NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institution)
POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE FOR THIRD YEAR B.TECH PROGRAMME

III YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	18A3102401	Electrical Measurements	3	-	-	3	40	60	100	3
2	18A3103401	Switching Theory and Logic Design	3	-	-	3	40	60	100	3
3	18A3102402	Power Systems-II	3	-	-	3	40	60	100	3
4	18A3102403	Power Electronics	3	-	-	3	40	60	100	3
5	18A3102601 18A3102602	**OE-II** 1) Renewable Energy Sources 2) Modeling & Simulation of Systems	3	-	-	3	40	60	100	3
6	18A3102491	Electrical Machines-II Lab	-	-	3	3	40	60	100	1.5
7	18A3102492	Power Electronics Lab	-	-	3	3	40	60	100	1.5
8	18A3102493	Electrical Measurements Lab	-	-	3	3	40	60	100	1.5
9	18A3100802	Indian Constitution	2	-	2	2	-	-	-	-
Total			**17**	**-**	**11**	**26**	**360**	**540**	**900**	**19.5**

III YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	18A3202401	Power Electronic Controllers & Drives	3	-	-	3	40	60	100	3
2	18A3202402	Instrumentation	3	-	-	3	40	60	100	3
3	18A3202403	Power Systems-III	3	-	-	3	40	60	100	3
4	18A3202301	IC Applications	3	-	-	3	40	60	100	3
5	18A3202404	Utilization of Electrical Energy	3	-	-	3	40	60	100	3
6	18A3202601 18A3202602	**OE-III** 1) Electrical and Hybrid Vehicles 2) MATLAB and Applications	3	-	-	3	40	60	100	3
7	18A3202491	Electrical Simulation Lab	-	-	3	3	40	60	100	1.5
8	18A3202391	MPMC Lab	-	-	3	3	40	60	100	1.5
Total			**18**	**-**	**8**	**26**	**360**	**540**	**900**	**21**

L - LECTURE T – TUTORIAL P - PRACTICAL
CIA – Continuous Internal Assessment SEA – Semester End Assessment

ELECTRICAL MEASUREMENTS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

ELECTRICAL CIRCUITS, ELECTRO MAGNETIC FIELDS,ELECTRICAL MACHINES, POWER SYSTEMS

Course Objectives:

1. Familiar with various measuring instruments used to detect electrical quantities.
2. Design and test instrument transformers for various electrical applications.
3. Measuring the most common physical quantities.
4. Measure electrical parameters using AC and DC bridges.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	List the various measuring instruments available.
CO2	Compare various electrical quantities and measure them.
CO3	Design various instrument transformers.
CO4	Test various instrument transformers.
CO5	Design and Measure the passive elements R, L and C by using various bridges.
CO6	Design the Digital meters and measure the electrical parameters.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	**3**	**1**	**2**									
CO2	**2**	**3**							**2**			
CO3	**3**	**3**	**2**									
CO4	**2**	**2**	**2**						**2**			
CO5	**3**	**2**	**2**									
CO6	**2**	**2**										

UNIT I

Measuring Instruments

Classification, deflecting, control and damping torques, Ammeters and Voltmeters, PMMC, moving iron type instruments, expression for the deflecting torque and control torque ,Errors and compensations. Extension of range using shunt and series resistance.

Measurement of Power and Energy

Single phase and three phase dynamometer wattmeter, LPF and UPF, expression

for deflecting and control torques, Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading using R.S.S. meter, Three phase energy meter, Trivector meter, maximum demand meters.

UNIT II

Instrument Transformers

Current Transformers, Theory, Ratio error and phase angle error. Potential Transformers - Theory, Ratio error and phase angle error.

Special Meters

Type of P.F meters-Single phase Electrodynamometer Power Factor meter-three phase Electrodynamometer . Type of Frequency meters – Mechanical Resonance type Frequency meter, Electrical Resonance type Frequency meter-Weston type Frequency meter-Ratio meter type Frequency meter, Saturable core Frequency meter.

UNIT III

Resistance Measurements

Method of measuring low, medium and high resistances, sensitivity of Wheat stone's bridge, Carey Foster's bridge- Kelvin's double bridge for measuring low resistance, loss of charge method for measurement of high resistance.

A.C. Bridges

Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owens's bridge. Measurement of capacitance and loss angle, Desauty Bridge, Wien's bridge, Schering Bridge.

UNIT IV

Digital meters

Introduction to digital meters, Digital Voltmeters-Successive approximation, ramp and integrating type, Digital frequency meter, Digital energy meters and Digital tachometer- Bidirectional meters accuracy class.

TEXT BOOKS:

1.A course in Electrical and Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & Co. Publications.

2. Electrical Measurements and measuring Instruments,E.W. Golding and F.C. Widdis, 5th Edition, Wheeler Publishing company.

3. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfrick and William D. Cooper, PHI, 2nd Edition.

REFERENCE BOOKS:

1.Principles of Electrical Measurements, H.Buckingham and Price, Prentice, Hall India.

2. Electrical Measurements, Forest Klaire Harris, John Wiley and sons.

3. Electrical Measurements: Fundamentals, Concepts, Applications, Martin.U.Reissland, New Age International Publishers Limited.

4. Electrical and Electronic Measurements, G.K.Banerjee, PHI Learning Private

Ltd.
E-RESOURCES:
http://nptel.ac.in/syllabus/108106070/

SWITCHING THEORY AND LOGIC DESIGN

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

MATHEMATICS,CIRCUITS

Course Objectives:

- To introduce the basic concepts of binary codes, error detecting and correcting codes.
- To study the representation of switching functions using Boolean expressions and their minimization techniques.
- To design and realize various combinational circuits, synchronous and asynchronous sequential logic circuits.
- To analyze various synchronous and asynchronous sequential logic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify the features of various number systems.
CO2	Identify the features of various binary codes.
CO3	Apply the concepts of Boolean algebra for the analysis
CO4	Design of various combinational & sequential logic circuits.
CO5	Design various digital circuits starting from simple ordinary gates to complex programmable logic devices & arrays.
CO6	Analyze various synchronous and asynchronous sequential circuits.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	**3**	**3**										
CO2	**2**	**3**	**3**									
CO3	**2**	**3**	**3**							1		
CO4	**2**	**3**	**3**							3		
CO5	**2**	**3**	**3**							2		
CO6	**2**	**3**	**3**									

UNIT I

Number Systems and Binary Codes:
Philosophy of number systems, complement representation of negative numbers, binary arithmetic, binary codes, error detecting & error correcting codes –Hamming codes.
Boolean algebra: Fundamental postulates of Boolean algebra, Basic theorems and properties.

UNIT II

Switching Functions: Switching functions- Canonical and Standard forms, Algebraic

simplification, Digital logic gates, Multilevel NAND/NOR realizations, Minimization of switching functions using K-Map up to 5-variables, Tabulation Method, Prime Implicant chart.

UNIT III

Combinational Logic Circuits: Adders, subtractors, multiplexers and de-multiplexers, decoders and encoders, code converters, 1 Bit ALU

Sequential logic: 1-bit memory cell, SR, JK, D and T flip-flops level triggering and edge triggering, conversions of Flip-Flop**.**

UNIT IV

Synchronous Sequential Machines: Finite state machines, Mealy and Moore models, Analysis of Clocked Sequential circuits, Design procedures, State reduction and State assignment, Design and realization of circuits using various Flip-flops.

TEXT BOOKS:

Switching and Finite Automata theory, ZviKohavi and Niraj k Jha, Cambridge University Press, 3rd edition, 2010.

REFERENCE BOOKS:

1. Digital Design, Morris Mano, PHI, 3rd Edition, 2001.
2. Fundamentals of Logic Design, Charles H. Roth, Thomson Publications, 5th Edition, 2009.

E-RESOURCES:

1. http://www.ece.ubc.ca/~saifz/eece256.htm
2.http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Guwahati/digital_circuit/frame/index.html

POWER SYSTEMS II

Lecture – Tutorial:	4-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Power Systems-I Concepts and Calculus

Course Objectives:

The Objectives of learning this Course are:

- To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- To study the short and medium length transmission lines, their models and performance
- To study the factors affecting the performance of transmission lines and compensation methods
- To study the performance and modeling of long transmission lines.
- To study the effect of travelling waves on transmission lines.
- To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Derive transmission line parameters for analyzing the behavior under different operating conditions.
CO2	Analyze the performance of short & medium transmission lines.
CO3	Analyze the performance of long transmission lines.
CO4	Understand the surge propagation, reflection and refraction in transmission lines and design the level of insulation coordination at various high voltages.
CO5	Utilize the knowledge on surge behavior of transmission line for protection of power equipment
CO6	Formulate physical and geometrical parameters of transmission line useful for its safe and efficient performance.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	3										
CO2		3	2									
CO3		3	2									
CO4		2										
CO5				3	2							
CO6		2	2									

UNIT I - TRANSMISSION LINE PARAMETERS

SERIES PARAMETERS OF TRANSMISSION LINES:

Conductor materials – Types of conductors : Solid, Stranded, Composite Stranded, Hollow Conductor Configurations: Bundled, Double Circuit & Parallel Line – Skin and Proximity effects: Description and effect on Resistance of Solid Conductors - Calculation of resistance for solid conductors –Calculation of inductance for single phase and three phase– Single and double circuit lines–Self & Mutual GMD – Symmetrical and asymmetrical conductor configuration with
and without transposition - Numerical Problems

SHUNT PARAMETERS OF TRANSMISSION LINES:

Ferranti effect – Charging Current - Capacitance calculations for single and three phase – Single and double circuit lines with symmetrical and asymmetrical configurations–Numerical Problems.

UNIT II – PERFORMANCE OF TRANSMISSION LINES

CORONA & COMPENSATION:

Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference & Induced EMF in communication lines – Static Compensation: Series & Shunt capacitor and Series & Shunt Inductor – Dynamic Compensation: Synchronous capacitor/inductor & Synchronous Phase Modifier.

SHORT & MEDIUM TRANSMISSION LINES:

Classification of Transmission Lines – Short, medium, long line and their model Representations – A B C D Constants, regulation and efficiency of Short line, Sending End Capacitance – Receiving End Capacitance - Nominal-T–Nominal-□ models – Numerical Problems - Zero & Maximum Voltage Regulation of Short Line.

UNIT III – TRANSIENTS IN LONG TRANSMISISION LINES

LONG TRANSMISSION LINES:

Rigorous Solution for Evaluation of A,B,C,D Constants of Long Transmission Line – Representation of Long Lines – Equivalent-T and Equivalent Pie network models - Interpretation of the Long Line Equations, regulation and efficiency– Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves –Numerical Problems.

POWER SYSTEM TRANSIENTS:

Types of System Transients – Travelling or Propagation of Surges – Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT IV – SAG AND INSULATORS

SAG & TENSION CALCULATIONS:

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and
Ice on weight of Conductor–Numerical Problems

INSULATORS & STRING EFFICIENCY:

Types of Insulators – String efficiency and Methods for improvement–Numerical

Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

TEXT BOOKS:

1. A course in Electrical Power systems, J.B. Gupta, Kataria Publications.
2. Electrical power systems - by C.L.Wadhwa, New Age International (P) Limited, Publishers, 1998.
3. Principles of Power Systems by V.K Mehta and Rohit Mehta S.Chand & Company Ltd.New Delhi 2004.

REFERENCE BOOKS:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
2. Modern Power System Analysis by I.J. Nagarath and D.P.Kothari, Tata McGraw Hill, 2nd Edition
3. Electrical Power Generation, Transmission and Distribution by S.N.Singh, PHI, 2003.

E-RESOURCES:

1. https://nptel.ac.in/courses/108105104/
2. https://nptel.ac.in/courses/108/105/108105067/

POWER ELECTRONICS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

- Knowledge of Laplace Transforms **[Mathematics]**
- Knowledge of Fourier Analysis & Differential Equations **[Mathematics]**
- Basic concepts of KVL **[Electric Circuits]**
- Basic concepts of transistors and diodes **[Electronic Devices & Circuits]**

Course Objectives:

- To study the characteristics of various power semiconductor devices and to design firing circuits for SCR.
- To understand the operation of single phase full–wave converters and analyse harmonics in the input current.
- To study the operation of three phase full–wave converters.
- To understand the operation of different types of DC-DC converters.
- To understand the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- To analyse the operation of AC-AC regulators.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate basic theory of operation of SCR, characteristics of power MOSFET & power IGBT and to design protection & Firing circuits.
CO2	Explore and interpret 1-□ Half Wave, Full wave converters, with the effect of source inductance and input harmonics.
CO3	Analyze various 3-□ uncontrolled & controlled rectifier circuits and Understand their Applications
CO4	Analyze & design various BUCK,BOOST & BUCK – BOOST converters in different modes with ripple calculation & operation of different modes with ripple calculation & operation of fly back converter
CO5	Analyze steady –state performance of 1-□ & 3-□ inverters & applications of PWM techniques ,operation of VSI & CSI
CO6	Analyze the operation of 1-□ & 3-□ AC – AC Regulators, Static V-I characteristics of TRAIC & operation of Tap changing Transformer with Anti-parallel connection of Thyristors

Contribution of Course Outcomes towards achievement of Program Outcomes

(1– Low, 2- Medium, 3 – High)												
	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	3	3	3	0	0	0	0	0	0	0	0	0
CO4	3	2	1	0	1	0	0	1	0	0	0	1
CO5	3	3	3	0	0	1	3	1	0	0	0	1
CO6	2	2	1	0	0	0	0	1	0	0	0	0

UNIT I

Power semiconductor& switching devices: Power electronic devices- Introduction, characteristics of ideal switch, real switch, V-I characteristics of power diodes, Silicon Controlled Rectifier (SCR), Metal Oxide Semiconductor Field Effect Transistor(MOSFET) and Insulated Gate Bipolar Transistor (IGBT), two transistor model of SCR, turn ON methods of SCR, turn OFF methods of SCR (voltage commutation), snubber protection for SCR, quadrant operation of power semiconductor devices, GATE drive circuits for MOSFET/IGBT.

UNIT II

AC to DC converters: Introduction, single phase fully controlled bridge rectifier with R, pure inductor, RL and RLE loads-effect of source inductance performance parameters of converters.

Three Phase Converters: Three phase uncontrolled and fully controlled bridge converters with R, RL loads-performance parameters of converters.

UNIT III

AC to AC Regulators: Introduction-single phase two SCRs in anti- parallel– with R and RL loads–derivation of RMS load voltage, current and power factor.

DC to DC converters: Introduction, Chopper classification, time ratio control, buck converter, boost converter, buck-boost converters – Voltage and Current ripple calculations and design of L & C for all converters.

UNIT IV

DC to AC converters: Introduction, single phase full bridge inverters, comparison between VSI & CSI, three phase VSI (180 &120 degree conduction modes).

Voltage control techniques for inverters: Pulse-width modulation techniques - single pulse, multi-pulse, sinusoidal pulse width modulation techniques.

TEXT BOOKS:

1. Power Electronics by P.S.Bhimbra, Khanna Publishers.
2. Power Electronics : Circuits, Devices and Applications by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: converters, applications & design by Nedmohan, Tore M. Undeland, Riobbins by Wiley India Pvt. Ltd.
4. Power Electronics MD Singh and K B Khanchandani, Tata – McGraw-Hill Publishing company, 1998.

REFERENCE BOOKS:

1. Power Electronics by Vedam Subramanyam, New Age International (P) Limited.
2. Power Electronics by V.R.Murthy , 1st edition -2005, OXFORD University Press
3. Power Electronics by P.C.Sen,Tata Mc Graw-Hill Publishing.
4. Thyristorised Power Controllers by G. K. Dubey, S. R. Doradra, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.

E-RESOURCES:

[1]. www.nptel.ac.in/courses/108101038/

INDIAN CONSTITUTION

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	-
Credits:	-	**External Marks:**	-

Prerequisites:

NIL

Course Objectives:

- To create awareness among students about the Indian Constitution.
- To create consciousness in the students on democratic values and principles articulated in the constitution.
- Gain consciousness on the fundamental rights and duties.
- Be exposed to the reality of hierarchical Indian social structure and the ways the grievances of the deprived sections can be addressed to raise human dignity in a democratic way.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the spirit and origin of the fundamental law of the land.
CO2	Understand how fundamental rights can be protected and understand the fundamental duties .
CO3	Understand the structure and formation of the Indian Government at center as well as state.
CO4	Understand when and how an emergency can be imposed and its consequences.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Meaning of the constitution law and constitutionalism, Historical perspective of the constitution of India, Salient features and characteristics of the constitution of India
Evolution:1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution.

UNIT II

Fundamental Rights under Indian constitution, scheme of the fundamental Rights, Scheme of the fundamental Right to Equality, Scheme of the fundamental Right to certain freedoms under Article 19 Scope of the right to life and personal Liberty under Article 21, Directive principles, Fundamental Duties

UNIT III

Federal structure and distribution of legislative and financial powers between the union and the states, Parliamentary form of government in India-the constitution powers and

status of the President of India, Amendment of the constitutional powers and procedure, The historical perspectives of the constitutional amendments in India, Local self government-Constitutional Scheme in India.
UNIT IV
Emergency Provisions, National Emergency, President Rule, Financial Emergency **Statutory Institutions**: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women
TEXT BOOKS:
1.The Constitution of India‖, 1950 (Bare Act), Government Publication. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar, ―*Framing of Indian Constitution*‖, 1st Edition, 2015.
REFERENCE BOOKS:
1.M. P. Jain, ―*Indian Constitution Law*‖, 7th Edition., Lexis Nexis, 2014. 2.D.D. Basu, ―*Introduction to the Constitution of India*‖, Lexis Nexis, 2015. 3. Subhash Kashyap, Our Parliament, National Book Trust, New Delhi 4. Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi 5. B.Z. Fadia & Kuldeep Fadia, Indian Government &Politics, Lexis Nexis, New Delhi
E-RESOURCES:

RENEWABLE ENERGY SOURCES

(Open Elective-II)

Lecture – Tutorial:	3 - 0	**Internal Marks:**	40
Credits:		**External Marks:**	60

Course Objectives:

- It introduces basics of solar energy like solar radiation, collection, storage and application.
- It also introduces the wind energy, biomass energy, geothermal energy and ocean energy as alternative energy sources.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Apply knowledge of mathematics physics and engineering to the analysis and design of renewable energy systems.
CO2	Identify, formulate, and solve engineering problems in the area of renewable energy system for clean, reliable and efficient electrical power
CO3	Design an electric system, or process to meet desired needs within realistic constraint for wind, solar thermal, solar PV systems.
CO4	Design an electric system, or process to meet desired needs within realistic constraint for bio mass geothermal and ocean energy systems.
CO5	Get the knowledge on modern issues in electrical power generation.
CO6	Get the ability to function effectively on multidisciplinary teams.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	3	3	2									
CO2	3	3	3									
CO3	2	2	2									
CO4	3	2										
CO5	2	3	2									
CO6	2	3	2									

UNIT I

Principles of Solar Radiation and Solar Energy Collection

Role and potential of new and renewable source, the solar energy option, environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data. Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT II

Solar Energy Storage, Applications and Photovoltaic Energy Conversion

Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications solar heating/cooling technique, solar distillation and drying. Solar cell fundamentals, solar cell classification, performance of solar cell- power from solar module.

UNIT III

Wind Energy and Bio-Mass

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria. Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

UNIT IV

Energy and Ocean Energy

Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.

Energy Conversion

Principles DEC, MHD generators, principles, MHD power generation systems. Fuel cells, principles, of fuels and operating conditions, merits and demerits of different types of fuel cells, mini-hydel power plants and their economics.

TEXT BOOKS:

1. Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 5th edition,2014.
2. Renewable Energy resources, Tiwari and Ghosal, Narosa,2005
3. Science and Technology of Photo Voltaics by Jayarama Reddy, BS publications, 2nd edition,2012

REFERENCE BOOKS:

1. Non-Conventional Energy by Ashok V Desai, New age, 2005.
2. Non-Conventional Energy Sources by B.H.Khan, Tata Mc Graw-hill Publishing Company, 2nd edition,2013.

E- RESOURCES

1. http://nptel.ac.in/courses.php
2. http://jntuk-coeerd.in/

MODELING & SIMULATION OF SYSTEMS

(Open Elective-II)

Lecture – Tutorial:	3 - 0	**Internal Marks:**	40
Credits:		**External Marks:**	60

Course Objectives:
• Presents the basic knowledge on simulation Terminologies. • Gives immense knowledge on discrete and continuous components. • Explains about Stastical models and Random Number Generation. • Improves Knowledge on model building techniques.

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Understand about the simulation terminologies.
CO2	Understand about the discrete components.
CO3	Have the knowledge in Stastical models in simulation.
CO4	Understand the properties of Random Number Generation.
CO5	Test the Random Number Generation.
CO6	Analyze the Model Building of various models.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	3	3	2									
CO2	3	3	3									
CO3	2		2									
CO4	3		3							2		
CO5	2	3	2							2		
CO6	2	3	2									

UNIT I

Introduction – Simulation Terminologies- Application areas – Model Classification –Types of Simulation- Steps in a Simulation study- Concepts in Discrete Event Simulation– Simulation Examples

UNIT II

Statistical Models in Simulation :Review of terminology and concepts, Useful statistical models, Discrete distributions. Continuous distributions, Poisson process, Empirical distributions.

UNIT III

Random-Number Generation: Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers, Tests for Random Numbers.
UNIT IV
Model Building – Verification of Simulation Models – Calibration and Validation of Models – Validation of Model Assumptions – Validating Input – Output Transformations.
TEXT BOOKS:
1. Jerry Banks and John Carson, " Discrete Event System Simulation", Fourth Edition,PHI, 2005. 2. Geoffrey Gordon, "System Simulation", Second Edition, PHI, 2006 (Unit – V).
REFERENCE BOOKS:
1. Frank L. Severance, " System Modeling and Simulation", Wiley, 2001. 2. Averill M. Law and W.David Kelton, " Simulation Modeling and Analysis, Third Edition, McGraw Hill, 2006. 3. Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice", Wiley, 1998.
E-RESOURCES:
1. http://nptel.ac.in/courses.php 2. http://jntuk-coeerd.in/

ELECTRICAL MACHINES-II LAB

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60
Prerequisites:			
Electrical Machines-I and Electrical Machines-II			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Understand the performance of three phase induction motors.
CO2	Control the speed of three phase induction motors.
CO3	Improve the power factor of single phase induction motor .
CO4	Improve the power factor of single phase induction motor .
CO5	Obtain the Equivalent Circuits.
CO6	Predetermine the regulation of three–phase alternator by various methods, find X_d/X_q ratio of alternator and asses the performance of three–phase synchronous motor.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	3	3	3	0	0	0	0	0	0	0	2	0
CO4	3	2	1	0	1	0	0	1	0	0	2	0
CO5	3	3	3	0	0	2	3	1	0	0	0	1
CO6	2	2	1	0	0	0	0	1	0	0	0	0

The following experiments are required to be conducted as compulsory experiments:

1. Brake test on three phase Induction Motor.
2. No–load & Blocked rotor tests on three phase Induction motor.
3. Regulation of a three –phase alternator by synchronous impedance & m.m.f. Methods.
4. Regulation of three–phase alternator by Potier triangle method.
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor.
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three phase alternator by loading with three phase induction motor.
10. Power factor improvement of single phase induction motor by using capacitors and load test on single phase induction motor.

POWER ELECTRONICS LAB

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60
Prerequisites:			
Power Electronics			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Study the characteristics of various power electronic devices and analyze gate drive circuits of IGBT.
CO2	Analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
CO3	Understand the operation of single phase AC voltage regulator.
CO4	Understand the working of Buck converter, Boost converter, single–phase square wave inverter and PWM inverter.
CO5	Understand the operation of resistive and inductive loads.
CO6	Understand the operation of various rectifiers and inverters.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	3	3	3	0	0	0	0	0	0	0	2	0
CO4	3	0	1	0	1	0	0	1	0	0	2	0
CO5	3	3	0	0	0	2	3	1	0	0	0	1
CO6	2	0	1	0	0	0	0	1	0	0	0	0

Any 10 of the Following Experiments are to be conducted

1. Study of Characteristics of Thyristor, MOSFET & IGBT.
2. Design and development of a firing circuit for Thyristor.
3. Design and development of gate drive circuits for IGBT.
4. Single -Phase Half controlled converter with R and RL load
5. Single -Phase fully controlled bridge converter with R and RL loads
6. Single -Phase AC Voltage Regulator with R and RL Loads
7. Single -Phase square wave bridge inverter with R and RL Loads
8. Three- Phase fully controlled converter with RL–load.
9. Design and verification of voltages gain of Boost converter in Continuous Conduction Mode(CCM) and Discontinuous Conduction Mode(DCM).
10. Design and verification of voltages ripple in buck converter in CCM operation.
11. Single -phase PWM inverter with sine triangle PWM technique.
12. 3-phase AC-AC voltage regulator with R-load.

ELECTRICAL MEASUREMENTS LAB

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60
Prerequisites:			
Electrical Measurements			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Measure the electrical parameters voltage, current,
CO2	Test transformer oil for its effectiveness.
CO3	Measure the parameters of inductive coil.
CO4	Measure the electrical parameters power, energy and
CO5	Measure the electrical characteristics of resistance, inductance and capacitance
CO6	Measure the Quality Factor and Dissipation Factors

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	2	3	3	0	0	0	0	0	0	0	2	0
CO4	2	0	1	0	1	0	0	1	0	0	2	0
CO5	3	0	0	0	0	2	3	1	0	0	0	1
CO6	2	0	1	0	0	0	0	1	0	0	0	0

Any 10 of the following experiments are to be conducted

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer wattmeter using phantom loading
3. Calibration of PMMC ammeter and voltmeter using Crompton D.C. Potentiometer
4. Measurement of resistance and Determination of Tolerance using Kelvin's double Bridge.
5. Capacitance Measurement using Schering bridge.
6. Inductance Measurement using Anderson bridge.
7. Measurement of 3 phase reactive power with single phase wattmeter for balanced loading.
8. Calibration of LPF wattmeter by direct loading.
9. Measurement of 3 phase power with single watt meter.
10. Calculation of Turns Ratio using AC Bridge.
11. Calibration of Electro dynamometer type PF Meter.
12. Dielectric oil testing using H.T test Kit.
13. Calibration of AC voltmeter and measurement of choke parameters using AC Potentiometer in polarform.
14. Measurement of Power by 3 Voltmeter and 3 Ammeter method.

POWER ELECTRONIC CONTROLLERS & DRIVES

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

- Knowledge of Laplace Transforms **[Mathematics]**
- Knowledge of **Electric Circuits , Power Electronics, Electrical Machines**
- Basic concepts of transistors and diodes **[Electronic Devices & Circuits]**

Course Objectives:

1. Learn electric drive system and multi quadrant operation
2. Understand operation of 1□, 3□ rectifiers fed DC motors
3. Understand operation of chopper fed DC motors
4. Know the speed control of converter fed Induction motor and Synchronous motor

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Learn the fundamentals of electric drive and different electric braking methods.
CO2	Analyse the operation of three phase converter controlled dc motors and four Quadrant operation of dc motors using dual converters.
CO3	Discuss the converter control of dc motors in various quadrants
CO4	Understand the concept of speed control of induction motor by using AC voltage Controllers and voltage source inverters.
CO5	Learn the principles of static rotor resistance control and various slip power recovery schemes
CO6	Understand the speed control mechanism of synchronous motors

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	3	3	3	0	0	0	0	0	0	0	2	0
CO4	3	2	1	0	1	0	0	1	0	0	2	0
CO5	3	3	3	0	0	2	3	1	0	0	0	1
CO6	2	2	1	0	0	0	0	1	0	0	0	0

UNIT I

Fundamentals of Electric Drives

Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

Controlled Converter Fed DC Motor Drives

1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics — Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

UNIT II

DC–DC Converters Fed DC Motor Drives

Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excitedDC motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operation – Closed loop operation (qualitative treatment only).

UNIT III

Stator side control of 3-phase Induction motor Drive

Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor byPWMvoltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

Rotor side control of 3-phase Induction motor Drive

Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

UNIT IV

Control of Synchronous Motor Drives

Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (qualitative treatment only).–Variable frequency control–Pulse width modulation.

TEXT BOOKS:

1. Fundamentals of Electric Drives – by G K DubeyNarosa Publications
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.

REFERENCE BOOKS:

1.Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.
2.Thyristor Control of Electric drives – VedamSubramanyam Tata McGraw

Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

E-RESOURCES:

1. www.siemens.com/Sirius
2. www.minglebox.com
3. www.abb.com
4. www.drives-and-controls.co.uk
5.http://nptel.ac.in/courses/108102046

INSTRUMENTATION

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60
Prerequisites:			
ELECTRICAL CIRCUITS, ELECTRO MAGNETIC FIELDS,ELECTRICAL MACHINES, POWER SYSTEMS			
Course Objectives:			
Focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices, that are in use to measure the important physical variables of various mechatronic systems.			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Understand the Basic principles of measuring systems.
CO2	Measure the Temperature and its ranges.
CO3	Measure of Level and Flow Rate
CO4	Measure Stress and design various stress measuring devices.
CO5	Measure the Force, Torque and Power by using various meters.
CO6	Study and Design various Transducers

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	**3**	**2**	**2**									
CO2	**2**	**2**	**2**									
CO3	**3**	**3**	**2**									
CO4	**3**	**3**	**2**									
CO5	**3**	**3**										
CO6	**3**	**3**										

UNIT I

Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. dynamic performance characteristics – sources of error, classification and elimination of error.

Measurement of temperature:Classification – ranges – various principles of measurement – expansion, electrical resistance – thermistor – thermocouple – pyrometers – temperature indicators.

UNIT II

Measurement of pressure:Units – classification – different principles used.

manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges.

Measurement of level: Direct method – indirect methods – capacitative, ultrasonic, magnetic.

Flow measurement:Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser doppler anemometer (LDA).

UNIT III

Stress strain measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

Oscilloscope:CRO-Time Base Generator-Horizontal and Vertical amplifiers-Lissajous Patterns-Sampling Oscilloscope-Analog and Digital type Data logger-Transient Recorder.

UNIT IV

Measurement of force, torque and power- Elastic force meters, load cells, torsion meters, dynamometers.

Signal Analysers-Wave Analysers-Harmonic Analysers-Basic Spectrum Analysers

Transducers: Principles of transducers, Thermistors, Thermo couples, Strain Gauge and Linear Variable Differential Transformers.

TEXT BOOKS:

1.A course in Electrical and Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & Co. Publications.

2. Electrical Measurements and measuring Instruments,E.W. Golding and F.C. Widdis, 5th Edition, Wheeler Publishing company.

3. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfrick and William D. Cooper, PHI, 2nd Edition.

REFERENCE BOOKS:

1.Measurement Systems: Applications & design by D.S Kumar.

2.Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE.

E-RESOURCES:

http://nptel.ac.in/syllabus/

POWER SYSTEMS III

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Concepts of Power Systems-I, Power Systems II and Microprocessors.

Course Objectives:

The Objectives of learning this Course are:

- To study the classification, operation and application of different types of electromagnetic protective relays.
- To explain the principle and operation of different types of static relays.
- To explain protective schemes, for generator and transformers.
- To impart knowledge of various protective schemes used for feeders and bus bars.
- To provide the basic principles and operation of various types of circuit breakers.
- To study different types of over voltages in a power system and principles of different protective schemes for insulation co–ordination.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Explain the working principle and constructional features of different types of electromagnetic protective relays
CO2	Compare different types of static relays with a view to application in the system.
CO3	Relate the acquired in depth knowledge of faults that is observed in high power generator and transformers and protective schemes used for all protections
CO4	Improve the ability to understand various types of protective schemes used for feeders and bus bar protection
CO5	Illustrate the principles of arc interruption for application to high voltage circuit breakers of air, oil, vacuum, SF6gas type
CO6	Explain different types of over voltages appearing in the system, including existing protective schemes

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	-	-	3	-	3	-	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-
CO4	-	2	2	-	2	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	2	-	-	2	-	-	-	-

UNIT I – PROTECTIVE RELAYING

ELECTROMAGNETIC RELAYS:

Protective Relaying Mechanism - Classification of Relays– Attraction Relays: Attracted Armature and Solenoid & Plunger Type - Balanced beam type attracted armature relay – Induction relays: Induction Disc, Watthour Meter and Induction Cup type – Torque equation

Applications of relays**:** Non- Directional Over Current Relays - Directional Over Current and Power Relays– Directional relays– Current, Percentage & Voltage Balance Differential Relays– Universal torque equation– Distance relays**:** Impedance, Reactance & Mho relays.

STATIC RELAYS:

Comparison of Static & Electromagnetic Relays – Basic Elements of Static Relay – Directional Static Overcurrent Relay – Static Differential Relay – Static Distance Relay – Microprocessor based Overcurrent Relay

UNIT II – ELECTRICAL APPARATUS PROTECTION

GENERATOR & TRANSFORMER PROTECTION:

Generators: Stator faults, Rotor faults and abnormal conditions – Differential & Merz Price Protection - Restricted, unrestricted earth fault, balanced earth fault, 100% earth fault and inter turn fault protection – Numerical examples on percentage winding protected.

Transformers**:** Transformer Faults **-** Percentage differential protection– Design of CT's ratio – Frame Leakage Protection - Buchholz relay protection–Numerical examples on CT ratios.

FEEDER & BUSBAR PROTECTION:

Protection of lines**:** Over current Protection schemes - Numerical examples - Carrier current and three zone distance relay using impedance relays.

Protection of bus bars: Circulating Current & Frame Leakage Protection.

UNIT III – ARC QUENCHING IN CIRCUIT BREAKERS

ARC PHENOMENON:

Arc Quenching: Formation, Maintenance & Extinction – AC & DC Circuit Breaking - Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching

CIRCUIT BREAKERS:

Description and operation of Air Blast– Air Break, Vacuum, SF6 and Double break

Oil circuit breakers– Miniature Circuit Breaker(MCB)

UNIT IV –OVER VOLTAGE PROTECTION & NEUTRAL GROUNDING

OVER VOLTAGE PROTECTION:

Causes of over voltages: Lightning, Switching, Insulation Failure & Arcing Grounds - Protection against Direct & Indirect lightning Strokes: Ground Wires, Protector Tubes and Horn gap - Rod Gap - Multi gap - Expulsion type - Valve type - Metal oxide lightning arresters – Surge Absorbers – Insulation coordination– BIL– impulse ratio–Standard impulse test wave– volt-time characteristics

NEUTRAL GROUNDING:

Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding**:** Solid Earthing, Resistance Earthing, Resonant Earthing, Voltage Transformer Earthing and Earthing Transformer.

TEXT BOOKS:

1. A course in Electrical Power systems, J.B. Gupta, Kataria Publications.
2. Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications
3. Power system protection- Static Relays with microprocessor applications by T.S.MadhavaRao, TMH.

REFERENCE BOOKS:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide, PHI, 2003.
2. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
3. Protection and Switch Gear by Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chothani, Oxford University Press, 2013

E-RESOURCES:

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://nptel.ac.in/courses/108/105/108105104/
3. https://www.coursera.org/lecture/electric-power-systems/system-design-switching-circuit-breakers-0MMaF

IC APPLICATIONS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60
Prerequisites:			

Course Objectives:

- To understand the basic operation &performance parameters of differential amplifiers.
- To understand & learn the measuring techniques of performance parameters of OP-AMP
- To learn the linear and non-linear applications of operational amplifiers.
- To understand the analysis & design of different types of active filters using opamps
- To learn the internal structure, operation and applications of different analog ICs
- To Acquire skills required for designing and testing integrated circuits

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Design circuits using operational amplifiers for various applications.
CO2	Analyze and design amplifiers and active filters using Op-amp.
CO3	Diagnose and trouble-shoot linear electronic circuits.
CO4	Understand the gain-bandwidth concept.
CO5	Understand the frequency response of the amplifier configurations.
CO6	Understand thoroughly the operational amplifiers with linear integrated circuits.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1			**1**		**3**			**2**				
CO2			**2**		**1**			**2**				
CO3			**3**	**1**								
CO4	**2**		**1**	**2**								
CO5		**1**	**1**									**2**
CO6	**1**		**2**									**3**

UNIT I

Part I

INTEGRATED CIRCUITS: Differential Amplifier- DC and AC analysis of Dual input Balanced outputConfiguration, Properties of other differential amplifier configuration (Dual Input Unbalanced Output, Single EndedInput – Balanced/ Unbalanced Output), DC Coupling and Cascade Differential Amplifier Stages, Level translator.

Part II

Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges,Power supplies, Op-amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics,741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.

UNIT II

Part I

LINEAR APPLICATIONS OF OP-AMPS: Inverting and Non-inverting amplifier,Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators,

Part II

NON-LINEAR APPLICATIONS OF OP-AMPS

Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.

UNIT III

Part I

ACTIVE FILTERS, : Design & Analysis of Butterworthactive filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters.

Part II

ANALOG MULTIPLIERS AND MODULATORS

Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.

UNIT IV

Part I

TIMERS & PHASE LOCKED LOOPS: Introduction to 555 timer, functional diagram, Monostable and Astableoperations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL

Part II

DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS: Introduction, basic DAC techniques,weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC

TEXT BOOKS:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.
3. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

REFERENCE BOOKS:

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria&Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.
3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin& Fredrick Driscoll, PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition

E-RESOURCES:

UTILIZATION OF ELECTRICAL ENERGY

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60
Prerequisites:			

Course Objectives:

This course primarily deals with utilization of electrical energy generated from various sources. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Demand side management concepts are also introduced as a part of this course.

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	To acquaint with the different types of heating techniques.
CO2	Demonstrate the concepts of electric welding.
CO3	To study the basic principles of illumination and its measurement.
CO4	To understand different types of lightning system including design.
CO5	To understand the basic principle of electric traction including speed–time curves of different traction services.
CO6	To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1			**1**		**3**			**2**				
CO2			**2**		**1**			**2**				
CO3			**3**	**1**								
CO4	**2**		**1**	**2**								
CO5		**1**	**1**									**2**
CO6	**1**		**2**									**3**

UNIT I

Electric Heating and Welding

Electric Heating: Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding: Electric welding–Resistance and arc welding–Electric welding equipment– Comparison between AC and DC Welding

UNIT II

Illumination

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere,sources of light,Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT III

Electric Traction-I

System of electric traction and track electrification, Special features of traction motor, methods of electric braking-plugging rheostatic braking andregenerative braking. Mechanics of train movement, Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

UNIT IV

Electric Traction-II

Calculations of tractive effort, power, specific energy consumption for given run, effect of varyingacceleration and braking retardation, adhesive weight and braking retardation adhesive weight andcoefficient of adhesion, Principles of energy efficient motors.

TEXT BOOKS:

1.Utilisation of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.

REFERENCE BOOKS:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.
3.Utilization of Electrical Power including Electric drives and Electric traction by J.B.Gupta, S.K. Kataria & Sons,10th edition, 2012
4.Sunil S Rao, "Utilization, generation & conservation of electrical energy", by Khanna publishers, first edition 2005.

E-RESOURCES:

1. http://nptel.iitm.ac.in/video.php?subjectId=108105060
2. http://www.nptel.ac.in/courses/108105061/Illumination%20%20Engineering/Lesson-20/pdf/L- 20(NKK)(IE)%20((EE)NPTEL).pdf
3. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/ www.bee-india.org
4. www.irfca.org

HYBRID AND ELECTRICAL VEHICLES

(Open Elective-III)

Lecture – Tutorial:	3 - 0	**Internal Marks:**	40
Credits:		**External Marks:**	60

Course Objectives:

- To present a comprehensive overview of Electrical and Hybrid Electric Vehicles.
- Introduces Electrical and Hybrid Vehicles.
- Gains knowledge on hybrid electric drive trains, Electric Propulsion.
- Proper Energy Storage and Proper Sizing of the vehicle can be learnt.
- Design of a hybrid electric vehicle, Energy storage requirements and energy management strategies.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
CO2	Design and develop basic schemes of electric vehicles.
CO3	Design and develop basic schemes of hybrid electric vehicles.
CO4	Choose proper energy storage systems for vehicle applications
CO5	Choose Proper Sizing of the Vehicle.
CO6	Identify various technologies used in vehicle networks.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	3	3	2									
CO2	3	3	2									
CO3	2	1										
CO4	3											
CO5	2	3	2									
CO6	2	3	2									

UNIT I
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. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance
UNIT II
Hybrid Electric Drive-trains: Basic concept of hybrid traction, introductionto various hybrid drive-train topologies, power flow control in hybrid 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, Configuration and control of Induction Motor drives
UNIT III
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, Hybridization of different energy storage devices, Matching the electric machine and the internal combustion engine (ICE)
UNIT IV
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
TEXT BOOKS:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
REFERENCE BOOKS:
1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003. 2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
E-RESOURCES:
1. http://nptel.ac.in/courses.php 2. http://jntuk-coeerd.in/

MATLAB AND APPLICATIONS

(Open Elective-III)

Lecture – Tutorial:	3 - 0	**Internal Marks:**	40
Credits:		**External Marks:**	60

Course Objectives:
• In this course students will be introduced to programming using MATLAB. This course covers the MATLAB environment, assignment, conditionals, scripts, functions, iterations, arrays and graphics.

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Have knowledge of writing MATLAB programs for engineering problems.
CO2	Handle graphics and draw plots.
CO3	Work with arrays, matrices and character strings.
CO4	Using Built-in functions and plot graphs.
CO5	Interpolate the data and curve fitting.
CO6	Solving Problems in linear algebra.

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	3											
CO2	3											
CO3	3											
CO4	3											
CO5	3		2									
CO6	3	3	2									

UNIT I
Basics of MATLAB – windows, input, output file types, platform dependence commands, general commands, special variables and constants, simple arithmetic calculation, arrays, numbers, printing simple plots, creating, saving and executing script files, function files.
UNIT II
Matrices, vectors, matrix and array operations, arithmetic operations, relational operations, logical operations, matrix functions, specialized matrices, character strings, character string functions.
UNIT III
Built in function – saving and loading data, plotting simple graphs, script files, function files, language specific features, if-end structure, if-else-end structure, if-else if-else-end structure, switch-case statement, for-end loop, while-end loop, break, continue, and return commands, advanced data objects.
UNIT IV
Solving problems in linear algebra, curve fitting and interpolation, data analysis and statistics, integration, ordinary differential equations
TEXT BOOKS:
1. Getting started with MATLAB by Rudrapratap, oxford university press, 2009. 2. MATLAB programming for engineers by Stephen J.Chapman, Thomson Learnning.
REFERENCE BOOKS:
1. MATALB: An introduction with applications by Amos Gilad, Wiley student edition. 2. MATLAB programming by Y.Kirani Singh, B.B.Chaudhuri, PHI Private limited, New Delhi 2008
E-RESOURCES:
1. http://nptel.ac.in/courses.php 2. http://jntuk-coeerd.in/

ELECTRICAL SIMULATION LAB

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60
Prerequisites:			
Power Electronics, Power Systems			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Simulate integrator circuit, differentiator circuit,
CO2	Simulate transmission line by incorporating line, load and transformer models.
CO3	Perform transient analysis of RLC circuit .
CO4	Perform transient analysis single machine connected to infinite bus(SMIB).
CO5	Simulate Boost converter, Buck converter.
CO6	Simulate full convertor and PWM inverter

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	2	3	3	0	0	0	0	0	0	0	2	0
CO4	2	0	1	0	1	0	0	1	0	0	2	0
CO5	3	0	0	0	0	0	0	1	0	0	0	1
CO6	2	0	1	0	0	0	0	1	0	0	0	0

Following experiments are to be conducted:

1. Simulation of transient response of RLC circuits
a. Response to pulse input
b. Response to step input
c. Response to sinusoidal input
2. Analysis of three phase circuit representing the generator transmission line and load. Plot
three phase currents & neutral current .
3. Simulation of single–phase full converter using RLE loads and single phase AC voltage
controller using RL loads
4. Plotting of Bode plots, root locus and nyquist plots for the transfer functions of systems
up to 5^{th} order
5. Simulation of Boost and Buck converters.
6. Integrator & Differentiator circuits using op–amp.
7. Simulation of D.C separately excited motor using transfer function approach.

Any 2 of the following experiments are to be conducted:

1. Modeling of transformer and simulation of lossy transmission line.
2. Simulation of single phase inverter with PWM control.
3. Simulation of three phase full converter using MOSFET and IGBTs.
4. Transient analysis of single machine connected to infinite bus(SMIB).

MPMC LAB

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60
Prerequisites:			
Micro Processors and Microcontrollers			

Course Outcomes:	
Upon successful completion of the course, the student will be able to:	
CO1	Write Assembly Language Program Using 8086 Micro Based On Arithmetic Operations
CO2	Write Assembly Language Program Using 8086 Micro Based On Logical Operations
CO3	Write Assembly Language Program Using 8086 Micro Based On Shift Operations
CO4	Interface 8086 With I/O And Other Devices
CO5	Do Parallel Communication Using 8051 Micro Controllers
CO6	Do Serial Communication Using 8051 Micro Controllers

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low, 2- Medium, 3 – High)

	PO a	**PO b**	**PO c**	**PO d**	**PO e**	**PO f**	**PO g**	**PO h**	**PO i**	**PO j**	**PO k**	**PO l**
CO1	3	1	2	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0
CO3	2	3	3	0	0	0	0	0	0	0	0	0
CO4	2	0	1	0	1	0	0	1	0	0	0	0
CO5	3	0	0	0	0	0	0	1	0	0	0	1
CO6	2	0	1	0	0	0	0	1	0	0	0	0

Any 10 of the following experiments are to be conducted:
Microprocessor 8086&Microcontroller 8051

PART- A: 8086 Assembly Language Programming

1.Introduction to MASM/TASM.

1. Arithmetic operation – Multi byte addition and subtraction, multiplication and division – Signed and unsigned arithmetic operation, ASCII – Arithmetic operation.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
3. By using string operation and Instruction prefix: Move block, Reverse string Sorting, Inserting, Deleting, Length of the string, String comparison.
4. Interfacing 8255–PPI
5. Interfacing 8279 – Keyboard Display.

PART- B: 8051 Assembly Language Programs

6. Finding number of 1's and number of 0's in a given 8-bit number
7. Addition of even numbers from a given array
8. Average of n-numbers
9. Reading and Writing on a parallel port using 8051
10. Timer in different modes using 8051
11. Serial communication implementation using 8051
12. Understanding three memory areas of 00 – FF Using 8051 external interrupts.

PART-C: 8051 Interfacing

13. Switches and LEDs
14. 7-Segment display (multiplexed)
15. Stepper Motor Interface
16. Traffic Light Controller

Equipment Required:

1. MASM/TASM software
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. ADC module
6. DAC module
7. Stepper motor module
8. Keyboard module
9. LED, 7-Segemt Units
10. Digital Multimeters