradays law of electromagnetic induction (as a component of Maxwell's equations) to solve and analyze problems of Performance and behavior of electromechanical devices such as Motors, Generators and Transformers.
4	CO4	Apply effective analysis tool like Poisson's and Laplace equations to current, current density, dielectrics and capacitances.
5	CO5	Analyze& Apply Biot-Savorts law.
6	CO6	Solve & Analyze problems of Capacitance of parallel plate capacitor, Capacitance of two wire line, Poissons.

Syllabus:

	Course Contents
Unit I	Review of Mathematics Scalar and vector fields, calculus of scalar and vector fields (Vector Algebra, Vector addition, vector subtraction, Dot product, Scalar product) in Cartesian and curvilinear coordinates, conversion of variables from Cartesian to cylindrical of Cartesian to spherical. (7Hours)
Unit II	Electrostatics Electric field, divergence & curl of electric field, Coulombs' law, the principle of superposition, point charges, field due to continuous volume charge distribution, field of line charge, field of sheet charges concept of flux density.

	(7Hours)
Unit III	Gauss's law, Energy and Potential of charge system Gauss's law, Application of Gauss's law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient, Energy density in Electrostatic field. (7Hours)
Unit IV	Conductors, Dielectric and Capacitance and Poisson's and Laplace's Equations (07 Hrs) Current and current density, continuity of current, metallic conductors, conductor properties and Boundary conditions, Nature of Dielectric materials capacitance and capacitances, Capacitance of parallel plate capacitor, Capacitance of two wire line, Poissons and Laplace equations. (6Hours)
Unit V	Magneto Statics Magnetic force between two small moving charges and the concept of magnetic field. Bio Savart's law, Magnetic flux density vector B and Magnetic flux .The law of conversation of magnetic flux, Ampere's law, magnetic scalar potential, application to various configurations. Magnetic fields of currents in presence of magnetic materials— current loop in a magnetic field (torque and behavior), elementary current loop and aggregates of current loops.Magnetization vector.Generalization of Ampere's law. Magnetic fields intensity and its interpretation. Boundary conditions, effect of applied magnetic field on materials substances, magnetic characteristics of ferromagnetic materials, B-H curve of iron and hysteresis loops, magnetic circuit, magnetic field problems. (7Hours)
Unit VI	Maxwell Equations The equation of continuity and displacement current, Maxwell's equations in different forms and the constitutive relations consequence of Maxwell's equations, plane electromagnetic waves in free space, boundary conditions with generalizations. (7Hours)
Text Books	
1	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University publication, 6 th Edition, 2014.
Reference Books	
1	G.W.Carter,"The electromagnetic field in its engineering aspects", Longmans, 1st Edition, 1954.
2	VW.J.Duffin,"Electricity and Magnetism", McGraw Hill Publication, 3rd Edition (Rev), 1980.
Useful links	
1	https://nptel.ac.in/courses/108102047

Contributions for syllabus designing:

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4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
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9	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E001(C)	Elective I (Introduction to Special Machines)	3	0	0	3

	Prerequisites for the course
1	All basic concepts studied in the subjects Electrical Machines-I & II

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/108102047
2	Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember basic principles of some special electrical machines.
2	CO2	Understand the basics of construction & principle of operation of special electrical machines.
3	CO3	Identify the different operational characteristics related to the special electrical machines.
4	CO4	Analyze the performance indices of special electrical machines.
5	CO5	Evaluate the operation & characteristics of special electrical machines.
6	CO6	Solve the different problems related to operation, supply conversion & performance indices of special electrical machines.

Syllabus:

	Course Contents
Unit I	SPECIAL AC MACHINES Inverted Induction Machine, Synchronous Induction motor, Linear induction Motors (LIM), High efficiency Induction motors, Repulsion motors, Schrage motors. (Only Elementary Aspects). (7Hours)
Unit II	FRACTIONAL KILOWATT MACHINES Reluctance motors, AC tachometers, AC Series Motor-Universal Motor, Stepper Motor & its types, Hysteresis Motor, (Only Elementary Aspects). (7Hours)

Unit III	SPECIAL D.C. MACHINES PMDC motors: Construction, Working, Characteristics & applications, BLDC Motors: Construction, Working, Characteristics & applications.. (7Hours)
Unit IV	PERMANENT MAGNET SYNCHRONOUS MOTORS Introduction, Construction, Working, Ideal PMSM, EMF and Torque equations, Armature MMF, Phasor diagram, Torque/speed characteristics, Applications.. (6Hours)
Unit V	SERVOMOTORS DC servomotors: Construction, working, torque speed characteristics, applications.AC servomotors: Construction, working, torque speed characteristics, applications, Comparison of servomotors with conventional motors. (7Hours)
Unit VI	SOFTWARE APPLICATIONS NPTEL, (Swayam) courses, Software Applications in Electrical Machines. (7Hours)
	Text Books
1	I.J Nagrath, D. P. Kothari,"Electric Machines", Fourth Edition, Tata McGraw-Hill Publishing Company Ltd.
2	AshfaqHussain ,"Electric Machines",SecondEdition,DhanpatRai& Co. Ltd.
	Reference Books
1	Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
2	Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.
	Useful links
1	https://nptel.ac.in/courses/108102047

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E001(C)	Elective I (Introduction to Special Machines)	3	0	0	3

	Prerequisites for the course
1	All basic concepts studied in the subjects Electrical Machines-I & II

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/108102047

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember basic principles of some special electrical machines.
2	CO2	Understand the basics of construction & principle of operation of special electrical machines.
3	CO3	Identify the different operational characteristics related to the special electrical machines.
4	CO4	Analyze the performance indices of special electrical machines.
5	CO5	Evaluate the operation & characteristics of special electrical machines.
6	CO6	Solve the different problems related to operation, supply conversion & performance indices of special electrical machines.

Syllabus:

	Course Contents
Unit I	SPECIAL AC MACHINES Inverted Induction Machine, Synchronous Induction motor, Linear induction Motors (LIM), High efficiency Induction motors, Repulsion motors, Schrage motors. (Only Elementary Aspects). (7Hours)
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Unit III	SPECIAL D.C. MACHINES PMDC motors: Construction, Working, Characteristics & applications, BLDC Motors: Construction, Working, Characteristics & applications..

	(7Hours)
Unit IV	PERMANENT MAGNET SYNCHRONOUS MOTORS Introduction, Construction, Working, Ideal PMSM, EMF and Torque equations, Armature MMF, Phasor diagram, Torque/speed characteristics, Applications.. (6Hours)
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Reference Books	
1	Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
2	Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.
Useful links	
1	https://nptel.ac.in/courses/108102047

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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E001(D)	Elective I (Electrical Power Utilization & Practice)	3	0	0	3

	Prerequisites for the course
1	All basic concepts studied in the subjects Power Systems-I & II.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2	Uppal S.L, "Electric Power", Khanna Publishers, 1988

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	The students should be able to understand the process and application of different types of Electric Heating equipments.
2	CO2	The students should be able to understand the process and application of different types of Welding equipments.
3	CO3	Students should be able to understand basics of illumination and working principles of different light sources.
4	CO4	The students shall be able to apply the fundamentals of illumination systems for lighting design for indoor/ outdoor installations for residential/ commercial and industrial applications.
5	CO5	The students should be able to understand the working principles and applications for various electrolytic processes for industrial applications.
6	CO6	The students should be able to understand the Refrigeration cycle process and electrical circuit used in different cooling system.

Syllabus:

	Course Contents
Unit I	Electric Heating Heating transfer methods, construction, working and applications Resistance heating, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, Dielectric heating. (7Hours)
Unit II	Electric Welding Principles of resistance welding, types, Principle of arc production, electric arc welding, characteristics of arc; Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminium and copper, Introduction to TIG, MIG Welding

	(7Hours)
Unit III	Design of Lightning System Lux level requirements for various applications, classification of light fittings and luminaires, factors affecting the design of indoor lighting installations, total lumen method of calculation, Illumination schemes; indoor and outdoor. Illumination levels General ideas bout street lighting, flood lighting, monument lighting and decorativelighting, light characteristics etc. (7Hours)
Unit IV	Electrolytic Processes Need of electro-deposition, Laws of electrolysis, process of electro-deposition, Equipment and accessories for electroplating, Factors affecting electro-deposition, Principle of galvanizing, anodizing and its applications, Electroplating on non-conducting materials, Manufacture of chemicals by electrolytic process, Manufacturing of chemicals by electrolysis process. (6Hours)
Unit V	Other Applications of Electrical Energy Terminology, Refrigeration cycle, Vapor compression type, vapor absorption type, Electrical circuit of a Refrigerator, Room Air conditioner window type & split type. Description of Electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler (7Hours)
Text Books	
1	Art and Science of utilization of electrical energy by H. Partab, DhanpatRai and Sons, Delhi
2	Uppal S.L, "Electric Power", Khanna Publishers, 1988
Reference Books	
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E002(A)	Elective II(Advance Renewable Energy System)	3	0	0	3

Prerequisites for the course	
1	Concepts of transistors & semiconductor physics studied in first year & some basics of Renewable Energy.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2	Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To Define the principle of energy conversion technique from biomass, geothermal and hybrid energy systems.
2	CO2	To Summarize the effects of air pollution and ecosystems Unit Contents Contact
3	CO3	To Identify the essential characteristics and technical requirements of photovoltaic and biomass energy systems.
4	CO4	To Analyze the need of various forms of non conventional energy sources, historical and latest developments
5	CO5	Illustrate design of biogas, geothermal and hybrid power plant.
6	CO6	Discuss about the environmental aspects of renewable energy resources.

Syllabus:

Course Contents	
Unit I	Biomass Energy Introduction, Biomass conversion technologies, Biogas generation, classification of biogas plants and their Operating system. Biomass as a source of energy, methods of obtaining energy from biomass, thermal gasification of biomass, Applications. (8Hours)
Unit II	Geothermal Energy Introduction, Geothermal sources, hydrothermal resources, Vapor dominated systems, Liquid dominated systems, hot water fields, Geo pressure resources, hot dry rocks, magma resources, volcanoes. Interconnection of geothermal fossil

	systems, geothermal energy conversion and applications. (6Hours)
Unit III	Hybrid energy systems Need for hybrid systems, types of hybrid systems site specific examples; PV–Diesel and battery systems, PV– Gas Hybrid system, Biomass gasifier based thermal back up for Solar systems, natural convection solar driers in combination with biomass back up heater. Biogas and solar energy hybrid system, typical applications. (6Hours)
Unit IV	Air pollution Primary, secondary, chemical and photochemical reactions, effects of CO, NO, CH and particulates, acid rain, global warming and Ozone depletion; monitoring and control of pollutants; noise pollution-sources and control measures; thermal-, heavy metals- and nuclear pollutions; industrial pollution from paper, pharmacy, distillery, tannery, fertilizer, food processing and small scale industries. (6Hours)
Unit V	Environment and Social Structure Environment impact assessment policies and auditing, conflicting world views and environmentally sustainable economic growth, introduction to Design For Environment (DFE), product lifecycle assessment for environment and ISO 14000; triple bottom line of economic, environment and social performance. (7Hours)
Text Books	
1	Non-conventional energy sources by G.D. Rai, Khanna Publishers
Reference Books	
1	Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E002(B)	Elective II (Analog Digital Electronics)	3	0	0	3

	Prerequisites for the course
1	All basic concepts studied in the subject Electronic Devices and Circuits in fourth semester.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2	Digital Electronic Principles, By Malvino PHI, 3 Edition

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Understand the operation and analyze the characteristics of semiconductor diodes, MOSFET, and BJT
2	CO2	Examine and design electronic circuits containing non-linear elements such as diodes, MOSFET, & BJT using the concepts of biasing, load lines, operating point and incremental analysis
3	CO3	Apply feedback techniques in amplifier and examine its effect on parameters of amplifiers (ex. Gain, bandwidth, i/p and o/p impedance, etc) and the stability of amplifier
4	CO4	Design different combinational circuits for various applications
5	CO5	Design various sequential circuits for different applications
6	CO6	Design and verify digital systems using combinational and sequential circuits

Syllabus:

	Course Contents
Unit I	Diode Circuits: P-N junction diode, V-I characteristics of a diode; half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuit. (7Hours)
Unit II	BJT Circuits Structure and V-I characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuit, high-frequency equivalent circuits. (7Hours)

Unit III	MOSFET Circuits: MOSFET structure and V-I characteristics.MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuit - gain, input and output impedances, trans-conductance, high frequency equivalent circuit (7Hours)
Unit IV	Number Systems Logic Simplification Binary/Hexa/octal/BCD Number system, Binary Arithmetic, Boolean Algebra and De Morgan's Theorem, Logic Gates, SOP & POS forms, Logic Optimization Technique, Karnaugh maps. Introduction to logic families, TTL and CMOS logic, Tri-state logic, Memory- classification, organization, operation and interfacing. (7Hours)
Unit V	Combinational logic Design: Comparators, Multiplexers, Demultiplexer, Encoder, Decoder, Arithmetic Circuit Design, Barrel Shifter, ALU. (6Hours)
Unit VI	Sequential logic Design: Sequential Logic Design Latches, Flip flop – S-R, J-K, D, T and Master-Slave JK FF, counters, Shift registers. (6Hours)
Text Books	
1	Digital Electronic Principles, By Malvino PHI, 3 Edition.
2	Modern Digital Electronics, R. P. Jain, McGraw Hill Education, 2009.
Reference Books	
1	Digital logic and Computer design, M. M. Mano, Pearson Education India, 2016.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E002(C)	Elective II(Electrical Machine Design)	3	0	0	3

Prerequisites for the course	
1	Basic concepts studied in the subjects Electrical Machine-I like transformers,Induction motors etc.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2	Sawhney, A.K., 'A Course in Electrical Machine Design', DhanpatRai& Sons, New Delhi,Fifth Edition, 1984.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember appropriate ratings, material, heating and cooling time constants.
2	CO2	Understand magnetic, electric materials, windings and transformers.
3	CO3	Apply concepts in design of electrical apparatus, devices and computer aided designing of transformer.
4	CO4	Analyze different materials, windings and modes of heat generation and heat dissipation in electrical machines.
5	CO5	Evaluate fault parameters in windings, voltage regulation and efficiency in transformer.
6	CO6	Design different types of transformers, heating coils and field coils.

Syllabus:

Course Contents	
Unit I	Review of material used in construction of electrical machines Classification of magnetic, electric and insulating materials, Design of Electrical machines along with their parts and special features, rating, Specifications, Standards, Performance and other criteria to be considered (7Hours)
Unit II	Design of Induction Motor Construction, Output equation of Induction motor, Main dimensions, choice of specific loadings,Design of squirrel cage rotor and wound rotor,Operating characteristics, Magnetizing current,Short circuit current, Circle diagram (7Hours)

Unit III	Design of synchronous machines Output equations, choice of specific loadings, Design of salient pole machines, Short circuit ratio, Armature design, Estimation of air gap length, Design of rotor,Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turboalternators (7Hours)
Unit IV	Design of transformer Design of distribution and power transformers, Types,Classification and specifications, Design and main dimensions of core, yoke, winding,tank (with or without cooling tubes) and cooling tubes, Estimation of leakage reactance,resistance of winding, No load current, Losses, Voltage regulation and efficiency,Mechanical force developed during short circuits, Their estimation and measures tocounteract them, Testing of transformers as per I.S.S., Numerical examples. (7Hours)
Unit V	Heating, Cooling and Ventilation Study of different modes of heat generation, Temperature rise and heat dissipation, Heating and Cooling cycles, heating and coolingtime constants, their estimation, dependence and applications, Methods of cooling /ventilation of electrical apparatus, Thermal resistance, radiated heat quantity of cooling medium (Coolant) Numerical. (6Hours)
Unit VI	Computer aided Design of Electrical machine Introduction, advantages various approaches of Computer Aided Designing, Computer Aided Designing of transformer, Winding of rotating Electrical Machines. Optimization of Design. (6Hours)
Text Books	
1	Sawhney, A.K., 'A Course in Electrical Machine Design', DhanpatRai& Sons, New Delhi,Fifth Edition, 1984.
2	M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Ltd, 2011
Reference Books	
1	J Pyrhonen,T. Jokinen and V.Hrabovcova, " Design of Rotating Electrical Machines" , Wiley,2009.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5E002(D)	Elective II(Electrical Installation & Design)	3	0	0	3

	Prerequisites for the course
1	Basic concepts studied in the subject Fundamentals of Electrical Engineering like resistance ,Inductance,Capacitance,wire gauges etc.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To Define various terms related to electrical installation system.
2	CO2	To Illustrate methods of installation, testing and commissioning of electrical apparatus and conductors.
3	CO3	To Apply knowledge to design the distribution system for residential, commercial, industrial applications and utility distribution networks and illumination design.
4	CO4	To Examine fault level at various locations in radial networks and be able to find rating and location of series reactors.
5	CO5	Design single line diagrams with specifications for distribution networks, motor and power control centers for industrial installations and design reactive power compensation.
6	CO6	Understand the fundamental principles for the design and installation of associated protective systems relating to electrical installations and understand the fundamental transformer testing and recognizes the limits of acceptance of each test.

Syllabus:

Course Contents	
Unit I	A.Electrical load assessment: Concept of electrical load, categories of load, types of loads, connected load, demand factor, Maximum demand, diversity factor, load factor, power factor, TOD Tariff, Industrial Electric Bills. B.Cables, conductors & bus-bars: Construction, selection, installation, testing of LT/ HT cables, overload & short circuit ratings, rating factors; Overhead line conductors, copper and aluminiumbusbars. (7Hours)
Unit II	A.Switching & protection devices: Types, specifications; selections of isolators, switches, switch fuse units, MCB, ELCB, MCCB,ACB, VCB, SF6 breakers, dropout/ horn gap fuses, AB switches, contactors for voltages upto 33 kV. B.Symmetrical Short Circuit Calculations Determining symmetrical short circuit currents at various locations for selecting proper circuit breaker rating & determining value of series reactors for limiting short circuit current. (7Hours)
Unit III	A. Electric supply to Induction Motors in industries: Types of rotors, SLD and working of DOL/ Star-Delta/ Autotransformer starters; types, specifications, selection of power contactors, Overload relays, short circuit protective devices. B.Reactive power management in industries: Reactive power compensation in industries using static capacitors, use of Power Triangle, Calculating payback period for capacitor investment due to reduced system currents. (7Hours)
Unit IV	A.Transformers: Specifications, ratings, selection, installation, testing & commissioning of transformers, protective device for transformers. B.Substations: Types of Substation, Substation scheme and components, 11kV & 33 kV, indoor/ outdoor substations, plan/ elevations, Earthing Arrangements. (7Hours)
Unit V	Necessity of earthing, concept of system & equipment earthing, Dimension & drawings of typical earth electrodes 1) Pipe Earthing 2) Plate Earthing , Earth tester & measurement of earth resistance , Megger. Design of PCC and MCC, Definition of various terms – Referene earth, earth electrode, earth grid, earth electrode resistance, earth leakage current, earthing conductor, earth mat. (6Hours)
Unit VI	General awareness of IS codes (IS 3043,IS 732,IS 2675, IS 5216,IS 2309), The India Electricity act 1910, The Indian Electricity supply Act 1948, Indian Electricity rule 1956, The electricity regulation commission act 1998, Electricity act 2003, National Electric Code (NEC), scope and safety aspects applicable to residential, commercial & Industrial installation (6Hours)

Text Books	
1	Electric Power Distribution system by A.S.Pabla, Tata Mcgraw Hill.
2	Electrical Engineering Handbook, C. L. Wadhwa.
Reference Books	
1	Design of Electrical Installations, V.K.Jain,Amitab Bajaj, Laxmi Publications Pvt Limited, 01-Jan-1993.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

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Program: B. Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5O001	Open Elective I - Electrical Safety & Management	4	0	0	3

Prerequisites for the course	
1	Basic concepts studied in the subject Fundamentals of Electrical Engineering like resistance, current earthing, wire gauges etc.

Prior Reading Material/useful links	
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
2	PradeepChaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
2	CO2	Summarize the Safety aspects during Installation of Plant and Equipment.
3	CO3	Describe the electrical safety in residential, commercial and agricultural installations.
4	CO4	Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
5	CO5	State the electrical systems safety management and IE rules.

Syllabus:

Course Contents	
Unit I	INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, principles of electrical safety, approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops. (7Hours)
Unit II	SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT: Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal

	protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment. (7Hours)
Unit III	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances. (7Hours)
Unit IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, Flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations. SF6 Breaker, Vaccum Circuit Breaker, AB Switches, HRC Fuses,etc. (7Hours)
Unit V	EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals. (6Hours)
Unit VI	SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.Review of IE rules and acts and their significance: Standards on electrical safety, safe limits of current, voltage . The Electricity Act, 2003, (Part1, 2, 3,4& 5) (6Hours)
Text Books	
1	S. Rao, Prof. H.L.Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.(units-I to V)
2	www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)
Reference Books	
1	PradeepChaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.
Useful links	
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview

Contributions for syllabus designing:

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2	Ms.S.V.Jethani	Asst.Prof.	JDCOEM,Nagpur
3	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5O001	Open Elective I - Industrial Instrumentation	4	0	0	4

	Prerequisites for the course
1	Basic concepts studied in the subject Electrical measurements like ,current measurement earthing,wire gauges etc.

	Prior Reading Material/useful links
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
2	Fundamentals of Industrial Instrumentation and Process Control: William C. Dunn, TMH Publication, 2nd edition.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Select the instruments for measurement of various physical quantities,
2	CO2	Select a transducer based on its operating characteristics for the required application.
3	CO3	Check various available techniques and select appropriate to obtain satisfactory task for the parameter to be measured.
4	CO4	Know advantages and limitations of selected techniques.

Syllabus:

Course Contents	
Unit I	Introduction to Industrial Instrumentation: Definitions, Dynamic Characteristics of Instruments, Zero-Order Instrument, First-Order Instrument, Second-Order System. Pressure Measurement: Introduction, Basic terms, Pressure formulas, Pressure measuring instruments, Application considerations. (7Hours)
Unit II	Temperature and Heat Measurement: Introduction, basic terms, Temperature and heat formulas, Temperature measuring devices, Application considerations. (7Hours)
Unit III	Level Measurement&Flow Measurement: Introduction, basic terms, Level formulas, Level sensing devices, Application considerations. Flow formulas, Flow measuring instruments, Application considerations.

	(7Hours)
Unit IV	Position and motion sensing: Basic definitions, measuring devices, application considerations. Force, Torque and Load cell: Basic definitions, measuring devices, application considerations (7Hours)
Unit V	Transducers: Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers. (6Hours)
Unit VI	Digital Data Acquisition systems & control: Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition.Instrumentation systems.Types of Instrumentation systems.Components of an analog Instrumentation Data –Acquisition system.Multiplexing systems.Uses of Data Acquisition systems.Use of Recorders in Digital systems.Digital Recording systems.Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits. (6Hours)
Text Books	
1	Industrial Instrumentation: K Krushnaswamy, New Age International E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.
2	E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.
Reference Books	
1	Fundamentals of Industrial Instrumentation and Process Control: William C. Dunn, TMH Publication, 2nd edition.
Useful links	
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview

Contributions for syllabus designing:

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4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5T004	Consumer Affairs	2	0	0	Audit

	Prerequisites for the course
1	Basic concepts of subject Engineering Economics studied in third semester

	Prior Reading Material/useful links
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Familiarize the students with their rights and responsibilities as a consumer, the social framework of consumer rights and legal framework of protecting consumer rights.
2	CO2	It also provide an understanding of the procedure of redress of consumer complaints, and the role of different agencies in establishing product and service standards.
3	CO3	The student should be able to comprehend the business firms' interface with consumers and the consumer related regulatory and business environment.

Syllabus:

Course Contents	
Unit I	Consumer and Markets: Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market, GST, and Digital consumer issues. Experiencing and Voicing Dissatisfaction: Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000 suite (7Hours)

Unit II	he Consumer Protection Law in India Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, and restrictive trade practice. (7Hours)
Unit III	Grievance Redressal Mechanism under the Indian Consumer Protection Law Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties. (7Hours)
Unit IV	Role of Industry Regulators in Consumer Protection i. Banking: RBI and Banking Ombudsman ii. Insurance: IRDA and Insurance Ombudsman iii. Telecommunication: TRAI iv. Food Products: FSSAI v. Electricity Supply: Electricity Regulatory Commission Real Estate Regulatory Authority (7Hours)
Text Books	
1	Khanna,SriRam,SavitaHanspal,SheetalKapoor,andH.K.Awasthi.(2007)ConsumerAffairs,UniversitiesPress.
2	Choudhary,RamNareshPrasad(2005).ConsumerProtectionLawProvisionsandProcedure,Deepand Deep PublicationsPvtLtd.
Reference Books	
1	Misra Suresh, (Aug 2017) “Is the Indian Consumer Protected? One India OnePeople.
Useful links	
1	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview

Contributions for syllabus designing:

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4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5L001	Power Electronics Lab	0	0	2	1

Prerequisites for the course	
1	Basic concepts of subject Power Electronics studied in current semester.

Prior Reading Material/useful links	
1	https://www.iitk.ac.in/new/power-electronics-laboratory

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the principle of operation of various basic semiconductor devices
2	CO2	To understand the characteristics of various types of semiconductor device and its working as converters.
3	CO3	To make use of various semiconductor device for the converters operation under various load types.
4	CO4	Examine the performance of various types of converters.
5	CO5	Compare various types of converters based on performance parameter.
6	CO6	To design the converters based on real time industrial applications.

Syllabus:

List of Experiments

- To study Gate drive circuit
- To study Reverse recovery time of diode
- To study Single phase half wave controlled converter
- To study Characteristics of junction gate fet
- To study Unsymmetrical half wave bridge rectifier
- To study SCR parallel inverter
- To study Lamp dimmer using DIAC and TRIAC

- To study Simulation of 3 phase full wave controlled rectifier
- To study Simulation of 3 phase inverter
- To study Simulation of buck converter

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5L002	Control System I Lab	0	0	2	1

Prerequisites for the course	
1	Basic concepts of subject Control System studied in current semester.

Prior Reading Material/useful links	
1	https://www.iitk.ac.in/new/control-systems-laboratory

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the basic concept of control system, types & effect of Feedback
2	CO2	To apply Block diagram and Signal flow graph technique
3	CO3	To apply knowledge for Time domain analysis.
4	CO4	To analyze the stability of a system & to construct Root Locus
5	CO5	To apply knowledge for Frequency domain analysis.
6	CO6	To construct state model of a system

Syllabus:

List of Experiments

- Potentiometer error detector
- Time response of second order systems
- Characteristics of synchros
- A.C. position control system
- D.C. position control system
- Determination of step & impulse response for a first order unity feedback system
- Lag and lead compensation - magnitude and phase plot

- Stability analysis (Bode, Root locus, Nyquist) of linear time invariant system using MATLAB
- State space model for classical transfer function using MATLAB

- Study the effect of addition of poles to the forward path transfer function of a closed loop system
- Effect of P, PD, PI, PID controller on second order systems

Contributions for syllabus designing:

Sr. No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
3	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
4	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
V	EE5L003	Power System II Lab	0	0	2	1

Prerequisites for the course	
1	Basic concepts of subject Power System II studied in current semester

Prior Reading Material/useful links	
1	http://virtuallab.dei.ac.in/Dreamweaver/index.html

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Define the different parameters of power system operation.
2	CO2	Illustrate the different parameters of power system operation and control.
3	CO3	To identify the different issues related to power systems
4	CO4	Analyze the different solution methods related to power system ..
5	CO5	Choose amongst the different analytical & numerical methods for power flow solutions.
6	CO6	Solve the different problems related to cost load flow, fault, reactive power and Stability constraints in the power systems

Syllabus:

List of Experiments

- Formation of Matrix in MATLAB.
- Formation of Bus Impedance Matrix Z-BUS
- Formation of Bus Admittance Matrix Y-BUS
- Load flow study using Newton Raphson method .
- Load flow study using Gauss Seidal Iteration Method .
- To study the system stability using point by point method.
- To understand modeling and performance of medium lines

- To study steady state stability of synchronous motor.
- To study symmetrical and unsymmetrical component analysis.
- To study Economic Load Dispatch Center.

Contributions for syllabus designing:

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1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6T001	Microprocessor and microcontroller	3	0	0	3

Prerequisites for the course	
1	Basic concepts of Analog & Digital Circuits like signals ,amplifiers etc.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the architecture of 8085 and 8051.
2	CO2	To understand interfacing and interrupt features of 8085 and 8051.
3	CO3	To develop program for basic applications
4	CO4	To distinguish and analyze the properties of Microprocessors & Microcontrollers
5	CO5	To explain programming logic and concepts of 8085 microprocessors and 8051 micro-controller.
6	CO6	To build strong foundation for designing real world applications using microprocessors and microcontrollers.

Syllabus:

Course Contents	
Unit I	8085 architecture: Architecture, register structure, addressing modes, instruction set of 8085, timing diagrams,Assembly Language Programming of 8085 (6Hours)
Unit II	Interfacing: Memory Interfacing: Interface requirements, Address space partitioning, Buffering of Buses, timing constraints, Memory control signals, Read and write cycles, interfacing SRAM, EPROM and DRAM sections. I/O Interfacing: Memory mapped I/OScheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports,Programmable peripheral interface (8255). Data transfer schemes: Programmable datatransfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven datatransfer schemes, Interfacing, Simple keyboards and LED displays. (6Hours)
Unit III	Interrupts and DMA: Interrupt feature, Need for interrupts, Characteristics of Interrupts,Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Developmentof

	Interrupt service subroutines, Multiple interrupt request and their handling, need fordirect memory access, Devices for Handling DMA, Programmable DMA controller8237. (7Hours)
Unit IV	Applications: Interfacing of A/D converters (ADC 0800/ADC 0808/ADC 0809),Interfacing of D/A converters (DAC 0800), Waveform generators, Multiplexed seven segment LED display systems, Measurement of frequency, phase angle and power factor-Traffic light controller, Stepper motor control (7 Hours)
Unit V	Introduction to microcontroller: 8051 architectures, 8051 Internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial ports, interrupt structure, SFRs and their addressing, watch-dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory, study of instruction set of 8051. (6Hours)
Unit VI	8051 Peripheral Functions : 8051 interrupt structures, Timer and serial functions, parallel port features : Modes of operation, Power control, features, Interfacing of 8051, Typical applications, MCS 51 family features (6Hours)
Text Books	
1	Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A", 3rd Edition, Penram International Publishing House, 1997.
2	Singh. I.P., "Microprocessor Systems", Module 9: Microcontrollers and their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997.
Reference Books	
1	Douglas, V.Hall. "Microprocessor and Interfacing Programming and Hardware", 2ndEdition, McGraw Hill Inc., 1992.
2	Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

Contributions for syllabus designing:

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1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6T002	Advance Control System	3	0	0	3

	Prerequisites for the course
1	All the basic concepts of the subject Control Systems-I studied in fifth semester

	Prior Reading Material/useful links
1	https://archive.nptel.ac.in/courses/108/103/108103007/

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the basic concepts of compensation, State variable analysis, Non linear Control System, Digital Control system.
2	CO2	To understand the basic concepts of compensation, State variable analysis, Nonlinear Control System, Digital Control system.
3	CO3	To apply different concepts to find controllability, observability and stability of non-linear control system, sampled data control system.
4	CO4	To analyze continuous time system using state space technique and investigate Controllability and Observability of the system, digital systems using the Z-transformation, and nonlinear system using the describing function technique and phase plane analysis
5	CO5	To evaluate various parameters of continuous time system, digital systems using the Z-transformation, and nonlinear system using various methods.
6	CO6	To design controllers to achieve desired specification

Syllabus:

Course Contents	
Unit I	COMPENSATION Need for compensation. Performance Analysis of Lead, Lag and Lag-lead Compensators in time & frequency domain, Bode Plots of Lead, Lag and Lag-lead Compensators. (7Hours)
Unit II	DESIGN BY STATE VARIABLE FEEDBACK Review of state variable representation. Eigen Values, Eigen Vectors, State Transition Matrix (STM), Model Matrix, Solution of state equation.Controllability and Observability. Design of SVF (7Hours)
Unit III	OPTIMAL CONTROL SYSTEM Performance Index (PI), Desirability of single P.I., Integral square error.Parameter Optimization with & without constraints. Optimal control problem with T.F. approach for continuous time system only. (7Hours)
Unit IV	CONTROLLER TUNING Review of analog PID controller, PID tuning methods in process control (Ziegler-Nichols tuning method), digital PID controllers. (7 Hours)
Unit V	NON LINEAR CONTROL SYSTEM (NLCS) Non Linear Control System: Types of non-linearities, characteristics of NLCS. Inherent & intentional non- linearities. Describing function method for Analysis Describing functions of some common non-linearities. Stability analysis. Limit cycles & stability of limit cycles. Phase -Plane Method: Singular points stability from nature of singular points Construction of trajectory by Isocline and Delta Method Computation of time. (6Hours)
Unit VI	DIGITAL CONTROL SYSTEM Representation of SDCS.Sample & Hold Circuit. Z – Transform. Inverse Z-Transform & solution of difference equation.Z & S domain relationship.Stability by bilinear transformation & Jury's test.Comparison of time response of continuous and digital control system, Effect of sampling period on transient response characteristic Discretization of continuous time state equation.Solution of Discrete time state equations. Controllability &Observability of Discrete time systems. (6Hours)
Text Books	
1	Benjamin C Kuo, “Automatic Control Systems”, Prentice Hall of India.
2	M. Gopal, “Control Systems- Principle of Design”, Fourth Edition, 2012, McGraw Hill.

Reference Books	
1	D'AzzoHoupis, Logakusha, Huelsoman, "Linear System Analysis", McGraw Hill
2	Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Education Inc.
Useful links	
1	https://archive.nptel.ac.in/courses/108/103/108103007/

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E003(A)	Elective III- Electrical Energy Conservation &Audit	3	0	0	3

Prerequisites for the course	
1	All the basic concepts of the subject Renewable Energy Sources studied in fifth semester

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview
2	Principles of Energy Conservation, Archie, W Culp, Published by McGraw Hill, 1991.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Know Present energy scenario with need of energy audit and energy conservation.
2	CO2	Classify and Manage electric and thermal energy in the industry.
3	CO3	Identify various aspects of energy audit such as planning, monitoring and implementation
4	CO4	Analyze the energy flow diagram of an industry and identify the energy wasted or a waste stream.
5	CO5	Evaluate the techno economic feasibility of the energy conservation technique adopted.
6	CO6	Choose appropriate energy conservation method to reduce the wastage of energy

Syllabus:

Course Contents	
Unit I	Basics of Energy Management and Conservation Global and Indian energy scenario. Global environmental concerns, Climate Change, Concept of energy management, energy demand and supply, economic analysis; Carbon Trading & Carbon foot prints. Energy Conservation: Basic concepts, Energy conservation in household, transportation, agricultural, service and industrial sectors; Lighting & HVAC systems in buildings. (10 Hours)

Unit II	Energy Audit Definition, need, and types of energy audit; Energy management (audit) approach: Understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Fuel & energy substitution; Energy audit instruments; Energy Conservation Act; Duties and responsibilities of energy managers and auditors. (8Hours)
Unit III	Material & Energy balance and Waste Heat Recovery Facility as an energy system; Methods for preparing process flow; material and energy balance diagrams. Cogeneration and waste heat recovery; (8Hours)
Unit IV	Energy Action Planning, Monitoring and Targeting: Energy Action Planning : Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability; Motivation of employees: Information system-designing barriers, strategies; Marketing and communicating: Training and planning. Monitoring and Targeting : Defining monitoring & targeting; Elements of monitoring & targeting; Data and information analysis; Techniques: energy consumption, production, cumulative sum of differences (CUSUM); Energy Service Companies; Energy management information systems; SCADA systems. . (8 Hours)
Unit V	Electrical Energy Management: Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, Demand side management: conservation in motors, pumps and fan systems; energy efficient motors. (8Hours)
Unit VI	Thermal energy Management : Energy conservation in boilers, steam turbines and Furnaces; Application of FBC, Heat exchangers and heat pumps. (8Hours)
Text Books	
1	Energy Management, P. O'Callaghan, McGraw - Hill Book Company, 1993.
Reference Books	
1	Energy Management Handbook, Wayne C. Turner, Wiley Inter Science Publication

Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

Contributions for syllabus designing:

Sr. No	Name of the person	Designation	Organization
1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
3	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
4	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
5	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
6	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E003(B)	Elective III- Linear Electronic Circuits	3	0	0	3

	Prerequisites for the course
1	All the basic concepts of the subject Digital Electronics studied in fourth semester

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To understand characteristics of IC and Op-Amp and identify the internal structure.
2	CO2	To introduce various manufacturing techniques.
3	CO3	To study various op-amp parameters and their significance for Op-Amp.
4	CO4	To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
5	CO5	To analyze and identify linear and nonlinear applications of Op-Amp.
6	CO6	To understand functionalities of PLL.

Syllabus:

	Course Contents
Unit I	OP-AMP Basics Block diagram of OP-AMP, Differential Amplifier configurations, Differential amplifier analysis for dual-input balanced-output configurations, Need and types of level shifter, current mirror circuits. Feedback topologies: Voltage series and voltage shunt feedback amplifier and its effect on Ri, Ro, bandwidth and voltage gain. (7 Hours)
Unit II	Linear Applications of OP-AMP Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, and instrumentationamplifiers. (7Hours)
Unit III	Non-linear Applications of OP-AMP Introduction to comparator, characteristics and applications of comparator, Schmitt trigger,clippers and clampers, voltage limiters, square wave generator, triangular wave generator,Need of precision rectifiers, Half wave and Full

	wave precision rectifiers. (7Hours)
Unit IV	Converters using OP-AMP V-F, I-V and V-I converter, Digital-to-analog converters (DAC): Weighted resistor, R-2Rladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope,Successive approximation, flash type. Monitoring and Targeting : Defining monitoring & targeting; Elements of monitoring & targeting; Data and information analysis; Techniques: energy consumption, production, cumulative sum of differences (CUSUM); Energy Service Companies; Energy management information systems; SCADA systems. . (8 Hours)
Unit V	Oscillators Principle of Oscillators, Barkhausen criterion, Oscillator types: RC oscillators (design ofphase shift, Wien bridge etc.), LC oscillators (design of Hartley, Colpitts, Clapp etc.), nonsinusoidaloscillators, and voltage controlled oscillators. (6Hours)
Unit VI	Active filters and PLL Design guidelines of Active filters: Low pass, high pass, band pass and band stop filters, Block diagram of PLL and its function. (6Hours)
Text Books	
1	Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
2	.Salivahanan and KanchanaBhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India 2008.
Reference Books	
1	Bali, “Linear Integrated Circuits”, McGraw Hill 2008
2	Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

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3	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E003(C)	Elective III- Introduction to AC and DC Drive	3	0	0	3

Prerequisites for the course	
1	Basic concets of Power Electronics studied in fifth semester such as AC/DC Converters,Inverters ,PWM etc.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview
2	H.Partab, “Modern Electrical Traction”, 1973, PritamSurat& Brothers

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Examine factors governing selection of Electric Motors like speed torque characteristics under starting, running, and braking for particular application in a common electric drive system.
2	CO2	Select motor rating, Flywheel of common drive motors for continuous and intermittent periodic duties.
3	CO3	Analyze control circuit of ac/dc contactors and relays for automatic starting and braking of ac/dc motors.
4	CO4	Analyze the performance and suitability of motors used in ac/dc traction, their performance characteristic, and control and braking.
5	CO5	Apply digital control of electric motor, plc programming in electrical drives.
6	CO6	Examine factors governing selection of Electric Motors like speed torque characteristics under starting, running, and braking for particular application in a common electric drive system.

Syllabus:

Course Contents	
Unit I	Introduction to Drives Basics of electrical drives and control ,Factors Governing Selection of Electric Motors, Types of Drives and Types of Load, Starting of electric motors, Speed control of Electric motors. Definition classification and speed torque characteristics of common drive motors and their characteristics under starting, running, Electric Braking. Types of enclosures.

	(7 Hours)
Unit II	Rating Rating & Service Capacity: Selection of Motor, Insulating materials, its classification, Temperature rise in Electrical machines, Power Capacity for Continuous and Intermittent Periodic Duties, Load Equalization: Flywheel Effect, Speed-Time Relations. Brief idea about drives commonly used in industries. (7Hours)
Unit III	AC and DC contactors and relays Control devices for industrial motors, AC and DC contactors and relays: Lock out contactors, magnetic structure, operation, arc interruption, contactor rating, and H.V. contactors. Control circuits for automatic starting and braking of DC motor and three phase induction motor. Control panel design for MCC. (7Hours)
Unit IV	Electrical Traction Electrical Traction: Electric Traction system, Speed time curve. Mechanics of Train movement. Traction motor: Motor Used in AC/DC Traction, Their Performance and Desirable Characteristics, Requirements and Suitability of Motor for Traction Duty. Control of D.C. Traction Motor, Series Parallel Control Starting and Braking of Traction Motor . (8 Hours)
Unit V	Traction motor control Traction motor control – Starting and speed control traction motors. Series parallel control with numerical. Starting and speed control of 3-phase induction motors. Braking of traction motor. (6Hours)
Unit VI	PLC, its programming and its applications in electrical drives.Digital control of Electric motor, Block diagram arrangement, comparison with other methods of control. (6Hours)
Text Books	
1	G. K. Dubey, “Fundamentals of electrical drives”, Second edition, (sixth reprint), Narosa Publishing house, 2001
2	M.L. Soni, P.V. Gupta, U.S.Bhatnagar, “A course in Electrical Power”, 1999, DhanpatRai& Sons.
Reference Books	
1	VedamSubrahamanyam, “Electric Drives –Concepts & Applications”, 1997, Tata McGraw-Hill.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

Contributions for syllabus designing:

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1	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E003(D)	Elective III- Electrical Power Distribution System	3	0	0	3

Prerequisites for the course	
1	Basic concepts of subject Power Systems-I such as Generation,Transmission & Distribution,voltage levels at distribution systems basic ideas of distribution system etc.

Prior Reading Material/useful links	
1	TuranGonen, "Electric Power Distribution SystemEngineering", 2nd Edition,2008,CRC Press
2	https://nptel.ac.in/courses/112104031

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember basic principles of distribution systems and reliability indices.
2	CO2	Understand the principle of operation of feeder, substation and data acquisition system.
3	CO3	To identify the different factors related to distribution systems.
4	CO4	Analyze the effect of various equipments on voltage control and substation protection requirements.
5	CO5	Evaluate voltage drop, power loss and line drop in distribution system
6	CO6	Solve different problems related to radial networks, reactive power requirements and substation protection

Syllabus:

Course Contents	
Unit I	Distribution systems Introduction to Distribution systems, Explanation of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor, Relationship between the load factor and loss factor, Classification of loads , Changes in load curve due to loads, use of captive generation & cogeneration in distribution network, Electricity Act 2003, Energy conservation act-2001, electricity rules-2005 (7 Hours)
Unit II	Feeders Radial and loop types, engineering considerations for voltage levels and loading, causes of unbalance and unequal drops.

	System analysis : Voltage drop and power loss calculations, manual methods of solution of radial networks, three-phase & non-three-phase primary lines load flow and symmetrical component applications. (7Hours)
Unit III	Distribution System Reliability Basic definition, appropriate levels of distribution reliability, Series & Parallel System, Markov Processes, Distribution reliability Indices, System and customer based indices, load and energy based indices, usage of reliability indices. (7Hours)
Unit IV	Voltage control Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop calculations and compensations, Reactive power requirements, economic consideration & best location. . (8 Hours)
Unit V	Distribution Automation Introduction to Distribution Automation, Data acquisition system and decentralized control, data acquisition and protection considerations of control panel, circuit breakers, fuses, relays, earthing. (6Hours)
Unit VI	Substation Substation layout, selection criteria, voltage and spacing load, space and location, distribution substation protection needs, distribution substation construction methods, trends in distribution substation, insulation coordination, voltage regulation, theoretical consideration for fault calculations. (6Hours)
Text Books	
1	A. S. Pabla,"Electric Power Distribution", Fourth Edition, 1997, Tata McGraw-Hill Publishing Company.
2	Kamaraju ,"Electrical Power Distribution System",Tata-McGraw Hill Publications.
Reference Books	
1	M. K. Khedkar& G. M. Dhole., "Electric Power Distribution Automation", University Science Press.
Useful links	
1	https://nptel.ac.in/courses/112104031

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E004(A)	Elective IV- Solar Photovoltaic Devices	3	0	0	3

Prerequisites for the course	
1	Basic concepts of Renewable Energy Systems such as PV cell,PV array,PV Panel & its types etc.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/112104031

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Calculate and analyse solar insolation on a collecting surface by locating the sun position at anygiven location and time, interpret sun path diagrams.
2	CO2	Interpret I-V curves from the circuit model of a PV cell, understand the impact of temperature andsolar insolation on I-V curves.
3	CO3	Evaluate the algorithms used for the maximum power point tracking of PV array.
4	CO4	Understand the principle of DC-AC power conversion in Grid connected PV system
5	CO5	Design standalone PV system by estimating the load, sizing and selecting the batteries, sizing and
6	CO6	Selecting the PV modules and other components

Syllabus:

Course Contents	
Unit I	Introduction : Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems. (7 Hours)
Unit II	Solar Radiation : Extra-terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky Insolation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insolation from measured data. (7Hours)

Unit III	PV Cells and Modules : Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays ; effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; Charge controller, Introduction of maximum power point tracking algorithms (7Hours)
Unit IV	PV Inverters: Principle of DC-AC conversion, Working of Grid-connected PV inverter, schemes and basic control; Introduction to Grid Interfacing standards. . (8 Hours)
Unit V	PV Systems with Battery Energy Storage: Power processing schemes and control for stand-alone applications; batteries for energy storage – types, charging, battery sizing and turn-around efficiency; other types of energy storage for PV systems; grid connected schemes with standby energy storage. (6Hours)
Unit VI	System Level Issues: Design related issues; grounding, dc arcing and other safety related issues; islanding; harmonics; electro-magnetic interference; energy yield and economics of a PV installation. (6Hours)
Text Books	
1	Solar Photovoltaic: Fundamentals, Technologies and Applications: Solanki, PHI Learning Pvt Ltd, 2009
2	Photovoltaic Systems Engineering: Roger A. Messenger & Jerry Ventre, CRC Press, 2004, 2nd edition.
Reference Books	
1	Renewable and Efficient Electric Power Systems: Gilbert M. Masters, John Wiley & Sons, 2004
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E004(B)	Elective IV- High Power Semiconductor Devices	3	0	0	3

Prerequisites for the course	
1	Basic concepts of Power Electronics studied in fifth semester such as Power Electronic devices ,AC/DC Converters,Inverters ,PWM etc.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/112104031
2	Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India,Third Edition, New Delhi.

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the principle of operation of various Power switching devices
2	CO2	To Understand the characteristics of various types of Power switching devices
3	CO3	To make use of steady state and dynamic models of Power switching devices
4	CO4	To analyse various types of Thermal Protection required for protection of Power switching devices
5	CO5	To compare various Thermal Protections and firing protection Circuits of Power switching devices
6	CO6	To design the Firing and Protecting Circuits for various Power switching devices.

Syllabus:

Course Contents	
Unit I	Power switching devices overview Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating. (7 Hours)
Unit II	Current Controlled Devices: BJT's – Construction, static characteristics, switchingcharacteristics; Negative temperature co-efficient and secondary breakdown; Power darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy– concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel

	operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor. (7Hours)
Unit III	Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and GATT. (7Hours)
Unit IV	Firing and Protecting Circuits: Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers. . (8 Hours)
Unit V	Thermal Protection: Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types (6Hours)
Unit VI	Phase Controlled Converters: Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters. (6Hours)
Text Books	
1	B.W. Williams ‘Power Electronics: Devices, Drivers, Applications and Passive Components, Tata McGraw Hill.
Reference Books	
1	Mohan, Undeland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E004(C)	Elective IV- Power Semiconductor Based Drive	3	0	0	3

Prerequisites for the course	
1	Basic concepts of Power Electronics studied in fifth semester such as Power Electronic devices ,AC/DC Converters,Inverters ,PWM etc.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/112104031

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember fundamental principles of power electronics and electric drives.
2	CO2	Understand the basics of construction & principle of operation ofvarious electric drives.
3	CO3	Apply suitable control methods to different motor drives.
4	CO4	Analyze the output of conventional drives and semiconductor based drives.
5	CO5	Evaluate the power factor, harmonics and ripple in motor current.
6	CO6	Solve the problems related starting, braking and speed control of motor drives.

Syllabus:

Course Contents	
Unit I	Dynamics of Electric Drives Fundamentals of torque equations, speed torque convention and multiquadrant operation, components of load torques, classification of load torques, steady state stability, load equation. Speed control and drive classification, close loop control of drives. (7 Hours)
Unit II	D.C. motor drives Controlled rectifier fed d.c. drives, single phase and three phase rectifier control of d.c. separately excited motor. Dual converter control of D.C separately excited motor. Power factor, supply harmonics and ripple in motor current. Chopper controlled dc drives of separately excited dc motor, chopper control of series motor, source current harmonics. (7Hours)
Unit III	Induction motor drives Stator voltage control, variable frequency control usingvoltage source

	invertors, and current sources invertors. Concept of scalar control of 3-ph Induction Motor, Basic philosophy of vector control of 3-ph I.M. their advantages and list of applications.Basic idea of energy conservation in fan and pump type loads using scalar controlled induction motordrives.(Numericals excluded) (7Hours)
Unit IV	Synchronous Motor Drives Starting Braking of synchronous motor, variable frequency control selfcontrolled synchronous motor drive employing load commutated thyristor inverter or cycloconverter, starting oflarge synchronous motors. . (7 Hours)
Unit V	Advanced Motor Drives Brushless DC motor, stepper motor drives, Introduction tosolar and battery powered drives.Energy conservation in electric drives. (7 Hours)
Unit VI	Traction drives: Conventional dc and ac traction drives, semiconductors converter controlled Drives, 25KV AC traction using semiconductor converter controlled dc motor. DC traction using semiconductor, chopper controlled dc motors, polyphase AC motors for traction drives. (7 Hours)
Text Books	
1	Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India,Third Edition, New Delhi.
2	G. K. Dubey, "Fundamentals of Electric drives", CRC Press
Reference Books	
1	Ned Mohan, "Power Electronics", John Wiley and Sons, 3rd Edition
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6E004(D)	Elective IV- High Voltage DC transmission(HVDC)	3	0	0	3

	Prerequisites for the course
1	Basic concepts of Power Electronics studied in fifth semester such AC/DC Converters etc.

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/112104031

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember basic principles of some HVDC Systems.
2	CO2	Understand the basics of HVDC Systems and their implementation.
3	CO3	To identify the different operational characteristics related to HVDC Systems.
4	CO4	Analyze the performance of HVDC Systems.
5	CO5	Evaluate the operation & characteristics of HVDC Systems.
6	CO6	Solve the different problems related to operation of HVDC Systems.

Syllabus:

	Course Contents
Unit I	DC POWER TRANSMISSION FUNDAMENTALS Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system. (7 Hours)
Unit II	HVDC CONVERTERS Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link. (7Hours)
Unit III	HVDC SYSTEM CONTROL HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link. (7Hours)

Unit IV	CONVERTER FAULTS AND PROTECTION Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines. . (7 Hours)
Unit V	Multi -Terminal DC (MTDC) Systems Introduction to MTDC Systems, Importance of Multi-Terminal HVDC Systems, Control of MTDC Systems, Interaction between AC-DC Power Systems. (7 Hours)
Unit VI	Modelling& Representation of HVDC systems Modeling Of HVDC Systems, Per Unit System, Representation for Power Flow Solution, and Representation for Stability Studies. (7 Hours)

Text Books	
1	J. Arrillaga,"High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983
2	K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.
Reference Books	
1	E. W. Kimbark, "Direct Current Transmission", Vol.I, Wiley Interscience, 1971
2	. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6O002	Open Elective II- Electrical AUTOCAD	4	0	0	4

	Prerequisites for the course
1	Basic idea of various softwares used in Electrical Engineering and Importance of AUTOCAD.

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/112104031
2	AutoCAD: A Visual Approach 2D Basics, Steven Foster, Autodesk Press, 1997

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Understand the concept and techniques of Engineering drawing and become familiar with the AutoCAD user interface.
2	CO2	Apply basic CAD concepts to develop and construct accurate 2D geometry through creation of basic geometric constructions.
3	CO3	Create advanced drafting and modifying tools in AutoCAD
4	CO4	Apply elements of drafting such as layers, dimensions, hatching, annotation, drawing formats, and 2D figures in projects with a focus on ANSI industry standards.
5	CO5	Create blocks and attributes in AutoCAD
6	CO6	Understand the concept and techniques of Engineering drawing and become familiar with the AutoCAD user interface.

Syllabus:

Course Contents	
Unit I	An introduction to Engineering Drawings and AutoCAD • Introduction to Engineering Drawing • Various types of Engineering Drawing used in Electrical Industry • Introduction to AutoCAD • Exploring GUI • Workspaces • Coordinate System • Display Control • File Management Tutorials. (10 Hours)
Unit II	Drafting Basic Geometry Shapes in AUTOCAD • Basic Geometry Shapes • Setting the standards • Drafting setting • Drawing tools for basic geometry • Modify tools • Object Properties • Tutorials (10 Hours)
Unit III	Advanced Drafting and Modifying Tools in AutoCAD • Drawing Tools • Advanced Modification Tools • Project and View (12 Hours)
Unit IV	Layer Management, Hatching and Annotations • About Layers • Introduction to Hatching • Isometric Drawing • Introduction to Dimensions • Various Dimensions creation and Editing Methods • Other Commands related to dimensioning • Leader • Text Annotations • Dimension Style Manager • Tutorials . (12 Hours)
Unit V	Application of Blocks and Attributes • Introduction to Blocks • Dynamic Blocks • Attributes • Tutorials on creating blocks (12 Hours)

Text Books	
1	AutoCAD: A Visual Approach 2D Basics, Steven Foster, Autodesk Press, 1997.
2	Concurrent Engineering Design: Three-Dimensional Modeling, Analysis, and Manufacturing Workshop for Lower Division College Faculty, Ronald Barr and DavorJurisic, University of Texas Press, 1996
Reference Books	
1	Engineering Drawing and Graphic Technology, T. French, C. Vierck, and R. Foster,McGraw-Hill, Inc., 1993.
2	AutoCAD 14 for Engineering Drawing by P. Nageshwara Rao, Tata McGraw Hill Publication. .
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

Sr. No	Name of the person	Designation	Organization
1	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
2	Ms.S.V.Jethani	Asst.Prof.	JDCOEM,Nagpur
3	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
8	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
9	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6O002	Open Elective II- Smart Grid Technology	4	0	0	4

	Prerequisites for the course
1	Basic concepts studied in subject Electrical Measurements and Instruments & Power systems-I such as measurement of fault current ,basics safety concepts in Electrical Engineering.

	Prior Reading Material/useful links
1	https://nptel.ac.in/courses/112104031

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
2	CO2	Summarize the Safety aspects during Installation of Plant and Equipment.
3	CO3	Describe the electrical safety in residential, commercial and agricultural installations.
4	CO4	State the electrical systems safety management and IE rules.
5	CO5	Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.

Syllabus:

	Course Contents
Unit I	INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops. (7 Hours)

Unit II	SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT: Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines. (7Hours)
Unit III	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances. (7Hours)
Unit IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations. SF6 Breaker, Vaccum Circuit Breaker, AB Switches, HRC Fuses,etc. . (7 Hours)
Unit V	EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals (7 Hours)
Unit VI	SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees. REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility. The Electricity Act, 2003, (Part1, 2, 3,4 & 5) (7 Hours)
Text Books	
1	S. Rao, Prof. H.L.Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.(units
2	www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit
Reference Books	
1	Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.
Useful links	
1	https://nptel.ac.in/courses/112104031

Contributions for syllabus designing:

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1	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
2	Ms.S.V.Jethani	Asst.Prof.	JDCOEM,Nagpur
3	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
4	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
5	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
6	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
7	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6T003	Research Methodology	2	0	0	Audit

	Prerequisites for the course
1	Basic Idea about what is research,its types & where it is carried out.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Remember the basic framework of research process.
2	CO2	Demonstrate various sources of information for research.
3	CO3	Develop an understanding of various research design and techniques.
4	CO4	Compare various sources of information for literature review and data collection.
5	CO5	Interpret the fundamental functions and working of analytical instruments used in research.
6	CO6	Discuss different methodologies and techniques used in research work.

Syllabus:

	Course Contents
Unit I	Introduction to Research Methodology Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, and Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process and Criteria of Good Research. Defining the Research Problem: Selecting the Problem, Necessity of Defining the Problem and Technique Involved in Defining a Problem (7 Hours)
Unit II	Research Design Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs: Exploratory research, Descriptive research, diagnostic research, Basic principles of experimental Design and Important Experimental Designs. (7Hours)
Unit III	Sampling Design, Measurement and Scaling Techniques Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe, Complex Random Sampling

	Designs. Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling
Unit IV	Methods of Data Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection and Case Study Method. . (7 Hours)
Unit V	Simulation in Research Meaning of Simulation, Need of Simulation, Appropriateness of Simulation, Advantages and Disadvantages of Simulation, Areas of Application, Study of any one tool relevant to electrical engineering area . (7 Hours)
Text Books	
1	C. R. Kothari, Research Methodology: Methods and Techniques, Second Re vised Edition, New Age International Publication, 2004.
2	J. Banks, J. C. Carson II, B. L. Nelson, D. M. Nicol, Discrete Event Systen Simulation, Fourth Edition, Prentice Hall of India Publication, 2006.
Reference Books	
1	K. N. Krishanaswamy, Appalyer Sivakumar, M. Mathiranjan, Managemen Research Methodology: Integration of Principles, Methods and Techniques Pearson Education, New Delhi, 2006.
Useful links	
1	https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Contributions for syllabus designing:

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6L001	Microprocessor and microcontroller Lab	0	0	2	1

	Prerequisites for the course
1	Digital logic concepts studied in the subject Analog & Digital circuits & programming concepts in subject Microprocessor and microcontroller.

	Prior Reading Material/useful links
1	http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	To remember the architecture of 8085 and 8051.
2	CO2	To understand interfacing and interrupt features of 8085 and 8051.
3	CO3	To develop program for basic applications
4	CO4	To distinguish and analyze the properties of Microprocessors & Microcontrollers
5	CO5	To explain programming logic and concepts of 8085 microprocessors and 8051 micro-controller.
6	CO6	To build strong foundation for designing real world applications using microprocessors and microcontrollers.

Syllabus:

List of Experiments
• Study of architecture of 8085
• Assembly language programmes for determination of smaller and larger no
• Assembly language programmes for ascending and descending order
• Multiplication/division of numbers
• Assembly language programmes for led flashing (Interfacing of 8051 Microcontroller with various display devices.
• Programming for speed and direction control of dc motor(Interfacing of 8051 Microcontroller with DC motor.
• Programming for speed and direction of stepper motor

• Study of hexadecimal, modulo-9, BCD counter
• Write a program to move a block of data using 8085 & verify
• Write a program using 8085 & verify for :A. Addition of Two 8-Bit Numbers,B. Addition of Two 16-Bit Numbers (With Carry).
• Write a Program Using 8085 & Verify for :a. Subtraction of Two 8-Bit Numbers. (Display Of Borrow),b Subtraction of Two 16-Bit Numbers. (Display Of Borrow)

Contributions for syllabus designing:

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1	Dr.V.S.Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Mr.A.V.Joshi	Asst.Prof.	JDCOEM,Nagpur
3	Mr.P.V.Ambade	Asst.Prof.	JDCOEM,Nagpur
4	Mr.M.S.Isasare	Asst.Prof.	JDCOEM,Nagpur
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VI	EE6L003	Computer Aided Design Lab	0	0	2	1

	Prerequisites for the course
1	Basic idea of various softwares used in Electrical Engineering and Importance of AUTOCAD.

	Prior Reading Material/useful links
1	http://vlabs.iitkgp.ac.in/tcad/

Course Outcomes:

Sr. No	Course outcome number	CO statement
1	CO1	Understand the concept and techniques of Engineering drawing and become familiar with the AutoCAD user interface.
2	CO2	Apply basic CAD concepts to develop and construct accurate 2D geometry through creation of basic geometric constructions.
3	CO3	Create advanced drafting and modifying tools in AutoCAD
4	CO4	Apply elements of drafting such as layers, dimensions, hatching, annotation, drawing formats, and 2D figures in projects with a focus on ANSI industry standards.
5	CO5	Create blocks and attributes in AutoCAD
6	CO6	Understand the concept and techniques of Engineering drawing and become familiar with the AutoCAD user interface.

Syllabus:

List of Experiments
• Introduction to CAD
• Study of AutoCAD software basics - GUI, limits and units, drawing tools, editing tools, annotations etc.
• Study of Coordinate systems- Cartesian and Polar (absolute and relative system of measurement) and practice drawing by using following tools: Grid, span, O-snap, Lines, Erase, Zoom.
• Create a 2D drawing of a given diagram by using drawing tools: circle, arc, rectangle, polygon, ellipse, and Editing tools: trim, move, copy, rotate, and practice of drawing using these commands.
• Study and create drawing by using Geometry modifying tools: fillet, chamfer, scale, stretch.
• Study and create drawing by using copying tools like array, mirror, block and offset.
• Draw regular solids: Cube, Prism, Pyramid, Cylinder, Cones
• Study and draw 3D drawing of the given object by using AutoCAD commands and tools.
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7	Mr. Vikas Raghote	Quality Control Manager	Livspace Ltd(Alumni JDCOEM,Nagpur)
8	Mr.Vaibhav Suryawanshi	Business Development trainee	Scholar Verzo Pvt.Ltd(Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7T001	Switch gear and protection	3	0	0	3

	Prerequisites for the course
1	Basic concepts studied in subject Power systems-I such as measurement of fault current ,relays ,C.Bs etc.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc21_ee110/preview
2	Switchgear protection and power system by Sunil S. Rao, Khanna Publishers, 13th edition, 2008..
3	Power System Relaying: Stanley H Horowitz, A G Phadke; Willey

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember basic features of protection system and its components.
2	CO2	Select the different components of protection system such as CT, PT, circuit breakers, relays etc
3	CO3	Apply principles of overcurrent relaying and achieve relay coordination for low and medium voltage distribution feeders
4	CO4	Apply distance relaying techniques to High Voltag Transmission lines.
5	CO5	Design protection schemes for equipment such as transformers, generators, motors etc.
6	CO6	Solve different problems related to relay, circuit breaker and equipment protection.

Syllabus:

Course Contents	
Unit I	Need of protection, protection principles,desirable attributes of protection,Faults, Primary & backup protection, Instrument transformers, basic trip circuit. Classification of relays, Review of electromechanical relays, induction relays, Setting characteristics of over current; directional, differential, percentage differential and distance (impedance, reactance, mho) relays, numerical, introduction to static relays, advantages & disadvantages. (5Hours)
Unit II	Review of calculation of fault currents, C. B. selection, fuse protection, over current protection, PSM and TMS setting, phase relay coordination, earth fault protection using over current relays, introduction to directional over-current relays.,Numerical overcurrent relays. (5Hours)
Unit III	Over current relaying, directional- over current relay, Protective zones, Distance protection,setting and coordination of distance relays,pilot protection with distance relays,Numerical distance relays,carrier distance Schemes, Unit carrier schemes. (4Hours)
Unit IV	Protection of generator, transformer and bus Bars by differential relaying and other relays,restricted earth fault protection, incipient faults, Buchholz relay,Protection of Induction Motors against overloads, short circuits, thermal relays. (5Hours)
Unit V	arc voltage, arc interruption, resistance switching, interruption of capacitive and inductive current, transient recovery voltage (TRV), circuit breaker ratings, classification of C.B.s - air break, air blast, vacuum, minimum oil and bulk oil, SF6 C.B. L.T. switchgear: - MCB, MCCB, ELCB, HRC fuses, type construction and application. (5Hours)
Text Books	
1	Fundamentals of power system protection by Y. G. Paithankar, S. R. Bhide., Prentice hall, India, second edition, 2010.".
2	Power System Protection and Switchgear- Badri Ram, Vishwakarma, McGraw Hill
3	Power System Protection and Switchgear-B. Ravindranath and M Chander,Wiley Eastern Ltd, New Delhi
Reference Books	
1	Switchgear protection and power system by Sunil S. Rao, Khanna Publishers, 13th edition, 2008..
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ee110/preview

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr. V. S. Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Prof M. Isasare	Asst.Prof.	JDCOEM,Nagpur
3	Prof A.V. Joshi	Asst.Prof.	JDCOEM,Nagpur
4	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
5	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
6	Ms.Shreya Ramteke	Technical Recruiter	Collabera Pvt.Ltd. (Alumni batch JDCOEM,Nagpur)
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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE7T002	High Voltage Engineering	3	0	0	3

Prerequisites for the course	
1	Basic concepts studied in subject Power systems-I such as Types of Insulators ,different voltage levels in power systems,breakdown voltage etc.

Prior Reading Material/useful links	
1	https://archive.nptel.ac.in/courses/108/104/108104013/
2	High Voltage Engineering Fundamentals by E. Kuffel, W. S. Zaengl, J. KuffelNewnes Publication, ISBN-0-7506-3634-3
3	High Voltage and Electrical Insulation Engineering by Ravindra Arora, Wolf Gang Mosch New Age International Publishers Ltd. Wiley Eastern Ltd., ISBN-978-0-470- 60961-3

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	The proper insulating medium / system; based on the insulation strength of the material for applying to high voltage systems
2	CO2	Over voltage phenomenon in power system with protection and insulation coordination
3	CO3	Generation & measurement techniques of high voltage and current for testing purpose.
4	CO4	HV tests carry out on various equipment's e. g. Cables, CBs, Insulators etc, using relevant testing IS and be able to give analysis of the test results.

Syllabus:

Course Contents	
Unit I	Breakdown in Uniform gap, non-uniform gaps, Ionization processes in gaseous dielectrics, Townsend's criterion for break-down, break-down in electro-negative gases, time lag for break-down, Streamer theory of break-down in gases, Paschen's law, break-down in non-uniform fields, practical considerations in using gases for insulation purpose; break-down in vacuum, Corona discharge (7Hours)
Unit II	Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials (7Hours)
Unit III	Lightning mechanism, types of lightning strokes, parameter and characteristics of lightning strokes, protection of power system against lightning over voltages,

	types of lightning arresters, surge absorbers; types of switching over voltages and their causes, protection against switching over voltages; Insulation coordination, BIL and SIL. (7Hours)
Unit IV	Generation of high D.C. voltage by rectifier, voltage doublers and multiplier circuit, generation of high AC voltage by cascade transformers, resonant transformer; generation of high frequency AC high voltage; impulse waveform, generation of impulse voltage, tripping and control of impulse generator; generation of switching surges; generation of impulse current. (7Hours)
Unit V	Measurement of high AC and DC voltages by micro ammeter, generating voltmeters, resistance and capacitance potential divider, series impedance voltmeter, CVT, magnetic type potential transformers, electrostatic voltmeter, peak reading AC voltmeters, sphere gap arrangement; measurement of impulse voltage by potential dividers and peak reading voltmeters; measurement of high AC, DC and impulse currents. (7Hours)
Unit VI	Non-destructive Testing: Significance of non-destructive testing, measurement of DC resistivity, measurement of dielectric constant and loss-factor, partial discharge phenomenon and measurement, discharge detection in power cables. High Voltage Testing of Electrical Apparatus: Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, lightning arresters and power capacitors. (7Hours)
Text Books	
1	High Voltage Engineering by M. S. Naidu, V. Kamaraju, Tata McGraw Hill Publication Co. Ltd New Delhi, 2013, ISBN-978-1-25-906289-6
2	High Voltage Engineering by C. L. Wadhwa, New Age International Publishers Ltd.
3	High Voltage Engineering by Prof. D. V. Razevig Translated from Russian by Dr.M. P. Chourasia Khanna Publishers, New Delhi.
Reference Books	
1	High Voltage Engineering Fundamentals by E. Kuffel, W. S. Zaengl, J. Kuffel-Newnes Publication, ISBN-0-7506-3634-3
2	High Voltage and Electrical Insulation Engineering by Ravindra Arora, Wolf Gang Mosch New Age International Publishers Ltd. Wiley Eastern Ltd., ISBN-978-0-470- 60961-3
3	Various IS standards for HV Laboratory Techniques and Testing
4	Fundamentals of High Voltage Engineering: S. K. Singh, Dhanpatrai& Co.
Useful links	
1	https://archive.nptel.ac.in/courses/108/104/108104013/

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr. V. S. Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Prof M. Isasare	Asst.Prof.	JDCOEM,Nagpur
3	Prof A.V. Joshi	Asst.Prof.	JDCOEM,Nagpur
4	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
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7	Ms.Snehal Tembhurne	Business Development Executive	Byjus Pvt.Ltd. (Alumni JDCOEM,Nagpur)

Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E005(B)	Flexible AC Transmission Systems	3	0	0	3

	Prerequisites for the course
1	Basic concepts studied in subject Power systems-I such as active & Reactive power etc. and in subject Power Electronics such as Converters,Inverters etc.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc23_ee58/preview
2	Thyristor Based FACTS controllers for Electrical Transmission System R. Mohan Mathur and Rajiv K. Verma (IEEE Press)

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember basic principles of operation of various types of compensators used for VAR generation in the power systems
2	CO2	Understand the problems and constraints related with stability of large interconnected systems and to study their solutions using different FACTS controllers
3	CO3	To identify the different issues related to the stability, active and reactive power control in power systems
4	CO4	Analyse the operation, characteristics and working of different FACTS controllers.
5	CO5	Evaluate the operation, characteristics and working of different FACTS controllers
6	CO6	Solve the different problems related to controlling the various parameters of transmission lines using different types of FACTS controllers

Syllabus:

	Course Contents
Unit I	FACTS concept and general system consideration: Transmission interconnection, flow of power in an AC System, factors affecting the loading capacity, power flow and dynamic stability consideration of transmission interconnection, relative importance of controllable parameters, facts controller. (7 Hours)

Unit II	Static shunt compensators: SVC And STATCOM Objective of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability. Power oscillation damping methods of controllable Var Generation, static Var compensators SVC And STATCOM, Comparison between STATCOM and SVC, Static VAR System (7 Hours)
Unit III	Static Series Compensators: GCS, TSSC,TCSC and SSSC Objective of series compensation, improvement of transient stability, power oscillation damping, Variable impedance type series compensators, Switching Converter type series Compensators (only SSSC), external (System) control for series reactive compensators. Application of SSSC in load Flow and transient stability studies. (7Hours)
Unit IV	Static Voltage and phase angle regulators: TCVR and TCPAR Objective of voltage and phase angle regulators, approaches to thyristor-controlled voltage and phase angle regulators (TCVR and TCPARs), switching converter-based, voltage and phase angle regulator, hybrid phase angle regulators. (7Hours)
Unit V	Combined Compensators (UPFC,IPFC) and special purpose Facts controllers The UPFC, operating principal V-I characteristics UPFC principal of operation modes of operation application.NGH-SSR damping scheme,Thyristor –controlled braking Resistor(TCBR). (5Hours)
Unit VI	Combined Compensators (UPFC, IPFC) and special purpose Facts controllers The UPFC, operating principal V-I characteristics UPFC principal of operation modes of operation application.NGH-SSR damping scheme,Thyristor–controlled braking Resistor(TCBR). (7Hours)
Text Books	
1	Understanding FACTS, Naryan G. Hingorani and Laszlo Gyugyi (Standard Publishers).
2	Flexible AC Transmission System (FACTS) by K.R.Padiyar(New Age Publications)
Reference Books	
1	Flexible AC Transmission System (FACTS)'Yong Hua Song and Johns (IEEE Publishers).
2	Thyristor Based FACTS controllers for Electrical Transmission System R. Mohan Mathur and Rajiv K. Verma (IEEE Press)
Useful links	
1	https://onlinecourses.nptel.ac.in/noc23_ee58/preview

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4	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
5	Dr. S. G. Tarnekar	Ex-Prof.	VNIT,Nagpur
6	Ms.Shreya Ramteke	Technical Recruiter	Collabera Pvt.Ltd. (Alumni batch JDCOEM,Nagpur)
7	Ms.Snehal Tembhurne	Business Development Executive	Byjus Pvt.Ltd. (Alumni JDCOEM,Nagpur)

Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E005(C)	Utilization of Electrical Energy and Traction	3	0	0	3

Prerequisites for the course	
1	Basic concepts studied in subject Electrical Power Utilization and Practice such as Illumination & basics of Traction.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/108102047
2	Utilization of Electrical Power by Dr. N. Suryanarayan, Wiley Eastern Ltd, Age International
3	Utilization of Electrical Energy by E.Openshaw Taylor, Orient Longman

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the types of electrical heating and welding processes
2	CO2	Understand concepts of illumination in indoor and factory lighting systems.
3	CO3	Apply energy saving mechanisms in pumping system and DG Set
4	CO4	Analyze the characteristics of DC and AC traction motor
5	CO5	Evaluate the performance of lighting systems and compressors.
6	CO6	Discuss methods of control and braking in electric traction

Syllabus:

Course Contents	
Unit I	Electric Heating i) Electric Heating : Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipments, transfer of heat. ii) Resistance Ovens : General constructions, design of heating elements, efficiency & losses, radiant heating. iii) Induction heating: Core type & core less induction furnace, indirect induction oven, medium and high frequency eddy - current heating. iv) Dielectric heating: Principle and application. v) Arc furnace : Direct & indirect arc furnace, power supply, characteristics & control.

	(6Hours)
Unit II	Electric Welding i) Importance, Advantages & Disadvantages of welding, classification of welding processes. ii) Resistance welding, Butt welding, Spot welding, Projection welding, Seam welding. iii) Electric arc welding: Carbon arc welding, metal arc welding, submerged arc welding, Stainless Steel welding iv) Ultrasonic welding, electron beam welding, laser beam welding. (6 Hours)
Unit III	Illumination Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, Colour Rendering Index (CRI), Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, flood lighting, street lighting, energy saving in lighting systems. (7Hours)
Unit IV	Fans and Pumps Fans and Blowers: Fan types, fan performance evaluation & efficient system operation, fan design & selection criteria, flow control strategies, fan performance assessment, energy saving opportUnit Ies. Pumps: Pump types, system characteristics. Pump curves, factors affecting pump performance, efficient pumping system operation, flow control strategies, energy conservation opportUnit Ies in pumping system. (7Hours)
Unit V	Compressors and DG sets Compressors: Compressor types, Compressor efficiency, Compressed air system components. Diesel Generating Systems: Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets. (7Hours)
Unit VI	Electrical Traction System of traction, System of Track electrification, Running Characteristics of DC and AC traction motor. Control of motor: Tapped field control, Rheostatic control, Series parallel control, Metadyne control. Braking: Regenerative Braking, Braking with 1-phase series motor, Magnetic Braking. Speed- Time curve for train movement, crest speed, average speed and schedule speed, simplified speed-time curve. (7Hours)
Text Books	
1	Utilization of Electric Power & Electric Traction by J. B. Gupta, Kataria& Sons
2	Utilization of Electrical Power by R. K. Rajput, Laxmi Publications Pvt. Ltd.
Reference Books	
1	Utilization of Electrical Power by Dr. N. Suryanarayan, Wiley Eastern Ltd, Age International
2	Utilization of Electrical Energy by E.Openshaw Taylor, Orient Longman
Useful links	
1	https://nptel.ac.in/courses/108102047

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E005(D)	Power system dynamics and control	3	0	0	3

	Prerequisites for the course
1	Basic concepts studied in the subject Power System II such as Load angle ,Power vs Load angle curve,Equal Area Criterion etc.

	Prior Reading Material/useful links
1	https://archive.nptel.ac.in/courses/108/101/108101004/
2	Power System Dynamics: K R Padiyar, B.S. Publishers, 2003, 2nd Edition.

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Toremember basic concepts of power system stability, operation and control
2	CO2	To understand concepts of power system stability, operation and control
3	CO3	To apply knowledge of active and reactive power control, synchronous machine modeling, excitation system in any power system
4	CO4	To examine power system stability and control its variables under different operating conditions.
5	CO5	To justify about system stability and its controlling operations
6	CO6	To modify any system for its stable operation

Syllabus:

	Course Contents
Unit I	Concept of Power system stability, Types of stability, Classical model of single machine connected to infinite bus and a multi machine system, mathematical modeling of power system elements for stability studies. (6 Hours)
Unit II	Small Signal Analysis, Fundamental concepts of Stability of Dynamic Systems, Small Signal Stability of Single Machine Infinite Bus(SMlB) System, Effects on Excitation system,Block diagram representation with exciter and AVR, Power System Stabiliser (PSS), State matrix including PSS, Small Signal Stability of Multi Machine Systems. (7 Hours)

Unit III	Rotor angle stability, classical method of rotor angle stability, equal area criteria for SMIB system, two machine systems, Numerical solution of swing equation, Multi-machine stability, factor affecting transient stability. (7 Hours)
Unit IV	Voltage stability & Voltage Collapse, Reactive power and voltage control, Voltage stability analysis, different criteria for voltage stability. (7 Hours)
Unit V	Unit Commitment Constraints in unit commitment – Spinning reserve – Thermal unit constraints – Other constraints – Solution using Priority List method, Dynamic programming method - Forward DP approach Lagrangian relaxation method – adjusting . (7 Hours)
Unit VI	Economic Dispatch Control Incremental cost curve- co-ordination equations with loss included (No derivation of Bmn coefficient) solution of co- ordination equations using Bmn co-efficient by iteration method Base point & participation factors. (6 Hours)
Text Books	
1	Power System Stability and Control by P.Kundur , EPRI Publications, California
2	Power System Operation and Control by A.J Wood and B.F Wollenberg, John Wiley and Sons
Reference Books	
1	Power system Stability and Control: P Kundur, , McGraw-Hill Inc., 1994
2	Power System Dynamics and Stability: P W Sauer & M A Pai, Pearson, 2003
Useful links	
1	https://archive.nptel.ac.in/courses/108/101/108101004/

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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
III	EE7E006(A)	Introduction to Green Energy	3	0	0	3

	Prerequisites for the course
1	Basics of PV Cell,PV array ,OC voltage SC current etc studied in the subject Renewable Energy Sources.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview
2	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the types of solar cells and geothermal energy sites
2	CO2	Understand concepts of wind energy conversion system
3	CO3	Apply green building measures for energy management
4	CO4	Analyze the characteristics of wind energy conversion systems
5	CO5	Evaluate the energy demand and renewable energy potential
6	CO6	Discuss concepts of energy generation using hydro power and geothermal energy.

Syllabus:

	Course Contents
Unit I	**Energy sources**: Introduction to nexus between Energy, Environment and Sustainable Development; Energy transformation from source to services; Energy sources, sun as the sourceof energy; biological processes; photosynthesis; food chains, classification of energy sources,quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory ofrenewability, renewable resources; overview of global/ India's energy scenario. (8 Hours)
Unit II	**Solar Energy:** Basic theory of flat plate collectors, solar heating of buildings, solar still, solar

	water heaters, solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells. Roof top solar PV systems. **Wind Energy:** Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, and applications. (8 Hours)
Unit III	**Ocean Energy:** Ocean energy resources-ocean energy routes - Principles of ocean thermal energy conversion systems- ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion. **Other Sources:** Hydropower, Nuclear fission and fusion-Geothermal energy: Origin, types ofgeothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion. (8 Hours)
Unit IV	**Green Buildings** :Environmental implications of buildings energy, carbon emissions, water use, waste disposal;Building materials: sources, methods of production and environmental Implications. EmbodiedEnergy in Building Materials: Transporation Energy for Building Materials; Maintenance Energyfor Buildings. Green Composites for buildings: Concepts of Green Composites. Water Utilisation in Buildings, Management of Solid Wastes.Urban Environment and Green Buildings. Green Cover and Built Environment (8 Hours)
Unit V	**Policy Issues:** The United Nations Framework Convention on Climate Change (UNFCCC). The Intergovernmental Panel on climate change (IPCC), the Kyoto Protocol. Energy Demand: Global and Indian trends - Determinants of energy demand; energy productivity and management of energy demand - Policy toward Electricity in India: pricing, implications of state subsidies, case for and against privatization in electricity generation and distribution; relevance to India of California experience in privatization of electricity distribution - Potential for renewable energy use in India (solar and wind energy) (8 Hours)
Text Books	
1	Energy and the Environment, 2nd Edition, John Wiley, 2006, Authors: Ristinen, RobertA. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., Publisher: Wiley, Location: New York, 2006.
2	Fundamentals of Solar Cells: PV Solar Energy Conversion, Alan L Fahrenbruch and Richard H Bube Academic Press, New York , 1983
3	Wind and Solar Power Systems , Mukund R. Patel, CRC Press; (1999)

Reference Books	
1	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
2	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E006	Digital Signal Processing	3	0	0	3

Prerequisites for the course	
1	Basics signaling concepts studied in the subject Analog & Digital Electronics.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ee20/preview
2	Digital signal processing Theory & Applications: N.G.Palan, Tech Max Publication, Prows and Manolakis, PHI Ltd, 3rd Edition.

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember different types of signals and systems
2	CO2	Understands signals mathematically in continuous and discrete-time, and in the frequency domain.
3	CO3	Analyze discrete-time systems using z-transform
4	CO4	Solve DFT using various FFT algorithms
5	CO5	Represent and design digital filters for various application
6	CO6	Apply digital signal processing for the analysis of real-life signals

Syllabus:

Course Contents	
Unit I	Introduction to Digital Signal Processing Frequency domain description of signals & systems, Advantages of Digital over Analog Signal Processing, Classification of signal and systems: Linearity, causality, stability, static dynamic, Time Invariance Time variance. Linear convolution, circular convolution, Analog-to-Digital and Digital-to-Analog Conversion. (7 Hours)
Unit II	Discrete-Time Signals and Systems Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate, Discrete-Time Systems Described by Difference Equations. Solutions of linear difference equations. (7

	Hours)
Unit III	The Z –Transform And Its Applications Definition. Properties of the region of convergence for the Z- transformer, Z - transform properties, Inverse Z - transform using contour integration, partial fraction expansion, Parseval'stheorem,Interpretation of stability in z-domainSolutions of difference equations. (6 Hours)
Unit IV	: Discrete Fourier Transform Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems. (7 Hours)
Unit V	Filter Design Techniques Design of discrete time IIR filters from continuous time filters. Frequency transformations of low pass IIR filters, Direct form I, Direct form II, Cascade and parallel structure for IIR and FIR Filter, Design of FIR filters by windowing method, FIR filter design by Fourier series method method. (7 Hours)
Text Books	
1	Digital signal processing Theory & Applications: N.G.Palan, Tech Max Publication, Prows and Manolakis, PHI Ltd, 3rd Edition.
2	Digital Signal Processing- A computer based approach: S. K. Mitra, McGraw Hill, 2011.
Reference Books	
1	Theory and Application of Digital Signal Processing: L. R. Rabiner and B. Gold, Prentice Hall, 1992.
2	Digital Signal Processing: S Salivahanan, AVallavaraj, Mc. Graw Hill Publica-tion. 2nd Edition 2. Discrete time signal processing.
3	Introduction to Digital Signal Processing: J. R. Johnson, Prentice Hall, 1992.
4	S.K.Mitra, "Digital Signal Processing", TMH Pub
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ee20/preview

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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E006(C)	Electrical Vehicle	3	0	0	3

	Prerequisites for the course
1	Basic concepts of Electrical Drives such as Converter based Induction Motor & DC moror Drives.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc23_ee01/preview
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles - Fundamentals, Theory, and Design: M.Ehsani, Y. Gao, S. E. Gay and A. Emadi, CRC Press, 2004.
3	Electric and Hybrid Vehicles: T. Denton, Routledge, 2016 .

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	To remember the basics of electric vehicles, and fundamentals
2	CO2	To Understand the models and architecture, technologies to describe electric vehicles
3	CO3	To apply the basic concepts to describe electric vehicles and their performance
4	CO4	To Analyze the different possible ways of energy storage
5	CO5	To Compare the different strategies related to energy storage systems.

	Course Contents
Unit I	Introduction : Conventional Vehicles: Basics of vehicle performance, vehicle power source, Characterization, transmission characteristics (7 Hours)
Unit II	Hybrid and Electric Vehicle: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

	. (8 Hours)
Unit III	Electric Trains :Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives . (8 Hours)
Unit IV	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis . (8 Hours)
Unit V	Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. (8 Hours)
Text Books	
1	Hybrid Electric Vehicles - Principles and Applications with Practical Perspectives: C. Mi, M. A.Masrur and D. W. Gao, John Wiley & Sons, 2011
2	. Hybrid Electric Vehicles - Energy Management Strategies: S. Onori, L. Serrao and G. Rizzoni,Springer, 2015.
Reference Books	
1	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles - Fundamentals, Theory, and Design: M.Ehsani, Y. Gao, S. E. Gay and A. Emadi, CRC Press, 2004.
2	Electric and Hybrid Vehicles: T. Denton, Routledge, 2016 .
Useful links	
1	https://onlinecourses.nptel.ac.in/noc23_ee01/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7E006(D)	Power Quality	3	0	0	3

	Prerequisites for the course
1	Basic concept of FACTS devices such as DVR,DSTATCOM etc.

	Prior Reading Material/useful links
1	https://onlinecourses.nptel.ac.in/noc21_ee103/preview
2	Electrical power system quality – R. C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty, Second edition, McGraw Hill
3	Understanding power quality problems, voltage sag and interruptions - M. H.J. Bollen, IEEE press, 2000, series on power engineering

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the basic principles related to Power quality
2	CO2	Understand the problems and constraints related with quality of power in large interconnected power systems
3	CO3	To identify the different issues related to the power quality in power systems.
4	CO4	Analyse the characteristics of different power quality problems
5	CO5	Evaluate the operation, and working of different mitigation methods for power quality problems.
6	CO6	Solve the different problems related to different power quality issues by controlling the various parameters in distribution systems

Course Contents	
Unit I	Introduction to Electric Power Quality, Power Quality standards, Different Power Quality terms and definitions (6 Hours)
Unit II	Voltage Sag and Interruptions, Sources of Voltage sag and interruptions, type and characteristics of voltage sag and interruptions, Factors affecting characteristics of voltage sag and interruptions, behavior of different equipments during voltage sag, concept of area of vulnerability, CBEMA and ITI Curves . . (7 Hours)
Unit III	Voltage Swell and transient over voltage, sources of over voltage like capacitor switching, load switching, lighting etc, various causes of voltage flicker and their effects. Short term and long term flickers, various means to reduce flickers, Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages. . (7 Hours)
Unit IV	Harmonic distortions, voltage and current harmonics, THD, sources of harmonics, ill effects of harmonics, interharmonics, harmonics filters, IEEE 519-1992 definitions, reactive power under harmonics, K-rated transformer.(7 Hours)
Unit V	Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring, Mitigation techniques at different environments. (6 Hours)
Text Books	
1	Electrical power system quality – R. C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty, Second edition, McGraw Hill
2	Understanding power quality problems, voltage sag and interruptions - M. H.J. Bollen, IEEE press, 2000, series on power engineering
3	Power Quality: C.Sankaran, CRC Press
Reference Books	
1	IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and require-ments for harmonics control in electrical power system
2	Power system quality assessment: J. Arrillaga, M.R. Watson, S. Chan, John Wiley and sons. .
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ee103/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7O003	Wind and Hydro Power Systems	4	0	0	4

Prerequisites for the course	
1	Basic concepts studied in subject Renewable Energy Systems such as Wind & Hydro power generation.

Prior Reading Material/useful links	
1	https://archive.nptel.ac.in/courses/121/106/121106014/
2	Paul Gipe , Karen Perez, (1999); Wind Energy Basics: A Guide to Small and Micro WindSystems, Chelsea Green Publishing Company

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the basic principles related to Power quality
2	CO2	Understand the problems and constraints related with quality of power in large interconnected power systems
3	CO3	To identify the different issues related to the power quality in power systems.
4	CO4	Analyse the characteristics of different power quality problems
5	CO5	Evaluate the operation, and working of different mitigation methods for power quality problems.
6	CO6	Solve the different problems related to different power quality issues by controlling the various parameters in distribution systems

Course Contents	
Unit I	Introduction to wind energy, Atmospheric circulations, Factors influencing wind, Variation of wind speed with height and time, Turbulence, Causes of turbulence, Power estimation in wind, Wind energy conversion principles, Components of wind energy Conversion Systems (WECS),Classification of WECS, Wind Turbine Aerodynamics. (10Hours)
Unit II	Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Power Developed, Maximum power coefficient (Betz Limit), Thrust, Efficiency, Rotor selectionRotor design considerations, Diameter of the Rotor. (10Hours)
Unit III	Wind Pumps: Design and working, Principle of wind Energy electricity generation: Stand Alone, Grid connected and hybrid WECS. Environmental Benefits and problems of wind energy. Economics of wind energy: Factors influencing the cost of energy generation, Life cycle cost analysis. Current Status and future prospects of wind energy, Wind energy in India case studies. (10 Hours)
Unit IV	Basics of Hydro Energy and is Availability: Energy in water, basic hydro energy conversion, energy conversion calculations and efficiency, categorization of hydroelectric power plants, viz. micro, small and large, decentralized hydroelectric plants, types of turbines and their applications in small hydro technologies, site requirements for hydro power, availability of sites globally and in India, environmental impact of various capacity hydroelectric plants... (10 Hours)
Unit V	Introduction to Small Hydro Power Technologies: Scale of turbines being considered, technologies for small hydro, turbine designs and efficiencies, control systems, safety, design considerations for a small hydro power plant, components of small hydro power plants, stand alone and grid interactive plants, operation and maintenance, standards and certification, manufacturing, quality assurance and testing . (10 Hours)
Unit VI	Small Hydro Power Plants: Typical design of small hydro power plants, design considerations for components, decentralized plants, generator designs, operation and maintenance, site requirements, environmental impact assessment, manufacturing and assembly, quality assurance, standards and certification . Economics of Small Hydro Power Plants: Cost of small hydro power plants, technology wise difference in costing, site development costs, environmental impact costs, life cycle costing, return on investment; impact of scale on the economics (10 Hours)
Text Books	
1	SirajAhmed:"Wind Energy-Theory and Practice" Second Edition, PHI Learning Pvt. Ltd, New Delhi, 2011.

Reference Books	
1	Garg L Johnson: "Wind Energy Systems" Prentice Hall. Inc, New Jersey,1985
Useful links	
1	https://archive.nptel.ac.in/courses/121/106/121106014/

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7O003 (B)	Industrial Electrical System	4	0	0	4

	Prerequisites for the course
1	Basic concepts of Isolators, relays & C.Bs studied in subject Switchgear and Protection.

	Prior Reading Material/useful links
1	https://archive.nptel.ac.in/courses/108/105/108105064/
2	Design of Electrical Installation: V.K. Jain & A. Bajaj

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Assess the electrical load and select the conductors suitable to carry load currents
2	CO2	Calculate the short circuit current at different locations and select proper switchgear
3	CO3	Design and select suitable components of starters for induction motor, understand its operation and select capacitors for reactive power management. .
4	CO4	Select and understand procedures for installation, testing and commissioning practices for transformers, substations & UPS Systems.
5	CO5	Design PCC & MCCs for residential, commercial and industrial installations.
6	CO6	Understand important features of IS 3043 for earthing, protection of building against Lightening & IE Rules.

Course Contents	
Unit I	Assessment of Electrical Load & Selection of Cables & Conductors : Electrical load assessment: Categories & types of electrical load, preparing load list, connected load, demand/ diversity/ load/power factor, TOD tariff, and industrial electric bills. Cables, conductors & bus bar: Construction, selection, installation, testing of LT/HT cables, overload and short circuit ratings, rating factors, overhead line conductors, aluminium & copper bus bar. (10 Hours)
Unit II	Symmetrical Short Circuit Calculations, Switching & Protective Devices :Symmetrical short circuit calculations: Determining symmetrical short circuit currents for selecting appropriate switchgear, determining specifications of current limiting series reactor. Switching & Protective devices: Types, specifications and selection of isolators, switches, switch fuse units, ELCB, MCB, MCCB, ACB,VCB and SF6 circuit breakers; dropout/horn gap fuses, AB switches, power contactors, capacitor duty contactors. (10 Hours)
Unit III	Electric Supply to Induction Motors and Reactive Power Management in Industries : Electric supply to induction motors: Power & control circuit for manual/automatic DOL, star-delta and autotransformer starters, working of these starters, selection of contactors, overload relays, short-circuit protective devices for induction motors. Reactive power management in industries: Determining kVAr rating of PF improvement by using power triangle, calculation of payback period of capital cost of capacitor installation against reduction in system losses.. (10 Hours)
Unit IV	Transformers, Substations, DG, UPS and Batteries: Transformers: Specifications, ratings, selection, installation, testing & commissioning. Substations: 11 & 33 kV, indoor/outdoor substations; plan/elevation/clearances UPS and Batteries: UPS systems, battery banks, sizing and selection of UPS and battery banks. (10 Hours)
Unit V	Design of Residential, Commercial and Industrial Installations :Design of PCC, MCC, APFC Panels; selection of all associated electrical apparatus, busbars, cables, switchgear, protective devices, instruments, testing, commissioning. Introduction to lightening protection of buildings. (10 Hours)
Unit VI	Earthing, & IE Rules: Earthing& IE Rules/ CEA Regulations: Earthing (IS 3043): Necessity of earthing, concept of system and equipment earthing, definition of various terms, types of earthing, earth tester, and measurement of earth resistance. IE Rules: Important IE rules applicable to residential, commercial and industrial installations. Central Electricity Authority (Measures relating to Safety and Electric supply) regulations 2010. (10 Hours)

Text Books	
1	. Electric Power Distribution: A.S. Pabla
2	Residential Commercial and Industrial Systems: H. Joshi, McGraw Hill Education
3	Handbook of Electrical Power Distribution: G. Ramamurthy
Reference Books	
1	Indian Electricity Rules latest edition
2	IS 3043 Code of practice for earthing
3	Manufacturers' catalogues
Useful links	
1	https://archive.nptel.ac.in/courses/108/105/108105064/
2	

Contributions for syllabus designing:

Sr.No	Name of the person	Designation	Organization
1	Dr. V. S. Dhok	Asst.Prof.	JDCOEM,Nagpur
2	Prof A.V. Joshi	Asst.Prof.	JDCOEM,Nagpur
3	Prof M. Isasare	Asst.Prof.	JDCOEM,Nagpur
4	Mr. J. S. Joshi	Professor (EE)	RKNEC,Nagpur
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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE8O004 (A)	Automation with PLC	4	0	0	4

Prerequisites for the course	
1	Basic Idea of Microcontrollers and Automation using Microcontrollers.

Prior Reading Material/useful links	
1	https://nptel.ac.in/courses/108105088
2	Programmable Logic Controllers: John Hacworth and Frederick D. Hackworth Jr, Pearson publisher
3	Programmable Logic Controllers: W. Bolton ,Newnes an imprint of Elesevier, 6th edition.

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Understand automation tools & its components.
2	CO2	Apply logic with ladder diagram for the industry application.
3	CO3	Understand the functioning of PLC . . .
4	CO4	Apply knowledge of PLC for design of Industrial Automation

Course Contents	
Unit I	Introduction to PLC : Technical Definition, advantages, chronological Evolution, Types of PLCs, Block Diagram, processor software/Executive software. PLC vs PC (10 Hours)
Unit II	Ladder diagram fundamentals : Introduction to basic components and their symbols, development of relay and contactor logic, Concept of PCC, MCC, Control desk , No, NC switches, limit switches, relay, contactor, timer, voltage to current converter, current to voltage converter, selection of sensor, Hydraulic motor control, fundamentals of Ladder Diagrams. (10 Hours)

Unit III	Fundamental PLC programming : Ladder diagram, physical component vs program components, examples (10 Hours)
Unit IV	**I**ndustrial Communication and networking : Evolution of Industrial Communication technology, types of communication interfaces, synchronization and timing in communication. . (10 Hours)
Unit V	Introduction to Industrial Automation : Industrial automation components, smart sensors, PLC, DCS and SCADA. Introduction to SCADA. Examples of some simple automated systems. (10 Hours)
Text Books	
1	. Programmable Logic Controllers and Industrial Automation: An Introduction MadhuchchandaMitra, SamarjitSengupta (Author), 2nd Edition
Reference Books	
1	Programmable Logic Controllers: John Hacworth and Frederick D. Hackworth Jr, Pearson publisher
2	Programmable Logic Controllers: W. Bolton ,Newnes an imprint of Elesevier, 6th edition.
Useful links	
1	https://nptel.ac.in/courses/108105088

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Program:B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE8O004	Solar PV Systems Engineering	4	0	0	4

Prerequisites for the course	
1	Basic idea of PV systems studied in subject Renewable Energy Systems in fifth semester.

Prior Reading Material/useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview
2	Renewable and Efficient Electric Power Systems: Gilbert M. Masters, John Wiley & Sons, 2004

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the basics of Solar PV Systems
2	CO2	Understand circuit model of PV cell and interpret I-V curves under different operating conditions.
3	CO3	Identify various algorithms used for the maximum power point tracking of PV array.
4	CO4	Analyze the principle of power conversions used in PV system
5	CO5	Explain the various applications of PV systems
6	CO6	Design PV system by estimating the load, sizing and selecting the batteries, sizing and selecting the PV modules and other components

Course Contents	
Unit I	Introduction : Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems (10 Hours)
Unit II	Solar radiation : Extra-terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky insulation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insolation from measured data. (10 Hours)
Unit III	PV cells and modules : Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays; effect of shading, use of bypass and

	blocking diodes; influence of temperature; types of solar cells and their performance; schemes for maximum power point tracking (10 Hours)
Unit IV	Maximum Power Point Tracking: Maximum Power Point Tracking and MPPT algorithms . (10 Hours)
Unit V	Power converters in Photovoltaic system: Introduction to DC-DC converter, DC-AC Converter, PV Grid Interface (10 Hours)
Text Books	
1	.Solar Photovoltaic: Fundamentals, Technologies and Applications: Solanki, PHI Learning Pvt Ltd, 2009
Reference Books	
1	Photovoltaic Systems Engineering: Roger A. Messenger & Jerry Ventre, CRC Press, 2004, 2nd
Useful links	
1	https://onlinecourses.nptel.ac.in/noc21_ph25/preview

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Program: B.Tech in Electrical Engineering

Semester	Course Code	Name of the course	L	T	P	Credits
VII	EE7L002	Computer Applications in Electrical Engineering Lab	0	0	2	1

Prerequisites for the course	
1	Basic idea regarding various softwares used in Electrical Engineering like MATLAB,PSIM,PCAD etc.

Prior Reading Material/useful links	
1	http://vlabs.iitkgp.ac.in/tcad/

Course Outcomes:

Sr.No	Course outcome number	CO statement
1	CO1	Remember the basic operations of various power plants.
2	CO2	Understand and interpret the requirements and basics of power plant installation and site selection.
3	CO3	Apply knowledge to Economic Operation of Power Systems and the knowledge related with its need.
4	CO4	Analyze various electric power plants operations and distinguish between properties.
5	CO5	Evaluate thermal, hydro, nuclear, gas power plant also able to Explain its fundamentals.
6	CO6	Design Economic Operation of Power Systems and also able to give solutions implementation of power plant on its basics.

Syllabus:

List of Experiments
1. To model transmissionlines using MATLAB 2. To find optimum loading of generators neglecting transmission losses using MATLAB 3. To find optimum loading of generators with penaltyfactors using MATLAB 4. SIMULINK model of single area load frequency control with and withoutPIcontroller andwithoutPIcontroller inSIMULINK. 5. Simulinkmodelfortwoareaload frequencycontrol 6. Simulink model for evaluating transient stability of single machineconnected to in-finitebus 7. To study impulse generator 8. To measure the dielectric strength of transformer oil. 9. To study the use of sphere gap as a voltmeter for measurement of high voltages. Formation of Z bus matrix using MATLAB

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Member Secretary

Chairperson