Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Third Year Electrical Engineering

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

Course outline
Semester - V and VI
w. e. f. 2020 – 21

Syllabus Structure for Third Year Engineering (Semester – V) (Electrical) (w. e. f. 2020 – 21)(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Power Electronics	D	3	-	-	3	40	60	-	-	100	3
Power System-I	D	3	-	-	3	40	60	-	-	100	3
Electromagnetic Field	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – I	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – I	F	3	-	-	3	40	60	-	-	100	3
Power Electronics Lab	D	-	-	2	2	-	-	25	25(OR)	50	1
Power System-I Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
Electronic Design Laboratory	D	-	-	2	2	-	-	25	25(OR)	50	1
Minor Project (Stage -I)	G	-	-	6	6	-	-	50	-	50	3
Constitution of India		-	-								-
		15	**0**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Professional Elective Course – I		Open Elective Course – I	
1	Signals and Systems	1	Fluid Mechanics and Machinery
2	Electrical Installation, Estimation and Distribution	2	Electronics Measurement
3	Solid State Devices and Circuits	3	Internet of Things
4	Advance Measurement and Instrumentation	4	Industrial Safety

Syllabus Structure for Third Year Engineering (Semester – VI) (Electrical) (w. e. f. 2020 – 21)(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Control System	D	3	-	-	3	40	60	-	-	100	3
Microprocessor and Microcontroller	D	3	-	-	3	40	60	-	-	100	3
Power System-II	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – II	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – II	F	3	-	-	3	40	60	-	-	100	3
Control System Lab	D	-	-	2	2	-	-	25	25(OR)	50	1
Microprocessor and Microcontroller Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
Power System-II Lab	D	-	-	2	2	-	-	25	-	25	1
Minor Project	G	-	-	6	6	-	-	50	25(OR)	75	3
Internship – II*	H	-	-	-	-	-	-	-	-	-	-
		15	**0**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Professional Elective Course – II		Open Elective Course – II	
1	Industrial Automation	1	Power Plant Engineering
2	Advance Power Electronics	2	Linear Integrated Circuits and Applications
3	Non-Conventional Energy System	3	Digital Logic and State Machine Design
4	Electrical Machine Design	4	Heat Transfer and Refrigeration

* Internship-II is a mandatory and non-credit course. It shall be during summer vacation after Semester – VI. The satisfactory completion of Internship should be submitted to University at the end of Semester – VIII.

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Syllabus for

Third Year Electrical Engineering

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3rd Cycle

COURSE OUTLINE

Semester – V

w. e. f. 2020 – 21

Power Electronics					
COURSE OUTLINE					
Course Title:	**Power Electronics**	**Short Title:**	**PE**	**Course Code:**	

Course description:

Technology has improved by lips and bounds making the power devices more closely to an ideal switch. Power electronics has already found an important place in modern technology and has revolutionized control of power and energy. As the voltage and current ratings and switching characteristics of power semiconductor devices keep improving, the range of applications continues to expand in areas such as lamp controls, power supplies to motion control, factory automation, transportation, energy storage, megawatt industrial drives, photovoltaic system and electric power transmission and distribution. The greater efficiency and tighter control features of power electronics are becoming attractive for applications in motion control by replacing the earlier electro-mechanical and electronic systems. Applications in power transmission include high-voltage dc (HVDC) converter stations, flexible ac transmission system (FACTS), and static-var compensators. In power distribution these include dc-to-ac conversion, dynamic filters, frequency conversion, and Custom Power System. The syllabus of Power Electronic deals with constructional and operational characteristic of power semiconductor devices, ac to dc , dc to ac converters, choppers and ac to ac converters.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog and Digital Electronics.

Course objectives:

Power Electronics is the art of converting electrical energy from one form to another in an efficient, clean, compact and robust manner for convenient utilization. The objectives of Power electronic is to create an awareness about the general nature of Power electronic devices, key features of the principal Power Electronic Devices, operational analysis of single phase uncontrolled half wave and full wave rectifiers supplying resistive, inductive, capacitive and back emf type loads. The objectives intended to understand the different configurations of inverters, coppers and cycloconverters.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the behaviour and fundamentals of semiconductor devices operated as power switches, protection and reliability of the switches.
2. Analysis of the triggering and commutation techniques for devices and how to overcome on difficult issues of devices using special devices.
3. Able to design of single-phase and three-phase thyristor converters and describe the role of power electronics as an enabling technology in various applications.
4. Learn the basic concepts of operation of dc-to-dc converters and dc-to-ac inverters and be able to analyze basic converter topologies for various applications such as energy conservation, renewable energy, transportation etc.

5. Illustrate the basic concepts of operation of ac voltage controllers and cycloconverters.

COURSE CONTENT

Power Electronics		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Thyristors: Static characteristics, turn-on methods, switching characteristics, (Turn-on and Turn-off), gate characteristics, two transistor models, ratings, protection: design of snubber circuits, di/dt, dv/dt; series and parallel operation of thyristor, string efficiency;
Thyristor family: Operating Characteristics of PUT, SCS, LASCR, Diac, Triac.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Firing circuits for thyristor: General layout, R firing circuit, RC firing circuit, UJT: basic structure, V-I characteristics, relaxation oscillator, voltage waveforms, synchronized UJT triggering circuit, ramp-and-pedestal triggering, pulse transformer in firing circuits, triac firing circuit, gate pulse amplifier.
Commutation Techniques: Forced and Natural, Classification of Forced Commutation: Class A, Class B, Class C, Class D, Class E, Class F.
Power switching devices: Introduction, Basic Structure, ON-OFF Control and Operational characteristics and Applications: Gate turn-off thyristor (GTO), Insulated Gate Bipolar Transistor (IGBT), MOS Controlled Thyristors (MCT)

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Controlled Rectifiers: Single-phase full wave rectifier: mid-point converter (M-2), bridge converters (B-2), with resistive and inductive load, single-phase semiconverter, with resistive and inductive load.Three-phase fully converters (B-6), three-phase semiconverters with resistive and inductive load. Effect of source impedance on performance of converters.
Dual Converters: Principle of operation, ideal and practical, without and with circulating current.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Choppers: Principle of operation, control strategies, step-down chopper, step-up chopper, types of chopper circuits: type A, type B, type C, type D, type E, thyristor chopper circuits: voltage-commutated chopper, current- commutated chopper, multi-phase choppers.
Inverters: Single-phase voltage source inverters: half-bridge and full-bridge (with Resistive and Inductive load), Modified McMurry half-bridge inverter, Modified McMurry full-bridge inverter, three phase bridge inverters (180-Degree and 120-Degree conduction mode Voltage source inverters), Series inverter, Single Phase Parallel inverter, Introduction to PWM techniques.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

AC voltage controller: Types, integral cycle control, single-phase voltage controller: half and full wave with resistive and inductive load, three phase AC voltage controller.

Cycloconverters: Principle, single-phase/single-phase, three-phase/single-phase, three-phase/three-phase, reduction of output harmonics.

Text Books:

1. Dr. P. S. Bimbhra, "Power Electronic" Khanna Publishers, 3rd edition, 2012.
2. Muhammad H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, Third Edition, 2012.
3. Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, Third Edition, 2014.

Reference Books:

1. M. Ramamoorty, "An Introduction to Thyristors and their Applications", East-West Press (Pvt.) Ltd., Second Edition, 2011.
2. V. R. Moorthy, "Power Electronics Devices Circuit and Industrial Applications", Oxford University Press, First Edition, 2015.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
5. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, International Second Edition, 2016.
6. P. C. Sen, "Modern Power Electronics", S. Chand and company, 2005.
7. SCR manual, General Electric, Fifth Edition.

Power System-I					
COURSE OUTLINE					
Course Title:	**Power System-I**	**Short Title:**	**PS-I**	**Course Code:**	

Course description:

Power System explores the knowledge of parameter, characteristic of transmission line. The subject also explores the performance of transmission lines.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Electrical Machines, Electrical Circuit Analysis

Course objectives:

The approach has always been to develop the thinking process of students in reaching a sound understanding of broad range of topic in power system area of electrical engineering. An Electrical Engineer should be able to solve the power system network under normal and abnormal conditions. This course is aim to cover the fundamentals of power system such as structure of power system, line constants and performance of transmission lines.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of power transmission, power plant terminology and importance of transmission line
2. Estimate the parameters of transmission lines in power systems.
3. Analyze the performance of short transmission line.
4. Analyze the performance of medium transmission line.
5. Analyze the performance of long transmission line.

COURSE CONTENT

Power System-I		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Transmission Line Parameters-I

Structure of Power System, Overview of transmission & distribution system, Various levels of power transmission, Voltage levels at generation, Transmission and distribution, introduction to overhead transmission lines and underground cables, Introduction to category of load and load curve, load duration curve, load factor, demand factor, diversity factor, Plant capacity factor, plant use factor.

Resistance of line, Skin effect, Inductance of line: Flux linkages of a Conductor, Inductance of a Single phase two wire line, Inductance of composite conductor lines-Self and Mutual GMD, GMR

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Transmission Line Parameters-II:

Inductance of Three phase overhead lines with symmetrical and unsymmetrical spacing, Effect of transposition, Bundled conductors, Proximity effect, Capacitance of a Transmission Line: Electric field and potential difference, Capacitance of a Single phase overhead line, Capacitance of Three phase symmetrical and unsymmetrical spaced lines

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Performance of Short Transmission Lines:

Classification of Transmission Lines: short, medium & long transmission lines. Short Transmission Lines: Regulation and Efficiency of a Transmission Lines, Effect of power factor on Transmission Efficiency and voltage regulation of a line

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Performance of Medium Transmission Lines:

Medium Transmission Lines: End Condenser method, Nominal T and π, method, Ferranti Effect, Charging current and line losses in open circuited line, Effect of Capacitance on performance of loaded line, Generalized circuit constants (ABCD parameters)

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Performance of Long Transmission Lines:

Introduction, Analysis of Long Transmission Lines (Rigorous Method), Evaluation of constant ABCD, Surge Impedance, Surge Impedance loading, Interpretation of the long line equations, Ferranti effect, equivalent circuit of a long line, power flow through a transmission line, Circle diagram, methods of voltage control, compensation of transmission lines

Text Books:

1. D. P. Kothari, I. J. Nagrath, "Modern Power System Analysis", 4th edition, Tata McGraw Hill Education, 2011.

Reference Books:

1. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill,4th edition,1985.
2. C.L. Wadhwa, "Electrical Power System", New Age International Limited,2017.
3. Stagg, El-Abiad, "Computer Methods in Power System Analysis" TMH.
4. Hadi Saadat, "Power System Analysis", Tata McGraw Hill, 2nd edition, 2009.
5. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
6. Chakraborthy, Soni, Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai & Co.limited 2008.
7. T.K Nagsarkar, M.S. Sukhija, "Power System Analysis" Oxford University. Press, 2007.
8. S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control", Pearson, 2009.

Electromagnetic Fields					
COURSE OUTLINE					
Course Title:	**Electromagnetic Fields**	**Short Title:**	**EMF**	**Course Code:**	

Course description:

Electromagnetic field theory is an important fundamental course with great academic relevance progress in this exciting theory has made possible the advent of many technologies, such as wireless communication, antennas and wave propagation, microwave engineering, etc. Interference and electrical noise problems that affect industry can also be better understood and their solutions can be provided using field theory.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Engineering Mathematics, Basic Electrical & Electronics Engineering

Course objectives:

Electromagnetic field theory is the subject of great research, academic and industrial importance and has a large number of applications. The objectives to understand basic concepts of static electric field and its associated quantities, Know the boundary condition particularly a boundary between conducting material and free space. The course also deals with significance of moving charges, force between two current carrying conductors, time varying field and radiation and antennas.

Course outcomes:

After successful completion of this course the student will be able to:

1. To apply the basic concept of mathematics and laws of electromagnetism to solve the complex engineering problem.
2. To obtain the electric and magnetic fields for simple configurations under static conditions
3. To analyze the different conditions of conductors, dielectrics and capacitance
4. To analyze static magnetic fields
5. To analyze time varying electric and magnetic fields and apply Maxwell's equation in different form

COURSE CONTENT

Electromagnetic Fields		Semester:	V
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Vector Calculus

Vector algebra-addition, subtraction, Components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Static Magnetic Fields

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Magnetic Forces, Materials and Inductance

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Electromagnetic Waves

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. R. K.Shevgaonkar, "Electromagnetic Waves", McGraw Hill

Reference Books:

1. W. Hayt, "Engineering Electromagnetic", McGraw Hill Education, 8th edition, 2012.
2. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
3. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
4. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
5. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press,

1966.
6. A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
7. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.

Signals and Systems (Professional Elective Course - I)

COURSE OUTLINE

Course Title:	**Signals and Systems**	**Short Title:**	**SS**	**Course Code:**	

Course description:

Signals play a major role in our life and it can be represented in a number of ways. Signal processing is a method of extracting information from the signal which in turn depends on type of signal and the nature of information it carries. This course describes the various signals with the help of mathematical tools such as FT, LT and ZT. It also introduces the state space approach of system.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Engineering Mathematics

Course objectives:

1. The objective of this course is to introduce the students to the various signals.
2. Study and understanding of representation of signals and systems.
3. To learn and understand different Transforms for Digital Signal Processing
4. Analysis of Discrete Time signals and systems

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the mathematical concepts of signal representation and transformations with their analysis.
2. Development of ability for generating proper solution to signal processing problems.
3. Students will be capable of understanding Digital Signal Processing and the analysis.
4. Apply initial and final valve theorem to the circuit.
5. Determine state model of linear system.

COURSE CONTENT

Signals and System		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Classifications of Signals and Systems

Classifications of Signals: Deterministic and non-deterministic signals, periodic and a periodic signals, even and odd signals, energy and power signals.

Singularity functions-unit impulse function, unit step function, unit ramp function, unit pulse function, representation of signals**. Classifications of Systems-**Static and dynamic systems, linear and non-linear systems, time variant and time invariant systems, stable and unstable systems. **Simple manipulations of**

discrete time signals-shifting, folding, time scaling. Representations of systems, Linear differential equations, Impulse response of a system. Analog to digital conversion of signals-sampling of continuous time signals, signal reconstruction.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Fourier Transform

Introduction: Trigonometric Fourier series, complex or exponential form of Fourier series, Parseval's identity for Fourier series.

Fourier Transform: Energy spectrum for non-periodic function, properties of Fourier Transform.

Discrete Fourier Transforms (DT): Discrete convolution, properties of convolution, circular convolution, Discrete -Time Fourier Transform (DTFT),properties of DFT

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Laplace Transforms

Definition, Region of Convergence (ROC), LT of some important function and numerical. Initial value theorem, Final value theorem. Convolution integral. S-Plane Poles and Zeros and numerical. Application of LT only in series R-L circuit and series R-C circuit.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Z-Transforms: Introduction, definition, Region of convergence (ROC), properties of the ROC for the z-transform and numerical. Properties of z-transform such as Linearity, Time Reversal, Time Shifting, Scaling, Differentiation, Convolution and numerical based on these properties.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

State space analysis: Concept of state (State variable and state model). State model of linear system. Eigen Values of Matrix A. Solution of state equation. Properties of State Transition Matrix and numerical.

Text Books:

1. I. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH, New Delhi, 2nd edition, 2009.
2. I. J. Nagrath, M. Gopal, "Control system engineering" New age, 5th edition, 2008.
3. Katsuhiko Ogata, "Modern Control engineering" Pearson, 5thedition, 2011
4. S. Salivahanan, C. Gnanpriya, " Digital Signal processing", McGraw Hill

Reference Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications" Fourth edition, Pearson Prentice Hall.
2. A. V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems" Prentice Hall, 1983.
3. A. Anand Kumar, "Signals and Systems", PHI, 2nd edition, 2012.
4. Rishabh Anand, "Signals and Systems", Khanna Book Publishing Co., Delhi
5. Tarun Rawat, "Signals and Systems", Oxford University Press, 2010.
6. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 2006.

Electrical Installation, Estimation and Distribution (Professional Elective Course - I)

COURSE OUTLINE

Course Title:	**Electrical Installation, Estimation and Distribution**	**Short Title:**	**EIED**	**Course Code:**	

Course description:

This course provides the knowledge about the various aspects of transmission & distribution system. The course includes the study of different components of transmission & distribution system, types of tariffs, earthing systems, different types of modern advanced tools such as PLC, SCADA to control system efficiently & economically, & basics of illumination engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Introduction to Electrical Engineering, Electrical Machines

Course objectives:

The objective of the course is to provide students with a firm grasp of the essential principles of a.c. and dc transmission and distribution systems. This course will help student to understand the concepts and terminology that are used in illumination engineering, designing & installation of electrical power system. The subject provides scope for practical applications of electrical power system engineering. The course provides bridge for higher studies in efficient and techno commercial aspect of power system.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand various methods of power distribution system.
2. Analyze parameter and design of different transmission components.
3. Draw substation layout as per the requirements, design of conductor size and components of systems as per IS.
4. Prepare the detailed wiring, earthing estimates of residential, commercial building and industrial sectors.
5. To familiarize with different scheme of illumination systems.

COURSE CONTENT

Electrical Installation, Estimation and Distribution		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Supply Systems

Typical A.C. Supply Scheme, A.C. transmission, D.C. transmission and comparison between them based on technical, stability and cost effectiveness. **Types of transmission:** overhead transmission, underground transmission and comparison between them. Various systems of transmission: D.C. systems:

Two wire dc, two wire dc with midpoint earthed, dc three wire system. **Single phase ac systems:** Single phase two wire, single phase two wire with midpoint earthed, single phase three wire system. Two phase ac systems: Two phase three wire system, two phase four wire system. **Three phase ac system:** Three phase three wire system, three- phase four wire system.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Overhead Transmission Line Components **The support** – poles, towers, and their types, cross arm and clamps, guys and stays. **Conductors**-characteristics of conductor material, types of conductor- solid conductor, bundle conductor, concentrically standard conductor (ACA, ACSR conductor). **Insulators** – types (pin, strain, shackle and suspension insulator), failure of insulators, potential distribution over suspension insulator string. String efficiency, method of improving of string efficiency. **Underground cables**; classification, construction of cable, requirements of insulating materials, insulation resistance. Capacitance dielectric stress in single-core/multi-core/ sheathed /armored cables. **Grading of cables** – capacitance grading and inter sheath grading.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Earthing and Design of Distribution System **Earthing:** System earthing, Equipment earthing, method and material for earthing. **Design of distribution system:** General design consideration for distribution system. Connection scheme of distribution system. Requirements of distribution system. Service mains, feeders, distributor A.C. distribution and D.C Distribution Feeder design based on Kelvin's law.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design and Estimation IE rules related to estimation and installation of electrical distribution system, independent, captive and on grid power generation system. Design and estimation of installation of residential buildings, commercial, industrial heads as per IE rules. Power factor improvement, economical power factor. Different types of electric tariffs. Introduction to SCADA and PLC panels.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Illumination: nature of light, definitions – plane angle, luminous flux luminous intensity, luminance and their units, luminous efficiency. Laws of illumination – inverse square law and Lambert's cosine law, polar curves. **Requirements of good lighting scheme**: Polar curves, direct, indirect , semi direct , semi-indirect lighting **Design of lighting scheme** : factors to be considered, working plane space to height ratio, absorption factor, maintenance factor, depreciation factor, coefficient of utilization Design of illumination schemes for industrial workshops assembly halls, street lighting. **Design of flood lighting schemes**: factors like reflection factor, waste light factor and beam factor and design of such schemes for typical installation.		
Text Books:		
1. S. L. Uppal, "Electrical Wiring, Estimation and Costing", Khanna Publishers, New Delhi, 1986.		

Reference Books:

1. J. B. Gupta, "Transmission and Distribution" S. K. Kataria and Sons, New Delhi, 2009.
2. V. K. Mehta, "Principle of Power System" S. Chand, New Delhi
3. S. L. Uppal, "Electric Power", Khanna Publishers, New Delhi.
4. H. Pratap, "Art and Science of Electrical Utilization", Dhanpat Rai and Sons, New Delhi.
5. B. D. Arora, "Electric Wiring, Estimating and Costing", New Heights, New Delhi
6. K. B. Raina, S. K. Bhattacharya, "Electrical Estimation and Costing", New Age International Publication, 1st edition, 1991.

Solid State Devices and Circuits (Professional Elective Course - I)					
COURSE OUTLINE					
Course Title:	**Solid State Devices and Circuits**	**Short Title:**	**SSDC**	**Course Code:**	

Course description:

This is a fundamental course, basic knowledge of which is required by all the engineers in every sphere of engineering & industry. This course includes study of semiconductor based electronic devices such as diodes, bipolar junction transistors, FETs, fabrication of integrated circuits its applications and related components. This course is designed to introduce to the students to the basic principles, characteristics, analysis and applications of electronic devices.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog and Digital Electronics

Course objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits.
3. To perform DC analysis of BJT and FET biasing.
4. To introduce and motivate students to the use of optoelectronics devices.
5. To analyze and design electronic circuits using semiconductor devices

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the working of DC power supply.
2. Analyze characteristics of semiconductor devices like diode, BJT, FET, MOSFET etc.
3. Learn fabrication of semiconductor devices on ICs.
4. Select best circuit for the given specifications/application.
5. Learn the different optoelectronics devices and their applications

COURSE CONTENT

Solid State Devices and Circuits		Semester:	V
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Diodes Applications: Full wave Rectifier Power Supply, transformer selection, RC and LC power supply filters: RC π filter, LC π filter, L input filter; power supply performance and testing, zener diode voltage regulator: with no load and with load, regulator performance, series clipping circuits, shunt clipping circuits, clamping circuits, DC voltage multipliers, diode logic circuits.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
BJT biasing: DC load line and bias point, base bias: circuit analysis, collector-to-base bias: circuit analysis, voltage divider bias: circuit analysis, comparison of basic bias circuits, trouble shooting BJT bias circuit, bias circuit design, thermal stability of bias circuits, biasing BJT switching circuits.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Fabrication of semiconductor devices on ICs: Processing of semiconductor materials, diode fabrication and packaging, transistor construction and performance, transistor fabrication, integrated circuits, IC components and circuits, transistor and IC packaging,		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
FET biasing: DC load line and bias point, gate bias, self-bias, voltage-divider bias, comparison of basic JFET bias circuits, troubleshooting of JFET bias circuits, JFET bias circuits design: design approach, gate bias design, self-bias design, voltage-divider bias design; MOSFET biasing, biasing FET switching circuits.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Optoelectronics devices: Light units, light-emitting diodes, seven –segment displays, photoconductive cells, photodiodes and solar cells, photo transistors, optocouplers, photomultipliers tube, laser diode.		
Text Books:		
1. David A. Bell, "Electronic Devices and Circuits" Oxford University Press, 5th Edition, 2015. 2. S. Salivahanan, N. Suresh Kumar, "Electronic devices and circuit", McGraw hill education (India) private limited, Chennai, 4th edition, 2017.		
Reference Books:		
1. Aloke K. Datta, "Semiconductor Devices and Circuits", Oxford university press, 1st edition, 2015. 2. R.L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson prentice hall, 9th edition, 2006. 3. T. Floyd, "Electronics Devices", Conventional current version, 7th Edition, Pearson, 4. D. Cheruku, B. Tirumala Krishna, "Electronics Devices and Circuits", Pearson		

Advance Measurement and Instrumentation (Professional Elective Course - I)

COURSE OUTLINE

Course Title:	**Advance Measurement and Instrumentation**	**Short Title:**	**AMI**	**Course Code:**	

Course description:

This course provides knowledge about transducers for measurement of different parameters such as pressure, temperature, level, flow, humidity etc.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course (s):

Physics, Measurement and Instrumentation

Course objectives:

The objective of the course is to provide students with a firm grasp of the essential principles of sensor and transducers.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply knowledge of material science and engineering for construction of sensor and transducers and analyze the characteristics of sensor and transducers for different applications.
2. Measure non electrical quantities like temperature, speed and vibration by transducers and understand the basic concepts of operations of tachometer, stroboscope and temperature transducers.
3. Analyze non electrical quantity like flow and level by transducers and understand the basic concepts of operation of level and flow transducers and its different types.
4. Study and analyze non electrical quantity like pressure transducer, vacuum transducer and viscosity and density sensing and measurement.
5. Understand and analyze non electrical quantity like Ph and conductivity sensors, Humidity and misc transducers.

COURSE CONTENT

Advance Measurement and Instrumentation		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Transducers: Definition, classification, selection criteria. Errors, loading effects, basic configuration of control system. Transducer specifications. Displacement, force and torque transducers. Force measuring transducers, electrical load cell, LVDT. Piezoelectric, vibrating type. Torque-strain gauge and other suitable transducers.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Speed, Vibration and Temperature Transducers

Tachometers, toothed rotor tachometers, Photoelectric, stroboscopic principal, Theory of acceleration pick- ups, their calibration, Type of accelerometer, Jerk meter.

Temperature Transducers: fills system thermometers, semiconductor temperature detector (thermostat and p-n junction) resistance thermometer, thermometer ultrasonic, crystal, infrared thermometer.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Level and Flow Measurement

Level transducers for liquid and solids- float type displacer. Air plug method, diaphragm box level gauge. DP cell, Load cell, bicolor direct reading. Vibrating, Ultrasonic, radioactive transducers, Reed switches, microwave sensors.

Flow transducer: Basic measurement principle, Bernoulli's theorem. Differential pressure type (orifice, venturi, pitot type). Variable area type, target type, magnetic. Ultrasonic vortex shedding, cross co-relation, positive displacement type. Mass flow meter, anemometer, total flow meter.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Pressure, Viscosity Transducers

Pressure transducer: Pressure scale and standards, manometer, elastic (Bellows, bourdon tube, diaphragm) type. Dead weight and vaccum gauge, testers, electrical pressure sensors (LVDT, strain gauge, load cell, piezo-electric, capacitive). Tuning fork type, differential sensors (capacitive, force balance and vibrating cylinder type).

Vacuum pressure measurement- McLeod gauge, thermal conducting and ionization type, Transducers for very high pressure measurement.

Viscosity and density sensing and measurement: capillary type, Shearle's rotating cylinder, cone and plate, falling and rolling ball type viscometers. Gravity meters, buoyancy type, DP cell type and electrical density sensors.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

pH, Conductivity, Humidity Sensors and Transducers

pH and conductivity sensors: pH scale and standards, principle of pH measurement. Different type of reference and measuring electrodes, ion selective electrodes. Principle of conductivity measurement, conductivity cells and bridges-their application. Effect of temperature on pH and conductivity sensors.

Humidity and misc. transducers: Pyrometer, Hygrometer (Hair, wire and Electrolysis type). Dew point meter, piezoelectric humidity meter. Infrared conductance and capacitive type probes for moisture measurement. Flow detectors, leak detectors Acoustic transducers and sound level measurement.

Text Books:

1. A. K. Sawhney. "Electrical & Electronic Measurement and Instrumentation", Danpant Rai & Co, 18th edition, 2007.
2. J. B. Gupta, "Electrical & Electronic Measurement and Instrumentation", S. K. Kataria& Son3rd edition, 2011.
3. R. K. Rajput, "Electrical & Electronic Measurement and Instrumentation", S. Chand.

Reference Books:

1. E. W. Golding "Electrical Measurements and Measuring instruments", Reem Publication, 3rd Edition.
2. Cooper and Derfllick, "Electronic Instrumentation and Measurements Techniques", 3rd edition, Prentice-Hall of India.
3. Bentley J.P., "Principles of Measurement Systems", Third Edition, Pearson Education Asia pvt.ltd. 4th edition, 2005.
4. Doebelin E.O., "Measurement Systems", McGraw Hill Book Co.
5. Patranabis D, "Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi.
6. Murthy D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi., 2nd edition.
7. Neubert H.K. P., "Instrument Transducers", Clarenden Press, Oxford.
8. R. K. Jain, "Mechanical and Industrial Measurement", Khanna Publication,1996.

Fluid Mechanics and Machinery (Open Elective Course – I)

COURSE OUTLINE

Course Title:	**Fluid Mechanics and Machinery**	**Short Title:**	**FMM**	**Course Code:**	

Course description:

The primary aim of this course is to provide students with a first introduction to continuum mechanics, in general and theoretical fluid mechanics in particular. Course is deal with understanding and hence predicting the properties of liquid and gases under external forces. Course provides introduction to principle concepts and method of fluid mechanics. Topics covered in the course include pressure, hydrostatics and buoyancy. Mass conservation and momentum conservation for moving fluids; viscous fluid flow, flow through pipes, dimensional analysis. Students will work to formulate and developed the problem solving skills essential to good engineering practice of fluid mechanics in practical applications.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course (s):

Engineering Mechanics, Applied Physics, Mathematics

Course objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To obtain the velocity and pressure variations in various types of simple flows
3. To analyze the flow in water pumps and turbines.
4. To understand fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
5. To implement basic laws and equations used for analysis of static and dynamic fluid.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze simple flow situations mathematically.
2. Access the performance of Hydraulic pumps.
3. Access the performance of Hydraulic Turbines.
4. Understand hydraulic press, accumulator and intensifier and also hydraulic crane, coupling, lift.
5. Understand Euler's equation of motion hence to reduce Bernoulli's equation and its application in fluid mechanics.

COURSE CONTENT

Fluid Mechanics and Machinery		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamental of Fluid Mechanics

Properties of fluid: Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow

Fluid Statics: Pascal's law, pressure at a point, Hydrostatic law derivation, Total pressure and centre of pressure for vertical, horizontal, inclined curve surface it's derivation.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Fluid Kinematics & Dynamics

Kinematics: Eulerian and lagrangian approach to solution, Definition of streamlines, Path line, steak line, Different types of flow; steady and unsteady flow, uniform and non- uniform flow, Laminar, Turbulent, compressible, incompressible, rotational, irrotational flows.

Fluid Dynamics: continuity equation for flow, Euler's equation, Bernoulli's equation along stream line for incompressible flow. Practical application of Bernoulli's equation: Pitot tube, venture meter, Orifice meter.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Hydraulic Pumps

Centrifugal Pump: Main Parts and working of Centrifugal pump, Work done by the Impeller, Different efficiencies and Head, Multistage centrifugal pump, Characteristic curves of centrifugal pump

Reciprocating Pump: Main Parts and working of Reciprocating pump, Discharge through Reciprocating pump, Slip of Reciprocating pump, Indicator Diagram, Air Vessels.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Fluid Systems: Introduction, Hydraulic Press, Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic lift, Hydraulic Crane, Hydraulic Coupling, Hydraulic Torque Converter, Air Lift Pump, Gear wheel Pump

Text Books:

1. Dr. R.K. Bansal, "Textbook of fluid mechanics and hydraulics machine", Laxmi publication New Delhi.
2. R.K. Rajput, "Textbook of fluid mechanics and hydraulics machine", S Chand and Co. Delhi.
3. Egor P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2001.
4. R. Subramanian, "Strength of Materials", Oxford University Press, 2007.
5. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, "Mechanics of Materials", Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005

Reference Books:

1. S. K. Som, G. Biswas, "Introduction to fluid mechanics", Tata McGraw Hill Publisher Pvt. Ltd.

2. P.N. Modi, S.M. Seth, "Hydraulics and Fluid Mechanics", Standard book house Delhi, 18th edition, 2011.
3. Victor Lyle Streeter, E. Benjamin Wylie, "Fluid Mechanics", Tata McGraw-Hill Publisher Pvt. Ltd.
4. Frank M. White, "Fluid Mechanics", Tata McGraw-Hill Publisher Pvt. Ltd, 4th edition, 2013.

Electronics Measurement(Open Elective Course – I)

COURSE OUTLINE

Course Title:	**Electronics measurement**	**Short Title:**	**EM**	**Course Code:**	

Course description:

This course provides knowledge about various electronics Measuring instrument, their block diagram, specifications and applications. It includes analog Instruments, digital instruments, Signal generators, Signal analyzers, and C.R.O.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Measurement and Instruments.

Course objectives:

The main objective of this course is to introduce and expose the students to various measuring instrument, their block diagram, specifications and applications. It includes analog Instruments, digital instruments, Signal generators, Signal analyzers, and C.R.O. The Student able to know the working principal and application of various electronics measuring instrument.

Course outcomes:

After successful completion of this course the student will be able to:

1. Know about various error and remedies to minimize these error
2. Understand working and Construction of digital instruments like digital voltmeter, digital frequency meter and power factor meter.
3. Understand the operation of various signals generators and their application in electronics measurement.
4. Understand signal analyzers and its different types for signal analysis.
5. Understand Cathode ray oscilloscope with its different types

COURSE CONTENT

Electronics Measurement		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Measurement, Error and PMMC device

Static Characteristics Accuracy, precision, sensitivity, resolution, Dynamic Characteristics.

Errors-Definition of error and explain gross error, systematic Error, random error, limiting errors.
Statistical Analysis. Arithmetic Mean, Deviation from Mean, Average Deviation, Standard Deviation, Permanent magnet moving coil mechanism. Explain with its diagram and derivation of torque. Advantages and disadvantages, DC ammeter and DC voltmeter. Basic circuit and multirange circuit of DC ammeter. Basic circuit and multirange circuit of DC voltmeter, Its sensitivity, Ohmmeter.
Series and shunt type of ohm meter its circuit and working with calibration.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Digital instruments

Digital multi meter. Block diagram of digital multi meter with working, Types of DVM General specifications of DVM. Linear Ramp type and Successive approximation type DVM. True RMS voltmeter, Digital Frequency Meter. Digital Phase Meter. Electrodynamometer, Power factor meter

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Signal Generators

Basic Standard Signal Generator, Standard signals Generator. AF Sine and Square wave generator, Function Generator.
Random noise generator, Sweep generator, Marker generator, Wobbluscope. Vectro scope, Q meter:- Working principle, Basic Q meter circuit , Application
Optical Time Domain Reflectometer (OTDR).

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Signal Analyzers

Basic Wave Analyzer, Frequency selective wave Analyzer, Heterodyne wave Analyzer, Harmonic distortion analyzers–Harmonic Distortion, Tuned circuit Harmonic analyzer, Heterodyne Harmonic Analyzer, Fundamental suppression Harmonic distortion analyzer. Spectrum analyzer-Basic spectrum analyzer using Swept receiver design. Fourier Analyzer, Logic Analyzer. Output power Meter, Field Strength Meter

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Oscilloscope

Block diagram of CRO:-vertical amplifiers, horizontal deflecting systems.
Delay line: lumped parameter delay line, distributed parameter delay line. Dual beam CRO, Dual trace CRO, Sampling (VHF) oscilloscope) and Digital readout oscilloscope.
Probes for CRO- Direct probe, passive voltage probe and active probe using FET.
Digital storage oscilloscope.

Text Books:

1. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw Hill, 2nd Edition, 2007.
2. A. Helfric, W. Cooper, “Modern Electronics Instrumentation and Measurement Technique”, Pearson LPE, 2005.

Reference Books:

1. A. K. Sawhney, "Electrical and Electronics Measurement and Instrumentation" Dhanpat Rai and company, 18th Edition, 2007.
2. R. K. Rajput, "Electrical and Electronic Measurements and Instrumentation", 3rdEdition, S. Chand Publication.

Internet of Things (Open Elective Course – I)					
COURSE OUTLINE					
Course Title:	**Internet of Things**	**Short Title:**	**IOT**	**Course Code:**	
Course description:					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

To emphasize on developing required skills amongst students and tests the outcomes of the study of a course, as opposed to routine learning and to create ability to acquire knowledge and apply fundamental principles to analytical problems and applications.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the design principles for connected devices
2. Understand the design principles of Internet connectivity
3. Analyze the concepts of knowledge acquiring, managing and storing
4. Understand the wide variety of sensors
5. Design the software for IoT applications

COURSE CONTENT

Data Base Management Systems		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Internet of Things: An Overview: Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT.

Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and Web Sockets

Internet Connectivity Principles: Internet Connectivity, Internet-Based Communication, IP Addressing

in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others		
Unit–III	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes, **Data Collection, Storage and Computing Using Cloud Platform:** Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms		
Unit–IV	**No. of Lectures: 08 Hours**	**Marks: 12**
Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology **Prototyping the Embedded Devices for IoT and M2M:** Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.		
Unit–V	**No. of Lectures: 08 Hours**	**Marks: 12**
Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs **IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT		
Text Books:		
1. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Education		
Reference Books:		
1. Peter Waher, "Learning Internet of Things" PACKT Publishing. First Edition, 2015.		

Industrial Safety (Open Elective Course – I)

COURSE OUTLINE

Course Title:	**Industrial Safety**	**Short Title:**	**IS**	**Course Code:**	

Course description:

This course describes identification of components needed to provide a safe environment, analyze resulting safety and health issues.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To identify the components needed to provide a safe and healthful work environment through case studies and review of injury statistics provided in the course.
2. To analyze safety and health issues resulting from worker complaints or OSHA violations and suggest potential remedies.
3. To identify potential workplace safety and health hazards and determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.
4. To demonstrate research skills necessary for mastery of the topic, which will entail a presentation on a specific industry? Worker compensation claims in the industry selected by the student will be evaluated and injury prevention methods reviewed in the report.
5. To conduct basic safety inspections using strategies that they have developed though hazard identification and job hazard analysis.
6. To review the principles for developing and implementing a successful occupational health and safety program and evaluation of a work site.
7. To compare past and contemporary philosophies of safety and accident prevention as well as be able to compare injury data from previous decades.
8. To identify the moral and economic consequences associated with the major classifications and causes of accidents and the cost of workers' compensation based on the risk classes of industries.
9. To explain the causal relationship between accidents and liability including the no fault workers compensation system and the third party liability type lawsuit.
10. To identify basic fire prevention and protection programs in the workplace.
11. To identify essential elements of an occupational safety and health program and the components of international standard organizations in safety and health..
12. To describe basic components of an effective company safety and health program including management commitment, employee involvement, hazard recognition and control and training.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the basic of safety and its need and objectives in industries.
2. Learn the role and responsibility of safety management and its activities.
3. Apply the knowledge of safety for awareness and training programs.
4. Apply the safety practices and inspections using strategies that developed through hazard identification analysis.
5. Categorize the different hazards and its safety precautions and action in different type of industry.

COURSE CONTENT

Industrial Safety		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Industrial Safety:

History and development of safety movement Need for safety, Safety legislation: Acts and rules, Safety standards and codes, Safety policy: safety organization and responsibilities and authorities of different levels. Accident sequence theory, Causes of accidents, Accident prevention and control techniques, Plant safety inspections, Job safety Analysis and investigation of accidents, First aid.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Industrial Safety Management:

Management**:** Concept, definition, nature and importance, Role and functions of a manager, Elements and functions of Management.

Management Principles**:** Authority, responsibility & power of Management, Span of Control.

Delegation and decentralization of authority. General principles of Management.

Industrial Safety**:** History of Safety Movement in India and abroad. The Accident Problem, Nature & size need for safety, legal, humanitarian, economic and social considerations.

Safety Management**:** Role of management in Industrial Safety. Safety Management Principles & Practices.

Unit–III	**No. of Lectures: 08 Hours**	**Marks: 12**

Safety Awareness & Training:

Training for Safety: Assessment of needs. Design & development of training programs. Training methods and strategies. Training of manager, supervisors & workers. Evaluation of training programs.

Training Program: In-Plant training programs. Out-of-plant training programs. Seminars, Conferences & Workshop, Programs for new workers. Job instructions Vs Safety instructions.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Safety Promotion & Publicity:

Safety suggestion schemes. Safety competitions, Safety incentive Schemes. Audio Visual Publicity, other promotional methods.

Human behavior and safety: Human factors contributing to accidents. Individual differences. Behaviour as function of self and situation. Perception of danger and acceptance of risks. Knowledge and responsibility vis-a-vis safety performance. Role of management, Supervisors and safety department in motivation.

Unit–V	No. of Lectures: 08 Hours	Marks: 12

Control of Physical and Chemical Hazards:

Purpose of lighting. Advantages of good illumination. Lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended minimum standards of illumination. Design of lighting installation, Lighting and color, Purpose of ventilation. Engineering Control of noise, Vibration damping, Noise isolation.

Hazardous properties of chemicals and appreciation of information provided in Material safety data sheets. Classification of dangerous materials. Safety in transportation of dangerous materials by road, rail, ships and pipelines. Safety in bulk storage of hazardous substances. Safety in handling of chemicals in the plant by pipelines.

Text Books:

1. R.S. Gupta, Handbook of Fire Technology, National Safety Council of India.
2. Major hazard control, A Practical Manual, Inter National Labour Office, 3rd impression
3. Encyclopedia of occupational health and safety, Inter National Labor Office, 4th revise edition, 1990.
4. R.K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, New Delhi, 2006.
5. Slote.L. Handbook of Occupational Safety and Health, John Willey and Sons, NewYork
6. Frank P. Lees, Loss of Prevention in Process Industries, Vol. 1 and 2, Butterwort Heinemann Ltd., London, 1991.

Reference Books:

1. Industrial Safety -National Safety Council of India.
2. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI,Mumbai Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi, 2001.
3. Industrial Safety and Pollution Control Handbook: National Safety Council and Associate Publishers Pvt. Ltd, Hyderabad (1993).
4. Risk Assessment and Environmental Management: D. Kofi Asvite- Dualy, John Willey & Sons, West Sussex, England (1998).
5. Gilbert M. M., Pearson, "Introduction to Environmental Engineering & Science": Education, Singapore (2004).
6. R.S. Gupta," Fire Technology", National Safety Council of India.
7. Major hazard control, Inter National Labor Office.
8. Encyclopedia of occupational health and safety, Inter National Labor Office.
9. Safety, health and working condition in the transfer of technology, Inter National Office.

Power Electronics Laboratory					
LAB COURSE OUTLINE					
Course Title:	**Power Electronics Lab.**	**Short Title:**	**PE lab**	**Course Code:**	

Course description:

Technology has improved by lips and bounds making the power devices more closely to an ideal switch. Power electronics has already found an important place in modern technology and has revolutionized control of power and energy. As the voltage and current ratings and switching characteristics of power semiconductor devices keep improving, the range of applications continues to expand in areas such as lamp controls, power supplies to motion control, factory automation, transportation, energy storage, megawatt industrial drives, photovoltaic system and electric power transmission and distribution. The greater efficiency and tighter control features of power electronics are becoming attractive for applications in motion control by replacing the earlier electro-mechanical and electronic systems. Applications in power transmission include high-voltage dc (HVDC) converter stations, flexible ac transmission system (FACTS), and static-var compensators. In power distribution these include dc-to-ac conversion, dynamic filters, frequency conversion, and Custom Power System. The syllabus of Power Electronic deals with constructional and operational characteristic of power semiconductor devices, ac to dc, dc to ac converters, choppers and ac to ac converters.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog and Digital Electronics.

Course objectives:

Power Electronics is the art of converting electrical energy from one form to another in an efficient, clean, compact and robust manner for convenient utilization. The objectives of Power electronic is to create an awareness about the general nature of Power electronic devices, key features of the principal Power Electronic Devices, operational analysis of single phase uncontrolled half wave and full wave rectifiers supplying resistive, inductive, capacitive and back emf type loads. The objectives intended to understand the different configurations of rectifier, inverters, coppers and cycloconverters.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Understand the behaviour of semiconductor devices operated as power switches and ability to design, set up, and test power electronic circuits in the laboratory
2. Describe the role of power electronics as an enabling technology in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc.
3. Able to design of single-phase and three-phase thyristor converters.
4. Learn the basic concepts of operation of dc-to-dc converters and dc-to-ac inverters and be able to analyze basic converter topologies.
5. Illustrate the basic concepts of operation of ac voltage controllers and cycloconverters.

LAB COURSE CONTENT			
Power Electronics Lab.		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments:

1. To study of R, RC, UJT firing circuits.
2. To study of characteristics of SCR, MOSFET.
3. To study forced commutation methods for SCRs.
4. To study operation of fully controlled converter with various types of loads.
5. To study operation of half controlled converter with various types of loads.
6. Three-phase full wave Rectifier
7. To study SCR parallel inverter, control circuit.
8. To study operation of SCR series inverter along controlled rectifiers.
9. To study operation of Step-down chopper.
10. To study operation of Step-up chopper with firing circuit.
11. To study the single-phase AC Voltage Controller.
12. To study the single-phase Cycloconverter

Note: Lab file should consist of **minimum Eight** experiments.

Text Books:

1. Dr. P. S. Bimbhra, "Power Electronic" Khanna Publishers, 3rd edition, 2012.
2. Muhammad H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, Third Edition, 2012.
3. Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, Third Edition, 2014.

Reference Books:

1. M. Ramamoorty, "An Introduction to Thyristors and their Applications", East-West Press (Pvt.) Ltd., 1991.
2. V. R. Moorthy, "Power Electronics Devices Circuit and Industrial Applications", Oxford University Press, First Edition, 2015.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
5. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, International Second Edition, 2016.
6. P. C. Sen, "Modern Power Electronics", S. Chand and company, 2005.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Power System-I Laboratory					
LAB COURSE OUTLINE					
Course Title:	**Power System-I Laboratory**	**Short Title:**	**PS-I lab**	**Course Code:**	

Course description:

Power System explores the knowledge of parameter, characteristic of transmission line. The subject also explores the performance of transmission lines.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	02	14	28	01

End Semester Exam (ESE) Pattern:	Practical (PR)

Prerequisite course(s):

Electrical Machines I&II, Electrical Circuit Analysis

Course objectives:

The objective of the laboratory is to impart the fundamental knowledge of parameters, surge impedance loading and reactive compensation of transmission lines. The objective of the laboratory is also to impart the fundamental knowledge of performance of transmission lines in terms of its regulation and efficiency. Students will able to develop their ability to apply the specific procedures for analyze the experimental results. In this lab course, students will be familiar with the use of different equipments, safety precautions on work place. This makes bridge on theoretical knowledge and practical practices.

Course outcomes:

After successful completion of lab Course, student will be able to:

1. Evaluate parameters of medium and long transmission line in power systems.
2. Estimation of surge impedance loading of transmission Line.
3. Analysis of reactive power compensation of transmission Line.
4. Analyze performance of short and medium transmission Lines.
5. Analyze performance of long transmission Line.

LAB COURSE CONTENT

Power System-I		Semester:	V	
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE):**		**25 marks**
		Internal Continuous Assessment (ICA):		**25 marks**

Teacher should facilitate learning following lab experiments:

1. Measurement of ABCD parameters of medium transmission line.
2. Measurement of ABCD parameters of Long transmission line.
3. To validate Ferranti effect on an unloaded transmission line.
4. Estimation of surge impedance loading of the transmission line.
5. Analysis of the effect of VAR compensation on the profile of receiving end voltage using capacitor bank.

6. Determination of reactive power required for zero regulation at different loads.
7. Analysis of voltage improvement of reactive power control using Tap changing transformer.
8. To determine the performance of the short transmission line by calculating its efficiency and regulation.
9. To determine the performance of the medium transmission line by calculating its efficiency and regulation.
10. To determine the performance of the long transmission line by calculating its efficiency and regulation.
11. Visit to HV/EHV substation or power generating substation.

Note: Lab file should consist of minimum Eight experiments.

Text Books:

1. D. P. Kothari, I. J. Nagrath, "Modern Power System Analysis" 4th edition Tata Mc.Graw Hill Education, 2011.

Reference Books:

1. W. D. Stevenson, "Elements of Power System Analysis", Mc Graw Hill, 4th edition, 1985.
2. C.L. Wadhwa, "Electrical Power System", New Age International limited, 2017.
3. Stagg, El-Abiad, "Computer Methods in Power System Analysis" TMH.
4. HadiSaadat, "Power System Analysis", Tata McGraw Hill2nd edition, 2009.
5. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
6. Chakraborthy, Soni, Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai &Co.limited, 2008.
7. T.K Nagsarkar, M.S. Sukhija, "Power System Analysis" Oxford University Press, 2007.
8. S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control", Pearson, 2009.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Electronic Design Laboratory

LAB COURSE OUTLINE

Course Title:	**Electronic Design Laboratory**	**Short Title:**	**ED lab.**	**Course Code:**	

Course description:

This course provides the students with comprehensive study of basic components and circuits of Analog and digital Electronics

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog & Digital Electronics.

Course objectives:

1. The goal of this course is to provide a good understanding on the design and implementation of analog and digital circuits for various applications such as amplification, filtering, frequency generation etc.
2. To prepare the students for operational amplifier, DAC, ADC CircuitDesign

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Develop the skill to build, and troubleshoot analog circuits.
2. Construct and test complex electronic circuits in the laboratory
3. Design and build analog circuits using analog and digital ICs.
4. Analyze the applications of analog ICs.
5. Illustrate different applications of digital ICs.

LAB COURSE CONTENT

Electronic Design Laboratory		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

List of Practicals:

1. Design of D.C. Power Supply using full wave rectifier with filter.
2. Design of Series Voltage Regulator
3. Design of three terminal IC based voltage regulator circuits
4. Design of Low Voltage and High Voltage regulator circuits using IC 723.
5. Implementation of SMPS and switching regulators
6. Implementation of waveform generator and oscillator using op-amp IC741,
7. Implementation of active Butterworth filters, Sallen Key filters using op-amp 741.
8. Design of Astableand Monostable multivibrators using IC 555 and applications.

9. Design of Decoders-BCD decoders, Encoders.
10. Design of digital multiplexers and demultiplexers.

Note: Lab file should consist of minimum five experiments.

Text Books:

1. N. C. Goyal, R. K. Khetan, "A Monograph on Electronics Design Principles", Khanna Publishers, 5th Edition, 2007.
2. R. A. Gayakwad, "Op-Amps and Liner Integrated Circuits", 4th Edition, PHI Learning Pvt. Ltd. 2012.
3. David A. Bell, "Electronic Devices and Circuits" Oxford University Press, 5th Edition, 2015.
4. Michael Jacob, "Application and Design with Analog Integrated Circuits", 2nd Edition, PHI.

Reference Books:

1. Sergio Franco, "Design with OP-AMP and Analog Integrated Circuits", 3rdEdition, TMH.
2. M. Morries Mano and Charles Kime, "Logic and computer design Fundamentals",4th Edition, Pearson Learning, 2014.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Minor Project (Stage – I)					
LAB COURSE OUTLINE					
Course Title:	**Minor Project (Stage – I)**	**Short Title:**	**MPROJ-SI**	**Course Code:**	

Course description:

Minor project represent the culmination of study towards the Bachelor of Engineering degree. The minor project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	06	14	84	03

End Semester Exam (ESE) Pattern: ----

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply knowledge of mathematics, science, and engineering to solve engineering problem by demonstration of prototype project.
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.
3. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues with greater sense of management.
4. Use resources, techniques, skills, modern engineering tools and software necessary for engineering practice.
5. Recognition of the need for, and an ability to engage in life-longed self learning.

LAB COURSE CONTENT

Minor Project (Stage – I)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**Internal Continuous Assessment (ICA):**	**50 marks**

At third year the students shall carry out a minor project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – V the students shall complete the partial work, and by the end of Semester – VI the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher canguidemaximum04groupsofminor projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – IV. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design.

Minor Project (Stage – I) may involve literature survey, problem identification, work methodology, preparing specification and material procurement, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design or analysis. Approximately more than 50% work should be completed by the end of Semester – V. Each student group should submit partial project report in the form of thermal bound at the end of Semester –V.

Each student group is required to maintain separate log book for documenting various activities of the project.

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project (stage – I) in Semester – V shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Constitution of India

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Third Year Electrical Engineering

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester – VI

w. e. f. 2020 – 21

Control System

COURSE OUTLINE

Course Title:	**Control System**	**Short Title:**	**CS**	**Course Code:**	

Course description:

The study of Control System Engineering is essential for the students of Electrical, Electronics, Mechanical, Aerospace& Chemical Engineering. It has applications ranges from Electrical Power System to process Control System. The course explores the knowledge of basic control systems, control system components, mathematical modeling, and time response & frequency response analysis. The course also deals in concept of design & its preliminary consideration.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Engineering Mathematics, Basic Electrical & Electronics Engineering, Introduction of Mechanical Engineering, Signals and Systems.

Course objectives:

1. The students should be able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.
2. The students should learn how to represent system by transfer function and block diagram reduction method and Mason's gain formula.
3. The students should able to learn time response analysis and demonstrate their knowledge to frequency response.
4. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.
5. The students should able to learn the design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.
6. The students should able to learn state variable technique. Controllability and observability and their testing.

Course outcomes:

Upon successful completion of Course, student will be able to:

1. Analyze open loop and closed-loop control systems for stability and steady-state performance
2. Design a closed-loop control system to satisfy dynamic performance specifications using frequency response, root-locus, and state-space techniques, as well as steady state error specifications
3. Compute stability of linear systems using the Routh array test and use this to generate control design constraints
4. Compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability
5. Design Lead-Lag compensators based on frequency data for an open-loop linear system

COURSE CONTENT

Control System		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Control System: Open loop & closed control; servomechanism, Physical system. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula, Reduction of parameter variation and effects of disturbance by using negative feedback

Unit-II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Time Response analysis: Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices.

Unit-III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Control System Components: Constructional and working concept of ac servomotor, synchronous and stepper motor**, Stability and Algebraic Criteria:** concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations, **Root Locus Technique:** The root locus concepts, construction of root loci

Unit-IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots

Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.

Unit-V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Design: The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.

State variable technique:

State variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

Text Books:

1. I. J. Nagrath & M. Gopal, "Control System Engineering", New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India, 1990
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley India Ltd, 8th edition.
4. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

Reference Books:

1. Norman S. Mise, Control System Engineering, Wiley Publishing Co.

2. Ajit K Mandal, “Introduction to Control Engineering” New Age International.
3. R. T. Stefani, B. Shahian, C. J. Savant and G.H. Hostetter, “Design of Feedback Control Systems” Oxford University Press, 2002.
4. Samarjit Ghosh, “Control Systems theory and Applications”, Pearson Education
5. J. P. Navani&SonalSapra, “Control System”, S. Chand Publishing.
6. Ambikapathy, “Control Systems”, Khanna Book Publishing Co. (P) Ltd., Delhi

Microprocessor and Microcontroller					
COURSE OUTLINE					
Course Title:	**Microprocessor and Microcontroller**	**Short Title:**	**MPMC**	**Course Code:**	

Course description:

The course explores knowledge of microprocessor and microcontroller. The course comprises of architecture, assemble language programming and interfacing of peripherals and their applications.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Analog and Digital Electronics

Course objectives:

To meet the challenges of growing technology, student will be conversant with the programmable aspect of microprocessor and microcontroller. Programming is a process of problem solving and communication in language of mnemonics. The object of course is to understand microprocessor and microcontroller demand, concept and develop skill in two discipline hardware and programming.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply basic electronic subject and software algorithm application for understanding Architectures assemble language of microcontroller and microprocessor
2. Develop assemble language programming and interfacing peripherals for wide application in electrical engineering
3. Develop assembly language source code for applications that use I/O ports, timer and single/multiple interrupts
4. Apply the knowledge of microprocessor and microcontroller in measurement of electrical quantities, microprocessor and microcontroller based electrical protection system
5. Do higher study in the field of automation, operation and control of power system by microprocessor and microcontroller

COURSE CONTENT

Microprocessor and Microcontroller		Semester:	VI
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I	No. of Lectures: 09 Hours	Marks: 12

8085 Microprocessor:

Organization, architecture, functional pin diagram, Generation of control signal, Addressing modes, Instruction format, Stack, subroutine, types of subroutine, I/O Mapped I/O and memory mapped I/O, interrupt - interrupt structure.

Unit–II	No. of Lectures: 09 Hours	Marks: 12

Assembly language Programming:

Classification of instructions, complete instruction set, assembly language programming include arithmetic and logical, conditional, branch control, stack, subroutine, interrupt, Serial data transfer program using RIM and SIM

Unit–III	No. of Lectures: 08 Hours	Marks: 12

Interfacing memory and Peripherals devices:

Memory module chip capacity, address space. Memory specification, Types of memory- ROM, RAM: static & dynamic, PROM, EPROM, EEPROM, memory organization & interfacing of RAM and ROM. Study of common IO peripheral devices, their architecture, control words and control register & different modes of operation 8255 PPI, 8279 keyboard display interface.

Unit–IV	No. of Lectures: 08 Hours	Marks: 12

Data Conversion and Applications :

D to A – types, Ladder, R-2R, A to D converters, SAR type, dual slope.

ADC and DAC interfacing with 8085 microprocessor

Microprocessor Applications: Frequency measurement, phase angle and power factor measurement, current and voltage, kVA, kW measurement.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Microcontroller:

8051microcontroller: Architecture, registers, SFRs pins, memory organization, I/O port structure, interrupts, timer and counter circuit, serial port. 8051Instruction set classification, addressing mode, simple assembly language programs. Programming related to Timer/Counter

Text Books:

1. R. S. Gaonkar. “Microprocessor Architecture, Programming, & Applications with 8085”, Penram International Publication (India) Pvt. Ltd., Third edition, 6th Edition, 2013.
2. B. Ram, “Fundamentals of Microprocessors & Microcontrollers” Dhanpat Rai Publication, 2014.

Reference Books:

1. N. Senthil Kumar, M. Saravanan, S. Jeevananathan, “Microprocessors & Microcontrollers” Oxford University Press, 2nd Edition, 2016.
2. Leventhal, “8085 Assembly Languages Programming” Tata McGraw Hill.
3. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, Second Edition.
4. Kenneth J. Ayala “The 8051 Micro Controller: Architecture, Programming”, Penram International, Mumbai.
5. K. M. Burchandi, “Advanced Microprocessors and Peripherals”, TMH, 3rd edition.
6. A. K. Gautam, “Advanced Microprocessors”, Khanna Publishing House

Power System-II					
COURSE OUTLINE					
Course Title:	**Power System-II**	**Short Title:**	**PS-II**	**Course Code:**	

Course description:

Power System explores the knowledge of symmetrical and unsymmetrical fault analysis. The subject emphasis on representation of power system components and load flow analysis.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Power System-I, Electrical Machines. Electrical Circuit Analysis

Course objectives:

The approach has always been to develop the thinking process of students in reaching a sound understanding of broad range of topic in power system area of electrical engineering. An Electrical Engineer should be able to solve the power system network under normal and abnormal conditions. This course is aim to cover constituents of power system, power system components representation. The objective of this course is also to analyze the power system in terms of symmetrical and unsymmetrical faults and different power flow analysis.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the representation of synchronous machine, transmission line and power transformer to evaluate the performance of power system.
2. Analyze the power system to calculate the effects of symmetrical faults on power system.
3. Analyze the power system in terms of symmetrical components and sequence networks of synchronous machines, transmission line and transformer.
4. Analyze the power system to calculate the effects of unsymmetrical faults.
5. Determine the power flow for a given system.

COURSE CONTENT

Power System-II		Semester:	VI
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit I	No. of Lectures: 09 Hours	Marks: 12

Representation of power system component

Introduction: Constituents of power system and role, necessity of power system analysis, Real, reactive, complex power and its direction.

Representation of power system: Single phase representation of balance three phase network, one line

diagram, impedance diagram (reactance diagram), per unit system, representation of synchronous machine and power transformer.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Symmetrical Fault Analysis

Introduction, Transient on a transmission line, three phase short circuit of an Synchronous machine on no load, short circuit current and reactances of synchronous machine on no load, Short circuit of a loaded synchronous machines, Analysis of symmetrical faults in power system networks, Fault MVA and fault current (steady state), , consideration of prefault load current, selection of circuit breaker, Current limiting reactors, location of reactors

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Symmetrical Components

Symmetrical components of 3 phase system, the phase operator, power invariance, phase shift in star delta transformers, physical significance of sequence components, sequence impedance and sequence network, sequence impedance of transmission lines, sequence impedance and network of synchronous machines, sequence impedance and network of transformers, sequence impedance and network of load, formation of sequence network of power system

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Unsymmetrical Fault Analysis

Shunt type and series type faults, symmetrical component analysis of unsymmetrical faults, Single line to ground fault (LG) on an unloaded generator , line to line fault (LL) on an unloaded generator, double line to ground fault(LLG)on an unloaded generator, unsymmetrical fault on power systems, Single line to ground fault (LG)on a power system, line to line fault (LL)on a power system , double line to ground fault(LLG)on a power system, Faults analysis of unsymmetrical faults, series or open conductor faults

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Load flow analysis

Introduction, bus classifications, bus admittance matrix, Self admittance and mutual admittance, formation of Y bus using step by step method, formation of Y bus using singular transformation, Primitive network, network variables in bus frame reference, bus incidence matrix, Representation of transformer, Approximate load flow study, iterative computation of Non linear algebraic equations- Gauss and Gauss Seidel iterative technique, Gauss Seidel method for power flow study, Newton Raphson method for power flow study

Text Books:

1. D.P. Kothari, I. J. Nagrath, "Modern Power System Analysis" 4th edition, Tata McGraw Hill.
2. C.L. Wadhwa, "Electrical Power System", New Age International limited publishers, 2017.

Reference Books:

1. W.D. Stevenson, Jr. "Elements of Power System Analysis", Mc Graw Hill, 4th edition,1985.
2. Stagg, El-Abiad, "Computer Methods in Power System Analysis" TMH.

3. Hadi Saadat; “Power System Analysis”, Tata McGraw Hill, 2nd edition, 2009.
4. L. P. Singh; “Advanced Power System Analysis & Dynamics”, New Age International
5. Chakraborthy, Soni, Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co.limited 2008.
6. T.K Nagsarkar, M.S. Sukhija, “Power System Analysis” Oxford University Press, 2007.
7. S. Sivanagaraju, G. Sreenivasan, “Power System Operation and Control”, Pearson, 2009.

Industrial Automation (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Industrial Automation**	**Short Title:**	**IA**	**Course Code:**	

Course description:

This course describes PLC & SCADA based Industrial Automation system which will improve the knowledge of the students about industrial processes using automation. The course will cover industrial automation systems in terms of their architecture, their interface to the process hardware, the functionality and the application development facilities.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Electrical Machines, Control system, Power systems-I

Course objectives:

The objectives of subject are that students will able to understand the role of industrial automation for different processes based on PLC system and its requirement. It also provides basic operation of programmable logic control and its function. Students will learn the input-output devices for the PLC, its operation, its selection according to application and its interfacing. It explores the knowledge of different configuration of PLC, its programming techniques for various applications, and it's interfacing with industrial machineries. It also helps to understand the application in different industries like power sector, in pharmaceuticals, in automobile industry etc and its installation.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply the knowledge of automation in machine control.
2. Design and conduct practical in realistic constrain on motors such that it is applicable in manufacturing, testing and maintenance field.
3. Design the automation system for fast and value added quality product for economical growth through technological development.
4. Solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.
5. Discharge professional duty in multidisciplinary teams of installation, maintenance and operation with séance of safety standards.

COURSE CONTENT

Industrial Automation		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Introduction to Industrial Automation and Control: Introduction to Process Control. Architecture of Industrial Automation Systems, Introduction to sensors and measurement systems, Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow

measurement techniques, Measurement of level, humidity and pH		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Signal Conditioning and Processing: Estimation of errors and Calibration, P-I- D Control, Controller Tuning, Implementation of PID Controllers, Special Control Structures: Feed forward and Ratio Control. Special Control Structures : Predictive Control, Control of Systems with Inverse Response Special Control Structures: Cascade Control, Overriding Control, Selective Control, Split Range Control.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Sequence Control: PLCs and Relay Ladder Logic, Sequence Control: Scan Cycle, RLL Syntax, Sequence Control: Structured Design Approach, Sequence Control Advanced RLL Programming, Sequence Control: The Hardware environment, Control of Machine tools: Introduction to CNC Machines, Control of Machine tools: Analysis of a control loop.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Actuators : Flow Control Valves, Hydraulic Actuator Systems : Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves, Pneumatic Control Systems: System Components, Pneumatic Control Systems: Controllers and Integrated Control Systems		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Electric Drives: Introduction, Energy Saving with Adjustable Speed Drives, Step motors: Principles, Construction and Drives, DC Motor Drives : Introduction, DC--DC Converters, Adjustable Speed Drives Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives Synchronous Motor Drives: Motor Principles, Adjustable Speed and Servo Drives Networking of Sensors, Actuators and Controllers : The Field bus The Field bus Communication Protocol Introduction to Production Control Systems		
Text Books:		
1. John Webb & Ronald, "PLC Principles and Application**",** Prentice Hall India. 2. S. K. Singh, "Computer Aided Process Control", Prentice Hall India.		
Reference Books:		
1. John Hackworth & Frederick D. Hackworth, "PLC: Programming Methods and Applications", Pearson Education, 2004. 2. Krushnakant, "Computer Based Process Control" Prentice Hall India, New Delhi, 2003.		

Advance Power Electronics (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Advance Power Electronics**	**Short Title:**	**APE**	**Course Code:**	

Course description:

Power electronics converters stresses a power semiconductor devices beyond the rating, how to relieving the problems. Technology has improved by lips and bounds making the power devices more closely to an ideal switch. Power electronics has already found an important place in modern technology and has revolutionized control of power and energy. As the voltage and current ratings and switching characteristics of power semiconductor devices keep improving, the range of applications continues to expand in areas such as lamp controls, power supplies to motion control, factory automation, transportation, energy storage, megawatt industrial drives, photovoltaic system and electric power transmission and distribution. The syllabus of Advance Power Electronic deals with snubber circuits, gate and base drive circuits, zero voltage/current switching, Switching dc Power Supply, Power conditioners and Uninterruptible Power Supplies etc.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power Electronics

Course objectives:

Power Electronics is the art of converting electrical energy from one form to another in an efficient, clean, compact and robust manner for convenient utilization. The objectives of Advance Power electronic is to create an awareness about the general nature of Power electronic devices, key features of the principal Power Electronic Devices, protection techniques and Industrial applications.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe the role of Power Electronics as an enabling technology in various applications.
2. Understand the behavior of semiconductor devices operated as power switches and their protections.
3. Classify the resonant converters.
4. Analyze and design power supplies.
5. Understand the industrial applications

COURSE CONTENT

Advance Power Electronics		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Snubber Circuits: Function and types of snubber circuits, Diode snubbers, Snubber circuits for

thyristors, Need for snubbers with transistors, Turn-off snubber, Overvoltage snubber, Turn-on snubber, Snubbers for bridge circuit configurations, GTO snubber Considerations.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Gate and Base Drive Circuits: Preliminary design considerations, dc-coupled drive circuit, Electrically isolated drive circuits, Cascode-connected drive circuits, Thyristor drive circuits, Power device protection in drive circuits, Circuit layout considerations.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Resonant Converters: Switch – Mode inductive current switching, zero – voltage and zero current switching, Classification of resonant converters, Basic resonant circuit concepts: Series resonant circuits, Parallel resonant circuits; Load resonant converters, Load resonant converters, Resonant switch converters

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Switching dc Power Supply: Linear power supply, Overview of switching power supply, dc-dc converters with electrical isolation, Control of switch-mode power supply, Current mode control, Power supply protection, Electrical isolation in feedback loop, Designing meet the power supply specifications.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Power conditioners and Uninterruptible Power Supplies: Power line disturbances, Power conditioners, Uninterruptible Power Supplies: on-line, off line.
High-Voltage dc Transmission, control of HVDC transmission, Static VAR control

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, Third Edition, 2014.
2. V. R. Moorthy, “Power Electronics Devices Circuit and Industrial Applications”, Oxford University Press, First Edition, 2015.

Reference Books:

1. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
2. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
3. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press, International Second Edition, 2016.
4. Muhammad H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, Third Edition, 2012.

Non Conventional Energy System (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Non Conventional Energy System**	**Short Title:**	**NCES**	**Course Code:**	

Course description:

Renewable energy sources are interdisciplinary subjects of science and technology. Energy technology is the back-boon of modern civilization and national economy. It is an applied science dealing with various renewable energy routes comprising the exploration and extraction of energy and by-products, transportation, storage, distribution and supply of secondary forms of energy. These courses explore available renewable energy sources and provide the platform to study judicious and economic choice of energy for environment friendly and sustain able developments.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Physics, Basic Electrical & Electronics Engineering, Power System - I

Course objectives:

The objectives of this course are to understand the various renewable energy sources, their conversion technology and application. The course will help to bring down gap between energy demand and energy generation with environment friendly. The course also provides basic knowledge for lifelong learning and higher education in field of energy conversion.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply the basic knowledge of science, mathematics and engineering for understanding the non-conventional energy system.
2. Understand facts, concepts and principles of exploration and extraction of energy for judicious and economics choice of energy for environmentally friendly and sustainable developments.
3. Analyze the data for wind and solar to demonstrate the correct usage of non-conventional energy system.
4. Understand the basic requirement, prediction of productivity and usage of Biomass plants.
5. Analyze the cost effectiveness and life estimation of non-conventional energy system with least environmental damage.

COURSE CONTENT

Non Conventional Energy System		Semester:	VI
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Basics of Energy Sources:

Fossil fuel based systems, Impact of fossil fuel based systems,Non conventional energy – seasonal

variations and availability, Renewable energy – sources and features, Hybrid energy systems, Distributed energy systems and dispersed generation (DG) Traditional energy systems: Sources, Features and characteristics and Applications in Transport, Agriculture and House hold lighting etc		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Solar thermal systems: Solar radiation spectrum, Radiation measurement, Technologies, Applications (Heating , Cooling, Drying, Distillation and Power generation **Solar Photovoltaic systems:** Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications, Battery charging, Pumping, Lighting		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microhydel: Operating principle, Components of a microhydel power plant, Types and characteristics of turbines, Selection and modification and Load balancing **Wind:** Wind patterns and wind data, Site selection Types of wind mills, Characteristics of wind generators and Load matching		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Biomass: Operating principle, Combustion and fermentation , Anaerobic digester , Wood gassifier, Pyrolysis and Applications (Bio gas, Wood stoves, Bio diesel and Combustion engine) **Hybrid Systems:** Range and type of Hybrid systems Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Costing: Life cycle costing (LCC), Solar thermal system LXCC, Solar PV system LCC, Microhydel LCC, Wind system LCC and Biomass system LCC		
Text Books:		
1. S. C. Tripathy, "Electrical Energy Utilization and Conservation", THM Publication, 2003. 2. S. Rao & Dr. B. B. Parulekar, "Energy Technology", Khanna Publishers, 3rd edition, 1994.		
Reference Books:		
1. Dr. H S Mukunda, "Understanding Clean Energy and fuels from Biomass", Wiley India		

Electrical Machine Design (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Electrical Machine Design**	**Short Title:**	**EMD**	**Course Code:**	

Course description:

The course consists of general factor of machine design, material classification, temperature rise and rating of machines. It explores the design concept of transformer core, winding overall dimension performance and cooling design of transformer. The course also provides sound understanding and basic concepts of rotating machine design.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Electrical Machines-I and II

Course objectives:

The approaches always were to develop the thinking process of students in reaching a sound understanding of broad range of topic in electrical machine design. The object is to promote the students' interest in learning more about latest trend in electrical machine design. The object is not great depth, but presentation through enough to give theory at a level that can be understood by undergraduate. With this beginning, the students will have the foundation to continue his education and able to do better in professional duties in the field of design and manufacturing industries.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply knowledge of mathematics, science, and engineering for design of electrical machines.
2. Understand the electrical engineering material characteristic for designing an energy efficient electrical machine.
3. Understand the temperature rise in electrical machines and impact on rating and duty of machines.
4. Ability to design an electrical machines and components to meet desired needs within realistic constraints such as economic, environmental, social, safety, manufacturability, and sustainability.
5. Ability to function on multidisciplinary teams with professional and ethical responsibility.

COURSE CONTENT

Electrical Machine Design		Semester:	VI
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Introduction: principles of design and design factors, rating, specifications, standards, brief study of magnetic, electric, insulating and other material. Theory of solid body heating, heating and cooling time curve, rating of machines, and type of duty.

Design of Starters-Shunt Motors, Series Motor, Slip ring induction motor.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Design of Transformer: Design of distribution and power Transformer,-types, classifications, specifications, core construction, transformer winding, design of transformer, output equation of single phase and three phase transformer ,overall dimension, design of core, winding, estimation of leakage reactance for H.V. and L.V. winding, resistance of winding, calculation of losses, determination of voltage regulation.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Performances Transformer: No Load Current of –single phase, Three phase, Magnetizing Volt-ampere, change of parameters with change of frequency, Temperature rise of transformers, transformer oil as a cooling medium, temperature rise in plain walled tanks, design of tank with tubes ,air blast cooling, forced oil circulation , thermal rating , heating time constant of transformers.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Induction motors: Relation between rating and dimensions of rotating Machines-symbols, Main dimensions, total loading, specific loading, output equation , factor affecting size of rotating machines, choice of specific magnetic loading, choice of specific electric loading , variation of output & losses with Linear dimensions, separation of D and L-d.c. Machines, Induction Motors, Synchronous Machines, standard Frames. Design of three phase Induction Motors-design output equation, choice of average flux density in air gap, choice of ampere conductors per meter, efficiency & power factor, main dimensions.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
D.C. Machine Windings: types of D.C. Windings, choice and design of simplex and duplex lap and wave Windings, equalizer connections, dummy coils, concept of multiplex Windings, reason for choosing them. **A.C. Machine Windings**: single and double layer, single phase ac Windings with integral and fraction slots, three phase Windings.		

Text Books:

1. A. K .Sawhney, Electric Machine Design Tenth Edition, Danpat Rai and sons.
2. A. E .Clayton, Performance and Design of DC Machine, Third Edition, ELBS, ISAAC Pitman Sons.
3. A. E. Clayton Performance and Design of AC Machine, Third Edition, ELBS, ISAAC Pitman Sons.

Reference Books:

1. N. Vinogradov, Electric Machine Winder, MIR Publication.
2. Say M. G. and E. O. Talyor, D.C. Electric Machine, ELBS, Pitman Sons.
3. R.Feinberg, PalgrareMacmillan, Modern Power Transformer Design Practices. First Edition,

Power Plant Engineering (Open Elective Course - II)					
COURSE OUTLINE					
Course Title:	**Power Plant Engineering**	**Short Title:**	**PPE**	**Course Code:**	
Course description:					
To understand the various components, operations, economics and applications of different types of power plants.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	03	**14**	**42**	**03**	
Prerequisite course(s):					
Physics					
Course objectives:					
At the end of the course, the student is expected to 1. To study basic components of thermal power plant. 2. To understand and analyse the basic cycle of power plant. 3. To understand operation of power plants using various fuel. 4. To study renewable energy based power plants. 5. To understand economics and environmental issues with power plant.					
Course outcomes:					
Upon completion of this course, the students are able to 1. Understand and justify Thermal Power Plant. 2. Classify Diesel, Gas and Combined cycle power plant. 3. Understand and justify Nuclear Power Plant. 4. Analyze various renewable energy sources and Energy generation. 5. Illustrate economic and environmental issues in power plant.					
COURSE CONTENT					
Power Plant Engineering		**Semester:**	**VI**		
Teaching Scheme:		**Examination Scheme**			
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**		**60 marks**	
		Duration of ESE:		**03 hours**	
		Internal Sessional Exams (ISE):		**40 marks**	
Unit I :	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction To Coal Based Thermal Power Plants Rankine cycle - Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.					
Unit II :	**No. of Lectures: 09 Hours**		**Marks: 12**		
Diesel, Gas Turbine And Combined Cycle Power Plants Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine					

power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

Unit III:	No. of Lectures: 08 Hours	Marks: 12

Nuclear Power Plants

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Power From Renewable Energy

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Energy, Economic And Environmental Issues Of Power Plants

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Text Books:

1. Nag. P. K., “Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

Reference Books:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 1984.
2. Black & Veatch, Springer, "Power Plant Engineering", 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

Linear Integrated Circuits and Applications (Open Elective Course - II)					
COURSE OUTLINE					
Course Title:	**Linear Integrated Circuits and Applications**	**Short Title:**	**LICA**	**Course Code:**	
Course description:					
Introduce the basic concepts of operational amplifier, linear & non-linear application of OP-AMP. Course includes basics and designing of various comparator and signal generators using OP-AMP, various data convertors, active filters, PLL and its use for communication applications. This course is designed to give a broad understanding of the operational amplifier, its application in various fields.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog and Digital Electronics.

Course objectives:

1. To understand characteristics of an Op-Amp and identify the internal structure.
2. To study various op- amp parameters and their significance for Op -Amp.
3. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
4. To analyze and identify linear and nonlinear applications of an Op-Amp.
5. To understand functionalities of PLL and its use in various applications in communication and control systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the characteristics of positive and negative feedback circuits.
2. Explain the difference between the frequency response of internally compensated and non-compensated op-amps and Analyze and identify linear and nonlinear applications of an Op-Amp.
3. Draw the frequency response of all active filters.
4. Understand the operations of basic comparators and converters.
5. Understand and apply the functionalities of PLL.

COURSE CONTENT

Linear Integrated Circuits and Applications		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Op-amp: Block diagram of general purpose operational amplifier, Analysis of Typical equivalent circuit. Op-amp with negative feedback: Block diagram representation of feedback configurations, voltage-series feedback amplifier, voltage-shunt feedback amplifier, differential amplifier.

Frequency response of an op-amp: Compensating network, frequency response of internally compensated op-amps, frequency response of internally non-compensated op-amps, high-frequency op-amp equivalent circuit, open-loop voltage gain as a function of frequency, closed loop frequency response, circuit stability.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

OP-AMP Applications

DC and AC Amplifier, AC amplifier with single supply voltage, peaking amplifier, summing, scaling and averaging amplifier, difference amplifier, subtractor, instrumentation amplifier, differential input and differential output amplifier, voltage-to-current converter with floating load, voltage-to-current converter with grounded load, current-to-voltage converter, integrator, differentiator.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Active filters

active filters, first-order low-pass Butterworth filter, second-order low-pass Butterworth filter, first-order high-pass Butterworth filter, second-order high-pass Butterworth filter, Band-pass filters: wide band-pass filter, narrow band-pass filter; Band-reject filters: wide band-reject filter, narrow band-reject filter; All-pass filter.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Comparators and converters

Basic comparators, zero crossing detector, Schmitt trigger, limitations of op-amp as a comparators, voltage limiters, voltage-to-frequency converter, frequency-to-voltage converter, analog-to-digital converter, digital-to-analog converter, sample-and-hold circuit.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Phase-locked loop

Operating principles, phase detector, low-pass filter, voltage-controlled oscillator; Monolithic Voltage-controlled oscillator (IC 566), Monolithic phase-locked loops, 565 PLL applications: frequency multiplier, frequency shift keying; Power amplifiers, monolithic power amplifiers: LM380 power audio amplifier,

Text Books:

1. Ramakant A. Gaikwad, "Op- Amp and Linear Integrated Circuits", PHI Learning Pvt. Ltd, Delhi, 2014.
2. David A. Bell, "Operational Amplifiers and Linear ICs", 3rd Edition, Oxford University Press, 2015.
3. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Pearson Education, 6th Edition, 2001.

Reference Books:

1. K. Botkar, "Integrated Circuits", Khanna Publishers, 10th Edition, 2010.
2. S. Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw Hill, 3 rd Edition, 2002.
3. J. Wait, L. Huelsman and G. Korn, "Introduction to Operational Amplifier Theory and Applications", McGraw Hill, 2nd Edition, 1991.

Digital Logic and State Machine Design (Open Elective Course - II)

COURSE OUTLINE

Course Title:	**Digital Logic and State Machine design**	**Short Title:**	**DLSMD**	**Course Code:**	

Course description:

This course provides knowledge of combinational, sequential logic and state machine design. This subject also provides introduction of NMOS and CMOS logic gates and programmable logic devices.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Basic Electrical & Electronics Engineering, Analog and Digital Electronics.

Course objectives:

1. To acquaint the students with the fundamental principles of combinational, sequential logic circuits.
2. This course provides the designing steps of state machine design.
3. This subject provides introduction of NMOS and CMOS logic gates and programmable logic devices.

Course outcomes:

After successful completion of this course the student will be able to:

1. Design of combinational and sequential circuits.
2. Design and implement of combinational and sequential logic design using MSI circuits
3. Design of state machine using Moore and Mealy types.
4. How to operate NMOS and PMOS transistors.
5. Understand the use of programmable logic devices like CPLD and FPGA in different applications.

COURSE CONTENT

Digital Logic and State Machine Design		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Combinational logic design: SOP and POS forms, Min term and Max term, Don't care condition, Simplification of logic functions-using Karnaugh Map (K- Map) for 2, 3 and 4 variables, Design circuits like half-adder, full-adder, half-subtractor, full-subtractor, BCD-to-7-segment decoder, encoder etc. Quine-McCluskey tabular method-four variables.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Combinational logic design using MSI circuits: Multiplexer, combinational logic design, multiplexer tree, demultiplexer, demultiplexer tree, adder with look-ahead carry, cascading of adders, subtraction using adder, BCD adder, BCD subtractor, Arithmetic logic unit, digital comparators, parity generators

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Sequential logic design: Registers, shift register, bi-directional shift register, ring counter, twisted ring counter, asynchronous counters, up/down counters, synchronous counters.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
State machine design: Moore and Mealy types, basic design steps, state diagram, state table, state assignment, choice of flip-flops and derivation of next-state and output expressions, timing diagram, design examples, Algorithmic State Machine, ASM chart.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Implementation technology: Transistor switches, NMOS logic gates, CMOS logic gates, CMOS inverter, introduction to programmable logic devices: PLA, PAL, CPLD and FPGA.		
Text Books:		
1. R. P. Jain, "Modern Digital Electronics" McGraw Hill Education (India) Private Limited, Fourth Edition, 2017. 2. Stephen Broown, Zvonko Vranesic, "Fundamental of Digital Logic with VHDL Design", McGraw Hill Publication, 3rd edition, 6th reprint, 2015. 3. A Kumar, Fundamentals' of Digital Circuits", Prentice Hall India, 3rdEdition. 4. Swati Saxena, Amit Saxena, "Introduction to Digital Design", Dhanpat Rai & Co.		
Reference Books:		
1. Thomas L. Floyd, "Digital Fundamentals", Pearson Prentice Hall, 8thEdition 2. Jr. Charles H. Roth, "Fundamentals of Logic Design", Thomson Brooks, 5thEdition 3. John F. Wakenly, Digital Design, Principles and Practics, Pearson Education , 4thEdition 4. A. Anand Kumar, Digital Electronics, PHI 5. R.Anand, Digital Electronics Khanna Publishing House		

Heat Transfer and Refrigeration (Open Elective Course - II)

COURSEOUTLINE

Course Title:	**Heat Transfer and Refrigeration**	**Short Title:**	**HV & R**	**Course Code:**	

Course description:

This course familiarizes undergraduate students with the terminologies associated with Heat Transfer, Refrigeration and Air-conditioning. The course will help students to understand phenomenon of convection and radiation heat transfer and build students ability to solve refrigeration problems and understand basic properties of refrigerants. The course also includes basic principles of psychometrics, applied psychometrics and study of different air conditioning system such air windows Air-conditioning and use of Psychometric chart to study the behavior of moist air at different conditions. Students will also familiarize with the SI and English Units commonly used in the field of heat transfer and refrigeration & air-conditioning

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	03	**14**	**42**	**03**

Prerequisite course (s): -

Applied Physics and Fundamentals of Thermodynamics

Course Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. To learn about different laws associated with convection and radiation heat transfer phenomenon.
3. To familiarize with the terminology associated with refrigeration systems and air Conditioning.
4. To understand basic refrigeration processes.
5. To understand the basics of psychrometry and practice of applied psychrometrics
6. To acquire the skills required to model and analyses different refrigeration as well as air conditioning processes and components.

Course Outcomes:

After successful completion of this course the student will be able to:

1. To formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
2. To analyze the phenomena of radiation heat transfer.
3. Understand the working principles of refrigeration systems.
4. They will be able to comprehend the phenomena of with application-based air conditioning system.
5. Understand the principle of Psychrometry.

COURSECONTENT

Heat Transfer and Refrigeration		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam(ESE):**	
Tutorials:	**--**	**Duration of ESE:**	**03 hours**

	Internal Sessional Exams (ISE):	**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**
Conduction: Introduction to heat transfer and its importance in engineering applications, Concepts and Mechanism of heat flow, Modes of heat transfer, Governing laws of heat transfer, Conduction mode: Thermal conductivity, Thermal diffusivity, heat transfer coefficient, radiation heat transfer coefficient, Thermal resistance and thermal conductance, Generalized one dimensional heat conduction equation and reduction to Fourier, Poisson and Laplace equations in wall, cylinder and sphere, Critical radius of insulation in cylinder and sphere.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Convection: Principle of heat convection: mechanism, natural and forced convection, Non-Dimensional Numbers in free and forced convection and their significance, Dimensional analysis for Natural and Forced Convection. Heat transfer coefficient, **External Flow:** Velocity Boundary layer and Thermal Boundary layer, Laminar and turbulent flow over a flat plate. **Radiation:** Thermal radiation: Concept, Black body radiation, Radiation laws: Planck's law, Kirchhoff's law, Wein displacement law, Lambert cosine law, Spectral and total emissive power, Stefan Boltzmann law, Emissivity, Irradiation and radiosity, Surface absorption, Reflection and transmission, emissivity. Radiation intensity, Radiation heat exchange between black bodies, Radiation shield.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction, standard rating of refrigerating machine, coefficient of performance of refrigerator and heatpump. Reversed Carnot cycle and its limitations, Need for aircraft refrigeration, Vapour compression refrigeration system: study of theoretical, use of p-h & T-scharts, Vapour absorption refrigeration: simple & modified vapour absorption, selection of refrigerant, chemical, physical and thermodynamic requirements of refrigerants, secondary refrigerant, Cascade refrigeration system. ODP and GWP.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Psychometric: Principle of Psychrometry, Properties of Moist air, Dalton's Law of Partial Pressure, Psychometric chart, Psychometric Process, Bypass factor, Sensible heat factor, Air washer, Adiabatic mixing of Two air stream, Study of various types of psychrometers.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Air-Conditioning System: Introduction, Factor Affecting Human Comfort, Components of Air-Conditioning system, Classification of Air-Conditioning, industrial and comfort air conditioning, Window and central air conditioning systems, Winter, Summer and Year-Round air conditioning systems. Effective temperature, Comfort Chart, room sensible heat factor, room sensible heat factor, Grand sensible heat factor, Effective room sensible heat factor.		
Text Books:		
1. R. K. Rajput, Heat and Mass Transfer", S. Chand & Company Ltd., New Delhi, 2007. 2. D. S. Kumar, "Heat and Mass Transfer" D. S. Kumar S. K. Kataria& Sons, Delhi, 2009. 3. P. K. Nag, "Heat Transfer" Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.		
Reference Books:		

1. J. P. Holman, “Heat Transfer”, Eighth Edition, McGraw Hill, 1997.
2. M. M. Rathore “Engineering Heat and Mass Transfer”, 2nd Edition, Laxmi Publications, New Delhi.
3. Yunus A Cengel, “Heat Transfer: A Practical Approach”, McGraw Hill, 2002
4. Arora S.C. &Domkundwar S., “A Course in Heat and Mass Transfer”, Dhanpat Rai & Sons, 4th Edition, 1994.
5. Arora C. P., "Refrigeration and air conditioning”, TMH, New Delhi, 3rd edition, 2012.
6. Khurmi Gupta, “Refrigeration and Air- Conditioning”, S Chand, New Delhi.
7. Monohar Prasad, "Refrigeration and air conditioning", New Age Publishers, New Delhi, 2nd edition, 2003.
8. Ananthnarayanan, "Basics of Refrigeration”, TMH, and New Delhi.
9. Arora and Domkundawar, “Refrigeration and air conditioning", Dhanpatrai and sons, New Delhi.
10. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982. New Delhi.

Control System Laboratory

LAB COURSE OUTLINE

Course Title:	**Control System Laboratory**	**Short Title:**	**CS lab**	**Course Code:**	

Course description:

The study of Control System Engineering is essential for the students of Electrical, Electronics, Mechanical, Aerospace & Chemical Engineering. It has applications ranges from Electrical Power System to process Control System. The course explores the knowledge of basic control systems, control system components, mathematical modeling, time response & frequency response analysis. The course also deals in concept of design & its preliminary consideration.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Mathematics, Basic Electrical & Electronics Engineering

Course objectives:

1. Able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.
2. To learn how to represent system by transfer function and block diagram reduction method and Mason's gain formula.
3. To learn time response analysis and demonstrate their knowledge to frequency response.
4. To learn stability analysis of system using Root locus, bode plot, polar plot and Nyquist plot.
5. To learn the design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain. Also able to learn state variable technique. Controllability and observability and their testing

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply the basic knowledge of science, mathematics and engineering for understanding the concept of open loop and closed-loop control systems and to find transfer function
2. Understand and identify the synchros characteristics and synchros as an error detector
3. Understand and identify the characteristic of two phase ac servomotors and identify its application for control system applications
4. Evaluate time domain response of second order system for step input by using software
5. Evaluate stability of system by bode diagram of an open loop transfer function by using software.

LAB COURSE CONTENT

Control System Laboratory		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments**:**

1. To determine speed-torque characteristics of an ac servomotor.
2. To study potentiometer as an error detector.
3. To study DC position control system
2. To determine time response of second order control system
3. To determine speed-torque characteristics of dc servomotor.
4. To study PID Controller.
5. To study synchro-transmitter and receiver and obtain output V/S input characteristics.
6. To Study Stepper Motor.s
7. To determine time domain response of a second order system for step input and obtains performance parameters by using software.
8. To convert transfer function of a system into state space form and vice-versa, byusing software.
9. To plot root locus diagram of an open loop transfer function and determine rangeof gain 'k' for stability by using software.
10. To plot a Bode diagram of an open loop transfer function by using software.
11. To draw a Nyquist plot of an open loop transfer functions and examine thestability of the closed loop system by using software

Note: Minimum **Eight** practicals are to be performed

Text Books:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India, 1990.
3. B.C. Kuo, Farid Golnaraghi, "Automatic Control System" Wiley India Ltd, 8th edition.
4. D. Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

Reference Books:

1. Norman S. Mise, Control System Engineering, Wiley Publishing Co.
2. Ajit K Mandal, "Introduction to Control Engineering" New Age International.
3. R. T. Stefani, B. Shahian, C. J. Savant and G.H. Hostetter, "Design of Feedback Control Systems" Oxford University Press, 2002.
4. Samarjit Ghosh, "Control Systems theory and Applications", Pearson Education
5. J. P. Navani, SonalSapra, "Control System", S. Chand Publishing.
6. Ambikapathy, "Control Systems", Khanna Book Publishing Co. (P) Ltd., Delhi

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Microprocessor and Microcontroller Laboratory

LAB COURSE OUTLINE

Course Title:	**Microprocessor and Microcontroller Lab.**	**Short Title:**	**MPMC lab.**	**Course Code:**	

Course description:

The practical course explores knowledge of microprocessor and microcontroller. The course comprises of architecture, assemble language programming and interfacing of peripherals and their applications.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Analog and Digital Electronics

Course objectives:

To meet the challenges of growing technology, student will be conversant with the programmable aspect of microprocessor and microcontroller. Programming is a process of problem solving and communication in language of mnemonics. The object of practical course is to understand microprocessor and microcontroller demand, concept and develop skill in two discipline hardware and programming.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Know the pin configuration and memory organization of a typical microprocessor and microcontroller.
2. Develop assemble language programming and interfacing peripherals for wide application in electrical engineering.
3. Develop assembly language source code for applications that use I/O ports, timer and single/multiple interrupts
4. Apply the knowledge of microprocessor and microcontroller in application of microprocessor and microcontroller based electrical protection system.
5. Do higher study in the field of automation, operation and control of power system by microprocessor and microcontroller.

LAB COURSE CONTENT

Microprocessor and Microcontroller Lab.		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments:

1. Study of architecture and instructions of 8085 along with opcodes.
2. Study of architecture and instructions of 8051.

3. 8255 interfacing
4. Memory interfacing
5. Microprocessor 8085 assembly language programs based on data transfer instruction
6. Microprocessor 8085 assembly language programs based on arithmetic instruction
7. Microprocessor 8085 assembly language programs based on logical instruction
8. Applications of microprocessor 8085 in measurement of electrical quantity.
9. Applications of microprocessor 8085 in Electrical drives and speed control for stepper motor.
10. Microcontroller 8051 assembly language programs based on data transfer instruction.
11. Microcontroller 8051 assembly language programs based on arithmetic and logical instructions.
12. Generation of delay using Timers of 8051 in mode 0, 1 and 2.

NOTE: The term work should include a **minimum eight** experiments on hardware kits and simulation.

Text Books:

1. R. S. Gaonkar. "Microprocessor Architecture, Programming, & Applications with 8085", Penram International Publication (India) Pvt. Ltd., Third edition, 6th Edition, 2013.
2. B. Ram, "Fundamentals of Microprocessors & Microcontrollers" Dhanpat Rai Publication, 2014.

Reference Books:

1. N. Senthil Kumar, M. Saravanan, S. Jeevananathan, "Microprocessors & Microcontrollers" Oxford University Press, 2nd Edition, 2016.
2. Leventhal, "8085 Assembly Languages Programming" Tata McGraw Hill.
3. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Second Edition.
4. Kenneth J. Ayala "The 8051 Micro Controller: Architecture, Programming", Penram International, Mumbai.
5. K. M. Burchandi, "Advanced Microprocessors and Peripherals", TMH, 3rd edition.
6. A. K. Gautam, "Advanced Microprocessors", Khanna Publishing House

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Power System-II Laboratory

LAB COURSE OUTLINE

Course Title:	**Power System-II Laboratory**	**Short Title:**	**PS-II lab**	**Course Code:**	

Course description:

Power System explores the knowledge of symmetrical and unsymmetrical fault analysis. The subject emphasis on representation of power system components and load flow analysis.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern: ----

Prerequisite course(s):

Power System-I, Electrical Machines. Electrical Circuit Analysis

Course objectives:

The objective of the laboratory is to impart the fundamental knowledge of reactances of synchronous machines, short circuit analysis for LLL faults. The objective of the laboratory is also to impart the fundamental knowledge of analysis of unsymmetrical faults such as LG, LL and LLG and determination of power flow for a given system. Students will able to develop their ability to apply the specific procedures for analyze the experimental results. In this lab course, students will be familiar with the use of different equipments, safety precautions on work place. This makes bridge on theoretical knowledge and practical practices.

Course outcomes:

After successful completion of lab Course, student will be able to:

1. Evaluate reactance of synchronous machine on no load and loaded condition.
2. Analyze the effects of symmetrical fault on power system.
3. Analyze the effects of unsymmetrical faults on power system.
4. Compute the Y-bus matrix for a given system.
5. Determine the power flow for a given system

LAB COURSE CONTENT

Power System-II		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**----**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments:

1. Static measurement of sub-transient reactance of a salient-pole alternator.
2. Measurement of negative sequence reactance of a synchronous machine.
3. Measurement of zero sequence reactance of a synchronous machine.
4. To perform short circuit analysis for LLL fault.
5. Determination of steady state power limit of a transmission line.

6. Unsymmetrical fault analysis for LG, fault on A.C / D.C network analyzer
7. Unsymmetrical fault analysis for LL fault on A.C / D.C network analyzer
8. Unsymmetrical fault analysis for LLG fault on A.C / D.C network analyzer
9. Formulation and calculation of Y- bus matrix of a system using software.
10. Computer aided solution of power flow problem by Gauss Seidal method.
11. Computer aided solution of power flow problem by Newton-Raphson method.
12. Visit to HV/EHV substation or power generating substation.

Note: Lab file should consist of minimum Eight experiments.

Text Books:

1. D.P. Kothari, I. J. Nagrath, "Modern Power System Analysis" 4th edition, Tata McGraw Hill.
2. C.L. Wadhwa, "Electrical Power System", New Age International limited publishers, 2017.

Reference Books:

1. W.D. Stevenson, Jr. "Elements of Power System Analysis", Mc Graw Hill, 4th edition, 1985.
2. Stagg, El-Abiad, "Computer Methods in Power System Analysis" TMH.
3. Hadi Saadat; "Power System Analysis", Tata McGraw Hill, 2nd edition, 2009.
4. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
5. Chakraborthy, Soni, Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai & Co.limited 2008.
6. T.K Nagsarkar, M.S. Sukhija, "Power System Analysis" Oxford University Press, 2007.
7. S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control", Pearson, 2009.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Minor Project					
LAB COURSE OUTLINE					
Course Title:	**Minor Project**	**Short Title:**	**MPROJ**	**Course Code:**	

Course description:

Minor project represent the culmination of study towards the Bachelor of Engineering degree. The minor project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	06	14	84	03

End Semester Exam (ESE) Pattern:	Oral (OR)

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply knowledge of mathematics, science, and engineering to solve engineering problem by demonstration of prototype project.
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.
3. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues with greater sense of management.
4. Use resources, techniques, skills, modern engineering tools and software necessary for engineering practice.
5. Recognition of the need for, and an ability to engage in life-long and self learning.

LAB COURSE CONTENT

Minor Project		Semester:	VI
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**End Semester Exam (ESE): (OR)**	**25 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

In continuation with Minor Project (Stage – I) at Semester – V, by the end of Semester – VI, the student should complete implementation of ideas as formulated in Minor Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic,

environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VI in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project in Semester – VI shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				**Assessment by Departmental Committee**			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Internship

Internship is a mandatory and non-credit course. It is mandatory for all admitted students to undergo Internship during the degree course. The course shall be of THREE weeks durationduring summer vacation after Semester - VI. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Students shall choose to undergo Internship / Innovation / Entrepreneurship related activities for Internship. Students shall choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small / Medium enterprises / academic institutions / research institutions. In case student want to pursue their family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the Department Head / TPO.

During the last year of FOUR year Bachelor of Engineering course the student should take project work, as specified in the curriculum, based on the knowledge acquired by the student during the degree course and during Internship. The project work provides an opportunity to build a system based on area where the student likes to acquire specialized skills. The work may also be on specified task or project assigned to the student during Internship.

The internship activities and list of sub-activities for Internship are as under.

- Innovation / Entrepreneurship:
    - Participation in innovation related Competitions for eg. Hackathons Robocon, Baha, IIT TechFest, Chemcon, Dipexetc
    - Development of new product/ Business Plan/ registration of start-up
    - Participation in Entrepreneurship Program of THREE weeks duration
    - Online certification courses by SWAYAM, NPTEL, QEEE etc.
    - Working for consultancy/ research project within the institutes
    - Training on Software (As per the need of respective branch);
    - Field Survey / Case Study
    - Work experience at family business
- Internship:
    - Internship with Industry/Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ academic institutions / research institutions
    - Online Internship
- Rural Internship

- Any Long Term Goals may be carried out by students in teams:
  - Prepare and implement plan to create local job opportunities.
  - Prepare and implement plan to improve education quality in village.
  - Prepare an actionable DPR for doubling the village Income.
  - Developing Sustainable Water Management system.
  - Prepare and improve a plan to improve health parameters of villagers.
  - Developing and implementing of Low Cost Sanitation facilities.
  - Prepare and implement plan to promote Local Tourism through Innovative Approaches.
  - Implement/Develop Technology solutions which will improve quality of life.
  - Prepare and implement solution for energy conservation.
  - Prepare and implement plan to Skill village youth and provide employment.
  - Develop localized techniques for Reduction in construction Cost.
  - Prepare and implement plan of sustainable growth of village.
  - Setting of Information imparting club for women leading to contribution in social and economic issues.
  - Developing and managing efficient garbage disposable system.
  - Contribution to any national level initiative of Government of India. For eg. Digital India/ Skill India/ Swachh Bharat Internship etc.

Faculty Mentor/Supervisors have to play active roles during the internship and minimum 20 students are to be supervised by each faculty mentor or as per the departmental strength. Mentor shall be responsible for selection of Internship activities by the student under his/her supervision and shall avoid repetition of activities by the student. The college / Institute shall facilitate internship for the students.

Every student is required to prepare a file for Internship containing documentary proofs (daily training diary, comprehensive report and completion certificate) of the activities done by him/her. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should include Date, Time of Arrival, Time of Departure, Main points of the day. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working.

After completion of Internship, the student should prepare a comprehensive report to indicate what he / she has observed and learnt in the training period. The report should include Internship Objectives (in measurable terms), Internship Activities, and Internship Outcome.

The completion certificate should be signed by the supervisor/ in charge of the section where the student has been working with performance remark as Satisfactory / Good / Excellent.

The evaluation of Internship shall be in Semester – VII. The evaluation shall be done by expert committee constituted by the concerned department including Department Head/ TPO/ faculty mentor or guide. It should be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.

- Adequacy & quality of information recorded.
- Originality.
- Adequacy and purposeful write-up.
- Practical applications, relationships with basic theory and concepts taught in the course.
- Skill / knowledge acquired

Hence the satisfactory completion of Internship shall be submitted to the university at the end of Semester - VIII of FOUR year Bachelor of Engineering course. Only after successfully completion of Internship, Internship should be printed in the final year mark sheet as COMPLETED.