SCHOOL OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING

GALGOTIAS UNIVERSITY

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COURSE BOOK

School of Electrical, Electronics and Communication Engineering **-2019**

Volume-I

Curriculum and syllabus for School of Electrical, Electronics and Communication

GALGOTIAS UNIVERSITY
(Under the Uttar Pradesh Private Universities Act No. 12 of 2019)

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GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B. Tech Electronics and communication engineering

Scheme: 2019-2020

Curriculum

Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA101	Mathematics-I (Multivariable Calculus)	3	1	0	3	20	50	100
2	BMA151	Exploration with CAS-I	0	0	2	1	50	-	50
3	BHS101	Professional Communication	2	0	0	2	50	-	50
4	BCS101	Fundamentals of Computer Programming	3	0	0	3	20	50	100
5	BCS151	Fundamentals of Computer Programming Lab - 1	0	0	2	1	50	-	50
6	BPH101	Engineering Physics	3	0	0	3	20	50	100
7	BPH151	Engineering Physics Lab	0	0	2	1			
8	BME101	Elements of Mechanical Engineering	3	0	0	3	20	50	100
9	BME151	Workshop Practice	0	0	4	2	50	-	50
		Total	14	1	10	19			
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA201	Mathematics-I (Matrices and Differential Equations)	3	1	0	3	20	50	100
2	BMA251	Exploration with CAS-II	0	0	2	1	50	-	50
3	BHS251	Professional Communication Lab	0	0	2	1	50	-	50
4	BCS251	Fundamentals of Computer Programming Lab - 2	0	0	2	1	50	-	50
5	BOC251	Engineering Clinic-1	0	0	2	1	50	-	50
6	BLE101	Psychology and Sociology	2	0	0	2	20	50	100
7	BCH101	Engineering Chemistry	3	0	0	3	20	50	100
8	BCH151	Engineering Chemistry Lab	0	0	2	1			
9	BEC101	Basic Electrical and Electronics Engineering	3	0	0	3	20	50	100
10	BEC151	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50	-	50
		Total	11	1	12	19			
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MATH2001	Functions of Complex Variables and Transforms	3	0	0	3	20	50	100
2	BECE2010	Digital Electronics	3	0	0	3	20	50	100
3	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	50	100
4	BECE2015	Electronics Devices and Circuits	3	0	0	3	20	50	100
5	BTEE2002	Network Analysis and Synthesis	3	0	0	3	20	50	100
6	BEE01T2001	Sensors and Transducers	3	0	0	1	20	50	100
7	BEE01T2002	Design and Engineering	2	0	0	2	20	50	100

8	ENVS1004	ENERGY AND ENVIRONMENTAL SCIENCE	2	0	0	0	50	-	50
9	BECE2011	Digital Electronics Lab	0	0	2	1	50	-	50
10	SLBT2021	English Proficiency and Aptitude Building - 3	0	0	4	2	50	-	50
11	BEE01P2003	Engineering Clinic-I	0	0	2	2	50	-	50
12	BEE01P2004	IoT Lab	2	0	0	2	20	50	100
		Total	22	0	8	25			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA402	Probability and Stochastic Processes	3	0	0	3	20	50	100
2	BEC407	Integrated Circuits	3	0	0	3	20	50	100
3	BEC408	Electromagnetic Field Theory	3	0	0	3	20	50	100
4	BEC409	Analog and Digital Communication	3	0	0	3	20	50	100
5	BEC410	Computer Architecture and Organization	3	0	0	3	20	50	100
6	BEC411	Microprocessors and Micro-Controllers	3	0	0	3	20	50	100
7	BOC451	Engineering Clinic-4	0	0	2	1	50	-	50
8	BEC455	Integrated Circuits Lab	0	0	2	1	50	-	50
9	BLL452	Logical and Critical Reasoning	0	0	2	1	50	-	50
10	BEC456	Microprocessor and Micro Controller Lab	0	0	2	1	50	-	50
		Total	18	0	8	22			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEC501	Control Systems	3	0	0	3	20	50	100
2	BEC502	EM Waves	3	0	0	3	20	50	100
3	BEC503	Object Oriented Programming and Data Structures	3	0	0	3	20	50	100
4	BEC504	Digital Signal Processing	3	0	0	3	20	50	100
5		Program Elective-I	3	0	0	3	20	50	100
6	BSB501	Engineering Economics and Management	3	0	0	3	20	50	100
7	BOC551	Engineering Clinic-5	0	0	2	1	50	-	50
8	BLL551	Effective Leadership and Decision Making Skills	0	0	2	1	50	-	50
9	BEC551	Digital Signal Processing Lab	0	0	2	1	50	-	50
10	BEC552	Communication Engineering Lab	0	0	2	1	50	-	50
11	BEC553	Industrial Internship	0	0	0	1	50	-	50
		Total	18	0	8	23			

Semester VI

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BLL601	Campus to Corporate program	3	0	0	3	50	-	50
2	BEC602	Computer Networks	3	0	0	3	20	50	100
3	BEC603	VLSI Design	3	0	0	3	20	50	100

4	BHS601	Professional Ethics and Human Values	2	0	0	2	20	50	100
5		Program Elective-II	3	0	0	3	20	50	100
6		Program Elective-III	3	0	0	3	20	50	100
7		Open Elective -1	3	0	0	3	20	50	100
8	BEC654	Computer Network Lab	0	0	2	1	50	-	50
9	BEC655	Design and Innovation Project	0	0	2	1	50	-	50
10	BLE601/ BLE602/ BLE603	Foreign Language - 1 (German, Japanese, French) *Optional	0	0	2	0	50	-	50
		Total	20	0	6	22			

Semester VII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEC701	Embedded Systems	3	0	0	3	20	50	100
2		Program Elective-IV	3	0	0	3	20	50	100
3		Program Elective-V	3	0	0	3	20	50	100
4		Open Elective-2	3	0	0	3	20	50	100
5	BEC702	Advance Communication Systems	3	0	0	3	20	50	100
6	BEC751	VLSI and Embedded Systems Lab	0	0	2	1	50	-	50
7	BEC752	Industrial Internship	0	0	0	1	50	-	50
8	BEC753	Technical Seminar	0	0	2	1	50	-	50
9	BEC754	Capstone Design - I	0	0	10	5	50	-	50
10	BLE701 / BLE702 / BLE 703	Foreign Language - 2 (German, Japanese, French) *Optional	0	0	2	0	50	-	50
		Total	15	0	16	23			

Semester VIII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEC801	Capstone Design - II	0	0	18	9	50	-	50
		Total	0	0	18	9			

List of Electives

Basket-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC501	Automation and Robotics	3	0	0	3	20	50	100
2	EEC502	Satellite Communication	3	0	0	3	20	50	100
3	EEC503	MEMS	3	0	0	3	20	50	100
5	EEC504	Digital System Design using VHDL	3	0	0	3	20	50	100

Basket-2

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC505	Principles of Secure Communication	3	0	0	3	20	50	100
2	EEC506	Neural Networks and Fuzzy Control	3	0	0	3	20	50	100

3	EEC507	Wireless Sensor Networks	3	0	0	3	20	50	100
4	EEC508	Nano Science and Technology	3	0	0	3	20	50	100
5	EEC509	Mobile Ad Hoc Networks	3	0	0	3	20	50	100

Basket-3

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC510	Digital Image Processing	3	0	0	3	20	50	100
2	EEC511	Information Theory and Coding	3	0	0	3	20	50	100
3	EEC512	Modern Digital Signal Processing	3	0	0	3	20	50	100
4	EEC513	ASIC Design and FPGA	3	0	0	3	20	50	100

Basket-4

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC514	Soft Computing	3	0	0	3	20	50	100
2	EEC515	Mobile Computing	3	0	0	3	20	50	100
3	EEC516	Microwave Engineering	3	0	0	3	20	50	100
4	EEC517	Biomedical engineering	3	0	0	3	20	50	100
5	EEC518	Radar Guidance and Navigation	3	0	0	3	20	50	100

Basket-5

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC520	Introduction to IoT and its Applications	3	0	0	3	20	50	100
2	EEC521	Optical Communication	3	0	0	3	20	50	100
3	EEC522	Mixed Signal Circuit Design	3	0	0	3	20	50	100
4	EEC523	Audio Visual Engineering	3	0	0	3	20	50	100
5	EEC524	PLC/SCADA	3	0	0	3	20	50	100

List of Open elective (Engineering courses) Proposed									
Basket 1									
Sl.No.	CourseCode	CourseTitle					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BOE601	Human Computer Interface	3	0	0	3	20	50	100
2	BOE602	Introduction to cyber Physical Systems	3	0	0	3	20	50	100
3	BOE603	Selected Topics in Signal Processing	3	0	0	3	20	50	100
4	BOE604	Selected Topics in Communication Engineering	3	0	0	3	20	50	100
5	BOE605	Autonomous Vehicles	3	0	0	3	20	50	100
6	BOE606	Data Science	3	0	0	3	20	50	100
7	BOE607	Computer Vision	3	0	0	3	20	50	100
8	BOE608	Artificial Intelligence	3	0	0	3	20	50	100
9	BOE609	Cyber Security	3	0	0	3	20	50	100

10	BOE610	Energy Management	3	0	0	3	20	50	100
11	BOE611	Estimation and Costing	3	0	0	3	20	50	100
12	BOE612	Data Envelopment Analysis	3	0	0	3	20	50	100
13	BOE613	Operation Management	3	0	0	3	20	50	100
14	BOE614	Construction Engineering	3	0	0	3	20	50	100
16	BOE615	Disaster Management	3	0	0	3	20	50	100
16	BOE616	Bioinformatics	3	0	0	3	20	50	100
Basket-2									
1	BOE701	Remote Sensing and GIS	3	0	0	3	20	50	100
2	BOE702	Automotive Electronics	3	0	0	3	20	50	100
3	BOE703	Sensors & Actuators	3	0	0	3	20	50	100
4	BOE704	IoT and Smart Cities	3	0	0	3	20	50	100
5	BOE705	Web Design and Management	3	0	0	3	20	50	100
6	BOE706	Principles of Telemedicine	3	0	0	3	20	50	100
7	BOE707	Mobile Application Development	3	0	0	3	20	50	100
8	BOE708	Business Analytics	3	0	0	3	20	50	100
9	BOE709	Cloud Computing	3	0	0	3	20	50	100
10	BOE710	Block Chain	3	0	0	3	20	50	100
11	BOE711	Augmented / Virtual Reality	3	0	0	3	20	50	100
12	BOE712	Digital Forensics	3	0	0	3	20	50	100
13	BOE713	Operations Research	3	0	0	3	20	50	100
14	BOE714	Renewable Energy	3	0	0	3	20	50	100
15	BOE715	Interior Design	3	0	0	3	20	50	100
16	BOE716	Landscaping	3	0	0	3	20	50	100
17	BOE717	Biology for Engineers	3	0	0	3	20	50	100

Name of The Course	**Basic Electrical and Electronics Engineering**				
Course Code	**BEC101**				
Prerequisite	**Physics,Modern Physics**				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

Course Outcomes

CO1	**Apply fundamental laws to analyze DC Circuits.**
CO2	**Outline the AC source and analyze the steady staeresponse of RL, RC and RLC phasors.**
CO3	**Summerize the Digital Number Systemand Boolean Algebra with small combinational circuit design.**
CO4	**Illustrate the operation and charecteristics of PN Junction Diode, BJT with application**
CO5	**Demonstrate the commonly used Sensors and Transducers and their applications**

Text Books

1. D.P. Kothari and I.J. Nagrath , “Basic Electrical Engineering”, Tata McGraw-Hill
2. V.Mittle, ArvindMittle, “Basic Electrical Engineering”, McGraw Hill
3. Robert L.Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory
4. A.P.Malvino, Donald Leach, “Digital Principles and Applications”, Tata McGraw- Hill
5. D.Patranabi, “Sensors and Transducers”, PHI

Reference Books

1. D.C.Kulshreshtha,”Basic Electrical Engineering”, Tata McGraw Hill
2. J. Edminister and M. Nahvi , “Electric Circuits”, 3rd Edition, Tata McGraw-Hill
3. Jacob Millman, Christos C.Halkias, SatyabrataJit, “Electronics Devices and Circuits”, Tata McGraw Hill
4. Morris Mano, “Digital Computer Design”, PHI

Course Content:

Unit I: Analysis of DC Circuit 8 Hours
Ohm’s law, Series and Parallel Circuits, Current and Voltage division, Kirchoff’s Law (KCL&KVL), Star-Delta Transformation, Nodal Analysis.
Unit II: Analysis of AC Circuits 8 Hours
Alternating signals, Derivation of Root Mean Square (RMS) value, Average value, Peak or crest factor, Form factor

Phasor representation of Pure Resistive, Pure Inductive, Pure Capacitive, R-L Series, R-C Series and R-L-C Series Circuits. Concept of lagging and leading power factor. Inductive and Capacitive reactance, CalculationofAC power.
Unit III: Digital Systems 9 Hours
Number System : Decimal form, Binary form, Octal form, Hexadecimal form and their interconversions **Logic Gates : Basic logic gates and Universal gates. Realization of basic gates using Universal gates.** **Combinational logic circuitsdesign :Boolean algebra, De-Morgan's law, SOP and POS form, Minimisationof logic circuits using Karnaugh Map. Design of Half adder and Full adder**
Unit IV: Semiconductor Devices 8 Hours
Semiconductor: Intrinsic & Extrinsic Semiconductors, PN Junction Diode – V-I Charecteristics of normal and ideal diode. Zener diode and its application as Voltage regulator, Avalanche and Zener breakdown **Diode Applications:Half Wave& Full Wave rectifiers, Filters** **Bipolar Junction Transistor (BJT): Construction and working of BJT. Characteristics and uses of Common Emitter (CE) Configurations**
Unit V: Transducers and Sensors 4 Hours
Sensors and Transducers Definitions, Crieteria to choose a sensor, Basic requirements of a Sensor and Transducer, Classification of Sensors, Commonly used Sensors and Transducers, Analogue and Digital Sensors

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Semester III

Name of The Course	Electronic Devices and Circuits				
Course Code	BECE2015				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

Course Outcomes

CO1	Realize the transistor biasing methods and Design analog electronic circuits using discrete components
CO2	Design common amplifier circuits and analyze the amplitude and frequency responses
CO3	Design various analog circuits to analyze their responses

CO4	Understand the principle of operation of different Oscillator circuits.
CO5	Understand the principle of operation of various amplifier circuits
CO6	Understand the recent trends and practical applicationsof electronic devices

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit-1 Introduction 8 hours
BJT and BJT Biasing .Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, Cascode amplifier. HF & LF compensation of RC coupled amplifier. Multistage Amplifiers.
Unit-2FET and FET Biasing8 hours
FET and FET Biasing. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. Small signal analysis of FET Amplifiers. High Frequency analysis of FET Amplifiers, VMOS & CMOS Concepts.
Unit-3Feedback amplifiers 8 hours
The feedback concept – Transfer gain with feedback – general characteristics and advantages of negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions
Unit-4Oscillators 8 hours
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators.
Unit-5Tuned amplifiers 8 hours
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization. Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.
Unit-6 Recent trends and Application 8 hours
Trend of Energy Saving in Electronic Devices, Application of oscillators- springs and damping, shock absorber in cars, Pendulum

Suggested Reading

1. 1.Jacob. Millman, Christos C.Halkias, ‘Electronic Devices and Circuits’, Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634556, 9780070634558.
2. Jacob Millman and C. Halkias, ‘Integrated Electronics – Analog and Digital Circuits and Systems’, Tata Mc Graw Hill, 2001, ISBN 0074622455, 9780074622452
3. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10th EditionPrentice Hall, 2009, ISBN 0135026490, 9780135026496

Name of The Course	Network Analysis and Synthesis				
Course Code	BTEE2002				
Prerequisite	Basic Electrical and Electronics Engineering				
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

1. To learn the concepts of network analysis in electrical and electronics engineering.
2. To learn linear circuit analysis, graph theory and network theorems.
3. Analyze two port networks using Z, Y, ABCD and h parameters.

Course Outcomes

CO1	Apply the knowledge of graph theory with basic circuital laws and simplify the network using reduction techniques
CO2	Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO3	Infer and evaluate transient response, Steady state response, network functions
CO4	Evaluate two-port network parameters and explain the inter-relationship among parameters for network analysis.
CO5	Synthesize one port network using Foster and Cauer Forms and
CO6	Examine active filter configurations for possible applications in network theory.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit-1GraphTheory 6 hours
Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set,Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.
Unit-2Network Theorems (Applications to ac networks) 9 hours
Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman'stheorem, compensation theorem, Tellegen's theorem.
Unit-3Network Functions and Transient analysis 11 hours
Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.
Unit-4Two Port Networks 10 hours
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & II Representation.
Unit-5Network Synthesis & Filters 9 hours

Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance,
Unit-6 Filters
Passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Suggested Reading

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.A.Chakrabarti, "Circuit Theory" DhanpatRai& Co

Name of The Course	Sensors and Transducers			
Course Code	BEE01T2001			
Prerequisite				
Co-requisite				
Anti-requisite				
L	T	P	C	
3	0	0	3	

Course Objectives

1. To make students familiar with the constructions and working principle of different types of sensors and transducers.
2. To gain an in-depth understanding of the operation of microcontrollers, machine language programming & interfacing techniques with peripheral devices
3. To gain an understanding of applications of microcontroller in designing processor-based automated electronics system.

Course Outcomes

CO1	Apply network theorems for the analysis of electrical circuits
CO2	Obtain the transient response of electrical circuits
CO3	Obtain the steady-state response of electrical circuits
CO4	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
CO5	Analyze two port circuit behavior.
CO6	Analyze the sensors used in IoT applications

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

UNIT-I: TRANSDUCERS 8-HOURS

Introduction to transducer, classification and characteristics of transducers, Resistive Transducers: principle of resistive strain gauge, signal conditioning circuit, Displacement Transducers: L.V.D.T, applications. Temperature Transducers: resistance temperature detectors (RTD), thermocouple. pressure transducers: diaphragm pressure transducer.
UNIT-II: SENSORS 8-HOURS
Introduction to sensors , classification, difference between transducer and sensors, Radiation Sensors: LDR, photodiodes - construction and response. Capacitive Sensor : stretched diaphragm type – microphone - construction and characteristics, ultrasonic sensor, optical sensor, magnetic sensor, sensor interface: signal processing ,introduction to smart sensor .
UNIT-III: MICROCONTROLLER 8-HOURS
Introduction to single chip microcontrollers, 8051-architecture –instruction sets , addressing modes, memory organizations, assembly language programming, programming interrupts, timers and serial communication .
UNIT-IV: IOT & EMBEDDED SYSTEM 8-HOURS
Introduction to IoT, physical design of IoT, logical design of IoT- functional blocks of IoT, challenges in IoT. introduction to embedded system ,difference between CISC and RISC Architecture, embedded system design methodologies, embedded controller design for communication, digital control.
UNIT-V: INTERFACING 8-HOURS
Sensors interfacing with embedded controller, ADC, DAC ,LCD, weather monitoring system, water monitoring system, line follower robot ,distance sensor interface .
UNIT-VI Sensor used in industry for IoT Application Development 6 hrs
Temperature Sensor,Proximity sensos, Water Quality sensors, Gas Sensors, Smoke sensors, IR sensors, Motion Detection sensors

Suggested Reading

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation' Dhanpat Rai and Co 2004.
2. D.V.S.Murty ,Transducers and instrumentations , 2nd edition, Prentice Hall of India,2012.
3. Mohammad Ali Mazidi and Janice Gillispie Maszidi "The 8051 Microcontroller and Embedded Systems" Pearson education, 2003, ISBN- 9788131710265, 2ndEdition
4. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
5. Microcontrollers: Architecture, Programming, Interfacing and System Design" ,Raj Kamal, "Pearson Education, 2005.
6. "The 8051 Microcontroller Architecture, Programming & Applications", 2e Kenneth .Ayala ;, Penram International, 1996 / Thomson Learning 2005.

Name of The Course	Design and Engineering
Course Code	BEE01T2002
Prerequisite	

Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To excite the student on creative design and its significance;

2. To make the student aware of the processes involved in design;

3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;

4. To get an exposure as to how to engineer a design.

Course Outcomes

CO1	**Realize the different elements involved in good engineering designs and apply them in practice when called for.**
CO2	**Explain the product oriented and user oriented aspects that make the design a success.**
CO3	**Implement innovative designs incorporating different segments of knowledge gained.**
CO4	**Analyse the existing resources and select the apt resources and modern design tools.**
CO5	**Illustrate the perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.**
CO6	**Explain the Engineering Design created proficiently to the society.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit-1 Introduction 8 hours
Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength;
Unit-2Design process 8 hours
Design process- Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design.
Unit-3Prototyping8 hours
Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the Design – from prototype to product; Planning, Scheduling, Supply chains, Inventory, handling, manufacturing/ construction operations; storage, packaging, shipping, marketing, feedback on design.
Unit-4 Design Attributes 8 hours
Product Centered and User Centered design, Product centered attributes and user centered attributes; Value engineering, concurrent engineering and reverse engineering in design; Culture based Design.
Unit-5 Modular Design 8 hours
Modular Design, design optimization, Intelligent and autonomous products, User interfaces, communication between products; autonomous products, internet of things; human psychology and the advanced products. IPR, product liability.
Unit–6 Technology Trends in Engineering Design 8 Hours
Introduction: Digital Twins, Artificial Intelligence, Robotics, 3D Printing, Generative Design

Suggested Reading

1. Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN-13: 978-0124158917 ISBN-10: 0124158919
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction- Wiley, ISBN-978-1-118-32458-5
3. Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, ISBN 978-94-011-3985-4 Springer

Name of The Course	Digital Electronics			
Course Code	BECE2010			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
2. To familiarize with the design of various combinational digital circuits using logic gates
3. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
4. To explain the various semiconductor memories and related technology
5. To introduce the electronic circuits involved in the making of logic gates

Course Outcomes

CO1	Design and analyze combinational logic circuits
CO2	Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
CO3	Understand Logic Families and Design memories
CO4	Design & analyze synchronous sequential logic circuits
CO5	Use HDL & appropriate EDA tools for digital logic design and simulation
CO6	Design application specific simple digital circuits.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit-1 Introduction 8 hours
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Unit-2MSI devices 8 hours
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.
Unit-3Sequential Logic Design 8 hours
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.
Unit-4Logic Families and Semiconductor Memories 8 hours
Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.
Unit-5 VLSI Design flow 8 hours
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.
Unit 6
Design and Implementation of Application specific digital circuits. Introduction of Microprocessors.

Suggested Reading

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.

2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition ,2006.
4. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

Name of The Course	Electromagnetic Field Theory			
Course Code	BECE2012			
Prerequisite	Physics			
Corequisite	Physics			
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials

- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcomes

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.
CO6	Understand the applications of Electromagnetism in Daily Life.

Unit-1 Coordinate Systems and Transformation 8 hours
Coordinate Systems and Transformation : Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.
Unit-2 Electrostatic fields 8 hours
Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law- Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.
Unit-3Magneto statics 8 hours
Magneto statics : Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.
Unit-4Magnetic forces 8 hours
Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.
Unit-5Time-varying Fields8 hours
Time-varying Fields: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form, Power and the pointing vector. Basics of Transmission lines.
Unit-6 Applications of Electromagnetism 6 hrs
Household Application, Industrial Application, Magnetic Levitation Trains, Communication System, medical Systems

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
4. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999

Name of The Course	Digital Electronics Lab				
Course Code	BECE2011				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	0	0	2	1	

Course Objectives

Students will learn and understand the Basics of digital electronics and able to design basic logic circuits, combinational and sequential circuits.

Course Outcomes

CO1	Understanding of Digital Binary System and implementation of Gates
CO2	Design the Sequential circuits with the help of combinational circuits and feedback element
CO3	Design data selector circuits with the help of universal Gates
CO4	Design the flip –flop and counters.
CO5	Design the counters with the help of sequential circuit and basic Gates.
CO6	Implement the projects using the digital ICs and electronics components

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.

2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.

3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.

4. Implementation and verification of Decoder using logic gates.

5. Implementation and verification of Encoder using logic gates.

6. Implementation of 4:1 multiplexer using logic gates.

7. Implementation of 1:4 demultiplexer using logic gates.

8. Implementation of 4-bit parallel adder using 7483 IC.

9. Design, and verify the 4-bit synchronous counter.

10. Design, and verify the 4-bit asynchronous counter.

11. Implementation of Mini Project using digital integrated circuits and other components.

Name of The Course	Engineering Clinic-I				
Course Code	BEE01P2003				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	0	0	4	2	

Course Objectives

1. To study basic electronic components
2. To observe characteristics of electronic devices

Course Outcomes

CO1	Plot the characteristics of semiconductor diodes and transistors to understand their behaviour.
CO2	Design, construct and test amplifier circuits and interpret the results
CO3	Operate electronic test equipment and hardware tools to characterize the behaviour of devices and circuits
CO4	Operate electronic test equipment and software tools to characterize the behaviour of devices and circuits
CO5	Design and test the Diode clippers, clampers and rectifiers.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Study of Instruments and components

2. V-I Characteristics of Si and Ge Diodes

3. Zener Diode Characteristics and Zener Diode as Voltage Regulator

4. Clippers and clampers

5. Half Wave and Full Wave Rectifiers

6. BJT Characteristics

7. FET Characteristics

8. BJT Biasing

9. FET Biasing

10. BJT as an Amplifier

11. UJT characteristics

Name of The Course	IoT Lab				
Course Code	BEE01P2004				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	0	0	2	2	

Course Objectives

1.To create an environment for research, design, development and testing of IoT solutions, in the field of energy management, communication systems, distributed sensor devices and advanced user interfaces

2.To provide a large-scale IoT system for the collection of information from the environment and its transfer to a server, as well as the skills necessary for the development of control logics, processing and display of data

3.To this end, IoT Laboratory is equipped with devices for the monitoring of energy consumption of electrical appliances, sensors for the monitoring of environmental parameters such as temperature and humidity and the communication infrastructure necessary to deliver the acquired information to a server

Course Outcomes

CO1	Investigate a variety of emerging devices and technologies such as smart sensing, pervasive connectivity, virtual interfaces & ubiquitous computing and their potential applications in consumer, retail, healthcare and industrial contexts
CO2	Collaborate on research with industry partners to address significant and complex challenges surrounding IoT technologies and applications
CO3	This may be used as a platform for conducting consultancy work required by government/Private organizations in around NCR
CO4	Enable faculty learning, research and hands-on experimentation to discover and demonstrate the promise of the Internet of Things
CO5	Provide students unique interdisciplinary learning and innovation experiences with IoT technologies

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Exercise on Eclipse IoT Project.

2. Experiments on few Eclipse IoT Projects.

3. Any Experiment on architecture of Iot Toolkit.

4. Exercise on smart object API Gateway service reference implementation in IoT Toolkit.

5. Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT Toolkit.

6. Experiment on Gate way as a service deployment in IoT Toolkit.

7. Experiment on application framework and embedded software agents for IoT Toolkit.

8. Exercise on working principle of Rasberry Pi.

9. Experiment on connectivity of Rasberry Pi with existing system components.

Semester IV

Name of The Course	Integrated Circuits				
Course Code	BECE2008				
Prerequisite	Analog electronics				
Corequisite	Analog electronics				
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the basic building blocks of linear integrated circuits
2. To learn the linear and non-linear applications of operational amplifiers
3. To introduce the theory and applications of analog multipliers and PLL
4. To learn the theory of ADC and DAC
5. To introduce the concepts of waveform generation and introduce some special function ICs

Course Outcomes

CO1	Illustrate the AC, DC characteristics and compensation techniques of Operational Amplifier
CO2	Realize the applications of Operational Amplifiers
CO3	Clarify and Analyze the working of Analog Multipliers and PLL
CO4	Classify and realize the working principle of various converter circuits using Op-Amps
CO5	Demonstrate the function of various signal generators and Waveform Shaping Circuits
CO6	Analyse the performance of Operational Amplifier Circuits.

Course Content:

Unit-1 Introduction 8 hours
Analysis of difference amplifiers, Monolithic IC operational amplifiers, specifications, frequency response of op-amp,, slew rate and methods of improving slew rate, Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers.
Unit-2
Differentiator, Integrator, Voltage to Current convertor, Low pass, high pass, band pass filters, comparator, Multi-vibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator, Sine wave Oscillators.
Unit-3
Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, Frequency synthesizers, Compander ICs.
Unit-4
Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter- Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope, Successive approximation, Voltage to Time and Voltage to frequency converters.

Unit-5
Wave shaping circuits, Multivibrator- Monostable&Bistable, Schmitt Trigger circuits, IC 555 Timer, Application of IC 555, Switched capacitor filter, Frequency to Voltage converters.
Unit 6
Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Optocouplers and fibre optic IC.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Sergio Franco, " Design with operational amplifiers and analog integrated circuits ", McGraw Hill, 2002, ISBN 0070530440, 9780070530447
2. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", 4th Edition, Prentice Hall, 2000, ISBN 0132808684, 9780132808682
3. Botkar K.R., " Integrated Circuits ", Khanna Publishers, 1996. Taub and Schilling, " Digital Integrated Electronics ", Tata McGraw-Hill Education, 2004, ISBN 0070265089, 9780070265080
4. Millman J. and Halkias C.C., " Integrated Electronics ", McGraw Hill, 2001, ISBN 0074622455, 9780074622452

Name of The Course	Signals and Systems				
Course Code	BECE2016				
Prerequisite	Engineering Mathematics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:To understand the basic properties of signal & systems • To know the methods of characterization of LTI systems in time domain • To analyze continuous time signals and system in the Fourier and Laplace domain • To analyze discrete time signals and system in the Fourier and Z transform domain

Course Outcomes

CO1	Understand various types of signals, classify, analyze and perform various operations on them.
CO2	Classify the systems and realize their responses
CO3	Analyze the response of continuous time systems using Fourier transforms
CO4	Use Laplace and Z transform techniques as tool for System analysis
CO5	Analyze the continuous and discrete time system functions
CO6	Understand the application of Sampling Theorem, Multirate Signal Processing and their applications in real-world problems

Course Content:

Unit-1 Introduction 8 hours
Signals and systems as seen in everydaylife, and in various branches of engineering and science. Types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; Basic Signals: unit impulse, unit step, unit ramp, exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit-2 Classification of Systems 8 hours
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit-3 Fourier Series and Transforms 8 hours
Continuous-time Fourier series: Periodic signals and their properties, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, Definition, conditions of existence of FT, properties, magnitude and phase spectra, Parseval's theorem, Inverse FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit-4 Laplace Transforms and Z Transforms 8 hours
One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping
Unit-5 Analysis of LTI systems 8 hours
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter
Unit VI: Multirate Signal Processing 8 hours
Sampling and data reconstruction process, Multirate Signal Processing, Sampling, Sampling rate conversion, introduction to compressive sensing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Signals and Systems, Robert, TMH
2. Signals and Systems by Oppenheim &Wilsky
3. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi
4. Linear Signals and Systems by B. P. Lathi

Name of The Course	Analog and Digital Communication
Course Code	ECE417
Prerequisite	Signals and Systems, Digital System Design

Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Outcomes

CO1	Analyze and compare different analog modulation schemes for their efficiency and bandwidth
CO2	Analyze the behavior of a communication system in presence of noise
CO3	Investigate pulsed modulation system and analyze their system performance
CO4	Analyze different digital modulation schemes and can compute the bit error performance
CO5	Analyze Source and Error control coding.
CO6	Utilize multi-user radio communication

Unit-1 Introduction Review of signals and systems 8 hours
Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.
Unit-2 Probability and random process 8 hours
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.
Unit-3Pulse modulation 8 hours
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.
Unit-4Elements of Detection Theory 8 hours
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion.
Unit-5Pass band Digital Modulation schemes 8 hours
Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels.
UNIT 6 MULTI-USER RADIO COMMUNICATION 8 hrs
Advanced Mobile Phone System (AMPS) – Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.

2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.

4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.

5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.

6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000

Name of The Course	DataBase Management System				
Course Code	BEE01T3003				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C

Course Objectives:

The scope of the course is Database System concepts and major application areas. The objective is to understand various data models and to develop the relational model of database including the rigorous practice of query language, SQL. The emphasis is to apply the concepts to wide range of applications.

Course Outcomes

CO1	Understand the relational database theory, application of database system in real life.
CO2	Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models.
CO3	Learn and apply Structured query language (SQL) for database definition and database manipulation.
CO4	Illustrate relational database theory, and be able to write relational algebra expressions for queries.
CO5	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
CO6	Illustrate the Concept of stored procedures and functions.

Course Content:

Unit I	Introduction:	10 Hrs
Introduction: An overview of database management system, database system Vs file system, Database system concept and architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML.		

Unit II	Data Model and ER Diagram	8 Hrs
Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model.		
Unit III	Relational data Model	7 Hrs
Relational data model concepts, integrity constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus.		
Unit IV	Database Language	8 Hrs
Introduction on SQL: Characteristics of SQL, advantage of SQL. SQL data type and literals. Types of SQL commands. SQL operators and their procedure. Tables, views and indexes. Queries and sub queries. Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus.		
Unit V	Data Base Normalization	7 Hrs
Functional dependencies, normal forms, first, second, third normal forms, BCNF		
Unit VI Database modifications using SQL. 6 hrs		
Database modifications using SQL. . PL/SQL: Basic Concepts-SQL within PL/SQL- Cursors -Concept of stored procedures and functions-packages-Triggers.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
2. Date C J, " An Introduction to Database Systems", Addision Wesley
3. Elmasri, Navathe, " Fudamentals of Database Systems", Addision Wesley
4. O'Neil, Databases, Elsevier Pub.
5. Leon & Leon,"Database Management Systems", Vikas Publishing House
6. Bipin C. Desai, " An Introduction to Database Systems", Galgotia Publications
7. Majumdar & Bhattacharya, "Database Management System", TMH (14)

Name of The Course	Integrated Circuits Lab				
Course Code	BECE2009				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	

	0	0	2	

Course Objectives

The student should be able to:

1. To acquire the basic knowledge of special function IC. At the end of the course,
2. Design oscillators and amplifiers using operational amplifiers.
3. Design filters using Opamp and perform experiment on frequency response.

Course Outcomes

CO1	To design various types of amplifier using Op-amp.
CO2	To design waveform generation circuits.
CO3	To design basic timer and analog and digital circuits.
CO4	To design simple logic circuits using digital ICs
CO5	To design various types of Analog Integated Circuits.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Operational Amplifiers (IC741)-Characteristics and Application.

2. Waveform Generation using Op-Amp (IC741).

3. Applications of Timer IC555.

4. Design of Active filters.

5. Study and application of PLL IC's

6. Design of binary adder and subtractor.

7. Design of counters.

8. Study of multiplexer and demultiplexer /decoders.

9. Implementation of combinational logic circuits.

10. Study of DAC and ADC

11. Op-Amp voltage Regulator- IC 723.

Name of The Course	Microprocessor and Micro Controller Lab			
Course Code	BECE3005			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	0	0	2	

Course Objectives

1. To expose students to the operation of typical microprocessor (8085) trainer kit.
2. To prepare the students to be able to solve different problems by developing different programs.
3. To develop the quality of assessing and analyzing the obtained data.

Course Outcomes

CO1	Write assembly language, C and C++ programs for arithmetic operations using Pentium processor based system
CO2	Write 8051 assembly language programs to control inbuilt timer and communication modules. CO3 Interface ADC and DAC modules with microprocessor based system.
CO3	Implement DSP functions using ARM processor.
CO4	To work on modules like stepper motor.
CO5	To verify and understand interfacing units.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Write a simple program for arithmetic operations – addition, subtraction, multiplication and division of 16 – bit number. (8086 Program)

2. Write a simple program for string operations like string concatenation, swapping. Write a program for interfacing LCD with 8086 and display a message.

3. Write a program for performing simple arithmetic operations. (8051 Programming)

4. Write a simple program for flashing LEDs using software delays, timers and interrupts. Write a program for interfacing Seven Segment Display and LCD with 8051 and display messages.

5. Write a program for interfacing Keypad with 8051 and display keypad input on LCD.

6. Write a program for square waveform generation, with different frequencies and duty cycles.

7. Write a program for serial communication through UART using polling and interrupt methods.

8. Write a program for interfacing ADC 0804 with 8051.

9. Write a program for Pulse Width Modulation using on-chip PWM and analog I/O modules.

10. Write a program for interfacing Seven Segment Display and LCD to ARM processor.

11. Write a program to interface ARM processor with PC using Tera - Term.

12. Write a program to generate various waveforms

13. Write a program for flashing LEDs using timers and interrupts.

Semester V

Name of The Course	Control Systems
Course Code	BEEE3002

Prerequisite	Signals and Systems				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

Course Outcomes

CO1	Identify the various control system components and their representations.
CO2	Analyze the various time domain parameters
CO3	Analysis the various frequency response plots and its system.
CO4	Apply the concepts of various system stability criterions.
CO5	Design various transfer functions of digital control system using state variable models.
CO6	To perform stability analysis of non linear control systems.

Course Content:

Unit-1 Introduction 8 hours
Control System: Terminology and Basic Structure-Feed forward and Feedback control theoryElectrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system
Unit-2 Transient response8 hours
Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems
Unit-3Closed loop frequency response 8 hours
Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation
Unit-4 Concept of stability 8 hours
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.
Unit-5 State variable representation 8 hours
State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.
Unit-6 Non linear Systems 8 hours
Effects of zeros, minimum and non-minimum phase systems. Linearization of nonlinear systems. Application of basic filter design to Navigation and Movement. Stability Analysis of non linear control systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Text Book (s)

1. M.Gopal, ―Control System – Principles and Design‖, Tata McGraw Hill, 4th Edition, 2012.

Reference Book (s)

1. K. Ogata, _Modern Control Engineering‘, 5th edition, PHI, 2012. 3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

2. Benjamin.C.Kuo, ―Automatic control systems‖, Prentice Hall of India, 7th Edition,1995.

Name of The Course	EM Waves			
Course Code	BEE01T3001			
Prerequisite	Electromagnetic Fields			
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
3. To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
4. To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
5. To impart knowledge on the concepts of Concepts of electromagnetic waves andTransmission lines.

Course Outcomes

CO1	Analyze transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
CO2	Provide solution to real life plane wave problems for various boundary conditions.
CO3	Analyze the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
CO4	Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
CO5	Understand and analyze radiation by antennas.
CO6	Explicate the recent advances in theory and applications of EM waves

Course Content

Unit-1 Transmission Lines	8 hours

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.
Unit-2 Maxwell's Equations 8 hours
Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.
Unit-3 Uniform Plane 8 hours
WaveHomogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.
Unit-4 Plane Waves at Media Interface 8 hours
Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.
Unit-5 Waveguides 8 hours
Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.
Unit 6 Recent Trends 5 hours
Novel Waveguide technologies and its future systems.

Text Book / Reference :

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
5. C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

Name of The Course	Digital Signal Processing				
Course Code	BECE3020				
Prerequisite	Signals and systems				
Corequisite	Signals and systems				
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

1. To learn discrete fourier transform, properties of DFT and its application to linear filtering
2. To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
3. To understand the effects of finite precision representation on digital filters
4. To understand the fundamental concepts of multi rate signal processing and its applications
5. To introduce the concepts of adaptive filters and its application to communication engineering

Course Outcomes

CO1	Apply digital signal processing fundamentals and Acquire the knowledge of representation of discrete-time signals in the frequency domain, using z-transform and discrete Fourier transform.
CO2	Design and Analyze FIR filters with desired frequency responses.

CO3	Design and Analyze IIR filters with desired frequency responses.
CO4	Realize FIR/IIR Filter structure and analyze the effects quantization errors in analog to digital conversion of signals
CO5	Understand architecture of DSP Processors, Compressive sensing, Multirate Signal Processing and their applications in real-world problems
CO6	Apply signal processing techniques to solve real time problems

Text Book (s)

1. John G. Proakis& Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007. (UNIT I – V)

Reference Book (s)

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, ―Digital Signal Processing‖, Second Edition, Pearson Education / Prentice Hall, 2002.

2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing‖, 8th Indian Reprint, Pearson, 2004.

3. Sanjit K. Mitra, ―Digital Signal Processing – A Computer Based Approach‖, Tata Mc Graw Hill, 2007.

4. Andreas Antoniou, ―Digital Signal Processing‖, Tata Mc Graw Hill, 2006.

Course Content:

Unit-1 Introduction 8 hours
Discrete and Fast Fourier Transforms: Introduction to DSP, DTFT, Relationship between DFT and other transforms DFT, Properties of DFT, Circular Convolution, DFT as a Linear Transformation, Fast Fourier Transform, Computing an Inverse DFT by doing a Direct DFT. Review of z transform and inverse Z transform.
Unit-2Finite Impulse Response Filters 8 hours
Finite Impulse Response Filters:- Magnitude and phase response of a digital filters, Frequency response of linear phase FIR filters, Design Techniques for FIR filters.
Unit-3Infinite Impulse Response Filters 8 hours
Infinite Impulse Response Filters:-IIR filter Design by Approximation of Derivatives, Impulse Invariant Method, Bilinear Transformation, Butterworth filters, Chebyshev Filters and Frequency Transformation.
Unit-4Realization of Digital Filters 8 hours
Realization of Digital Filters: Basic Structures for IIR Systems, Basic Structures for FIR system. Effects of Finite Word Length in Digital Filters: Introduction, Rounding and Truncation Errors, Quantization effects in analog to digital conversion of signals
Unit-5 Multi Rate Signal Processing 8 hours
Introduction to wavelets, Multirate Signal Processing, Sampling, Sampling rate conversion, introduction to compressive sensing.
Unit 6 DSP Processors 5 hours
Architecture of DSP Processors & applications: Harward architecture, pipelining, Multiplier-accumulator (MAC) hardware, architectures of fixed and floating point (TMSC6000) DSP processors. Applications

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Communication Engineering Lab			
Course Code	BEE01P3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	0	0	2	**1**

Course Objectives

1. To practice the basic theories of Analog communication system and experiments as it is a key analysis tool of engineering design.
2. To give a specific design problem to the students, which after completion they will verify.

Course Outcomes

CO1	Generate AM and FM signals and evaluate their performance.
CO2	Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals.
CO3	Generate digital modulation signals for ASK, PSK and FSK and perform their detection.
CO4	Simulate MSK, DPSK, QPSK and DEPSK schemes and estimate their BER.
CO5	Study and analyse about communication.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. Fourier Synthesis

2. AM Transmitter & Receiver

3. FM Transmitter & Receiver

4. AM/FM Radio Receiver

5. Analog signal sampling & Reconstruction

6. Generation & Detection of PAM/PWM/PPM

7. Generation & Detection of PCM

8. Generation & Detection of DM/SIGMA DELTA/ ADM

9. Baseband digital data transmission

10. Data conditioning & Reconditioning

11. Generation & Detection of BPSK/DPSK/DEPSK

12. Simulation of digital modulation schemes.

Semester VI

Name of The Course	Advanced Communication Systems				
Course Code	BEE01T3005				
Prerequisite	Analog and Digital Communication				
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

The student will learn and understand

1. Analog and digital communication systems, and their design parameters
2. Role of Digital Modulation and encoding techniques in different application.
3. the concept of Spread Spectrum techniques and Multiple Access Techniques.
4. The features and architectures used in 4G and 5G communication

Course Outcomes

CO1	To analyze the design parameters of analog and Digital communication systems
CO2	To apply the different modulation and encoding techniques to according to the need of application.
CO3	To apply spread spectrum techniques to secure communication in network.
CO4	To analyse the noise in coherent receiver and understand diversity techniques.
CO5	To understand the Emerging Trends in Communication including 4G, WiMax, and 5G
CO6	Explain and address the challenges in communication networks.

Course Content:

Unit-1 Introduction 8 hours
Introduction to different communications systems and their applications, Mathematical Models of Communication Channel, Designing parameters of analog and digital communication systems.
Unit-2 Digital Modulation Techniques 8 hours
Digital Modulation Techniques, BPSK, QPSK, Temporal waveform encoders, Multi carrier modulation schemes, OFDM, Wavelet based OFDM, QAM
Unit-3 Multiple Access techniques 8 hours
Introduction, Generation of PN Sequences,Properties of PN Sequences DS and FH spread spectrum, CDMA system based on FH and DS spread spectrum signals, Applications, Introduction to Multiple Access Techniques
Unit-4Coherent Systems and Diversity Techniques: 8 hours

Coherent receiver, Homodyne and heterodyne detection, noise in coherent receiver, Fading, Diversity Techniques, Quality of service (QoS)
Unit-5 Introduction to 4G: 8 hours
Status and Key Technologies,4G WIRELESS SYSTEM FEATURES, 4G Network Structure, protocol stack architecture, WIMAX System Architecture, Limitation of 4G.
Unit-6 Evolution towards 5G 8 hours
Evolution towards 5G. Challenges in 5G Networks, Emerging Trends in 5G Networks

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Andrew J Viterbi, “CDMA Principles of spread spectrum communications”, Addition Wesley, (1995).
2. J S Lee and L E Miller, “CDMA systems engineering handbook”, Artech House, (1998).
3. Marvin K Simon, Jim K Omura, Robert A Scholtz, Bary Klevit, “Spread Spectrum Communications”, (1995).
4. Sergio Verdu, “Multiuser Detection”, Cambridge University Press, (1998).
5. Andrew S Tanenbaum, “Computer Networks”, Prentice Hall of India.

6. J.G.Proakis,” Digital Communication (4/e)”, McGraw- Hill, 2001

7. S. Haykin, “Communication systems (4/e)”,John Wiley, 2001

8. B.P. Lathi, Zhi Ding, “Modern Digital and Analog Communication Systems (4/e)”,Oxford university Press, 2010

Name of The Course	VLSI Design			
Course Code	BECE3013			
Pre-requisite	Semiconductor Devices, Integrated Circuits, Digital Design			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To bring both Circuits and System views on design together.
2. Study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits.
3. Understand standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis.
4. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

CO1	Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
CO2	Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
CO3	Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
CO4	Be able to design and solve complex problems.
CO5	Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.
CO6	Design and analyse architectures and functional blocks.

Unit-1 Integrated Circuit: Fabrication And Characteristics 7 hours
Integrated circuit technology, basic monolithic integrated circuits, epitaxial growth, Masking and etching, diffusion of impurities, transistors for monolithic circuits, monolithic diodes, Integrated resistors, Integrated capacitors and inductors, monolithic circuit layout, additional isolation methods, LSI and MSI, the metal semiconductor contacts.
Unit-2 Introduction to MOS Transistor 8 Hours
The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS, Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances, Numerical and spice simulations.
Unit-3 MOS Inverters: Static and Switching Characteristic, Interconnect Effects 10 Hours
Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters, Numerical and spice simulations
Unit-4 Combinational and Sequential MOS Logic Circuits 7 Hours
Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High-Performance Dynamic CMOS Circuits, Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates), Introduction, Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop
Unit-5 Memories and VLSI Design Methodologies 7 Hours
Introduction, Read-Only Memory (ROM) Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits Introduction, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles, Design Quality, Packaging Technology, Computer-Aided Design Technology
UNIT 6 IMPLEMENTATION STRATEGIES 6
Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. S.M.Sze, “VLSI technology”, 2nd Edition, Tata McGraw Hill Education, 2003, ISBN 9780070582910

2. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital
3. Integrated Circuits – Analysis and Design”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
4. N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.
5. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.
6. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits”, Addison Wesley 1993.
7. Randel& Geiger, “ VLSI Analog and Digital Circuit Design Techniques” McGraw- Hill,1990.
8. John P. Uyemura, "Introduction to VLSI Circuits and Systems," John Wiley & Sons, ,Inc, 2002.

Name of The Course	VLSI and Embedded Systems Lab				
Course Code	BEE01P3009				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	0	0	2	**1**	

Part-A: VLSI Lab Course Objective:

1. To design and draw the internal structure of the various digital integrated circuits
2. To develop VHDL/Verilog HDL source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer.
3. To verify the logical operations of the digital ICs (Hardware) in the laboratory.

Course Outcomes

CO1	Design and draw the internal structure of the various digital integrated circuits
CO2	Develop VHDL/Verilog HDL source code, perform simulation using relevant simulator andanalyze the obtained simulation results using necessary synthesizer.
CO3	Understand serial communication, port RTOS on microcontroller.
CO4	Use embedded C for reading data from port pins.
CO5	Understand the interfacing of data I/O devices with microcontroller.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

VHDL/ Verilog HDL

1. Realization of Logic Gates.

2. 3- to - 8Decoder- 74138.

3. 8 x 1 Multiplexer-74151 and 2 x 4 De-multiplexer-74155.

4. 4-Bit Comparator-7485.

5. D Flip-Flop-7474.

6. Decade counter-7490.

7. Shift registers-7495.

8. ALU Design.

Part-B: Embedded Systems Lab

1.Write a program to toggle all the led to port and with some time delay using ARM7 PO1, PO2 PSO1

2 .Write a program to interface LCD with ARM7 PO1, PO2 PSO1

3 .Write a program to interface 4*4 matrix keypad with ARM7

4 .Write a program for interfacing LED and PWM and to verify the output in the ARM7

5 .Write a program to interface Stepper motor with ARM7

6 .Write a program for interfacing of DC motor with ARM7 PO1, PO2, PO3 PSO1 7 Write a program to study and characteristics of the programmable gain amplifier (PGA)

8 .Write a Program realization of low pass, high pass and band pass filters and their characteristics

9 .Write a program to interface ADC and DAC with

10. Digital function implementation using digital blocks A. Counter for blinking LED B. PWW C. Digital buffer and digital inverter

11 .Write a program to verify Timer operation in different modes

12 .Write a Program to interface stepper motor with PSOC

Semester VII

Name of The Course	Data Communication and Networking			
Course Code	BEE01T4002			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Outcomes

CO1	Understand and explain the concept of Data Communication and networks, layered architectureand theirapplications.
CO2	Differentiate between Analog and Digital Signals, Guided and Unguided Media
CO3	Understand the data communication link considering elementary concepts of data link layer protocols for error detection and correction.
CO4	Understand the data flow in network layer and differentiate between unicast and multicast routing protocols.

CO5	Estimate the congestion control mechanism to improve quality of services in networking applications
CO6	Understand and analyzes the security issues in network

Course Content:

Unit-1 Introduction 8 hours
Introduction to Data Communication, Network Criteria, Physical Structures, Network Models, Categories of Networks, Protocols and Standards, The OSI Model, TCP/IP Protocol suit, Addressing
Unit-2 Physical Layer and Media 8 hours
Analog and Digital Signals, Transmission Impairments, Multiplexing, Guided and Unguided Media, Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Structure of Switch.
Unit-3 : Data Link Layer 8 hours
Introduction, Types of Errors, Detection Versus Corrections, Block Coding, Framing, Flow and Error Control, Multiple Access, CSMA, CSMA/CD, CSMA/CA, IEEE Standards, Data Link Layer, Physical Layer, MAC Sublayer, IEEE 802.11, Blue Tooth, Passive Hubs, Repeaters, Active Hubs, Bridges, Routers, Two Layer Switches, Three Layer Switches
Unit-4 Network Layer 8 hours
IPv4 Addressing, IPv6 Addressing, Address Mapping, Delivering, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols
Unit-5 Transport Layer 8 hours
Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, Data Traffic, Congestion, Congestion Control, QoS in Switched Networks
Unit-6 Security 3 hours
Symmetric-Key Cryptography, Asymmetric-Key Cryptography, Security Services

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

Name of The Course	Communication Networks Lab			
Course Code	BEE01P4002			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	0	0	2	1

Course Objectives

1. To understand the working principle of various communication protocols.
2. To analyze the various routing algorithms.

3. To know the concept of data transfer between nodes.

Course Outcomes

CO1	Understand fundamental underlying principles of computer networking
CO2	Understand details and functionality of layered network architecture.
CO3	Apply mathematical foundations to solve computational problems in computer networking
CO4	Analyze performance of various communication protocols.
CO5	Compare routing algorithms and Practice packet /file transmission between nodes.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

List of Experiments:

1. PC to PC Communication Parallel Communication using 8 bit parallel cable Serial communication using RS 232C

2. Ethernet LAN protocol: To create scenario and study the performance of CSMA/CD protocol through simulation

3. Token bus and token ring protocols: To create scenario and study the performance of token bus and token ring protocols through simulation

4. Wireless LAN protocols: To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.

5. Implementation and study of stop and wait protocol

6. Implementation and study of Goback-N and selective repeat protocols

7. Implementation of distance vector routing algorithm

8. Implementation of Link state routing algorithm

9. Implementation of Data encryption and decryption

10. Transfer of files from PC to PC using Windows / Unix socket processing

Elective Baskets

1. Communication and Networking

Name of The Course	Satellite Communication
Course Code	BECE3103
Prerequisite	Analog and Digital Communication
Co-requisite	
Anti-requisite	

	L	T	P	C
	3	0	0	3

Course Objectives

Satellite Communication Systems provide vital and economical fixed and mobile communication services over very large coverage areas of land, sea and air. In this course, you will learn the fundamentals and the techniques for the design and analysis of satellite communication systems.

Course Outcomes

CO1	Explain the fundamentals of satellite communication systems
CO2	Design a satellite communication link under specified characteristics.
CO3	Explain the modulation and multiplexing techniques in satellite communication.
CO4	Describe propagation effects and their impact on satellite-earth links
CO5	Demonstrate the working of satellite based systems.
CO6	To conduct a simulation-based design project requiring some independent reading, programming

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit I:Basic Knowledge:. 6 Hours
Elements of Satellite Communication Orbital mechanics look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit
Unit II: Satellite subsystems 10 Hours
Sub Systems: Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.
Unit III:Different modulation schemes: 8 Hours
Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access techniques.
Unit IV: Error control for digital satellite links: 8 Hours
Error control for digital satellite links: error detection and correction, channel capacity, error control coding schemes. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.
Unit V: Introduction of various satellite systems 8 Hours
Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems.

Unit VI Satellite Applications 6 hours
Satellite Applications: Satellite mobile services, VSAT, GPS, Radarsat, Direct broadcast satellites (DBS)-Direct to home Broadcast (DTH)

Suggested Reading

1. Satellite Communications / Dennis Roddy / McGraw-Hill (T)
2. Satellite Communications / Pratt, Bostian, Allnutt / John Wiley & Sons. (T)
3. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill. (R)

Name of The Course	Principles of Secure Communication				
Course Code	EEC505				
Prerequisite	Digital communication system				
Corequisite	Digital communication system				
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the communication systems and various methods of communication system.
2. To understand the ways to provide security to communication systems.

Course Outcomes

CO1	Understanding of the various types of spread spectrum techniques for secure communication.
CO2	Slow and fast frequency hopping, performance of FHSS in AWGN Channel.
CO3	Analyze the various cryptographic techniques and Apply the Encryption standards like DES, AES.
CO4	Understanding the principle of Block Cipher and Encryption Standards.
CO5	Knowing current network authentication applications, PKI, Web security and their vulnerabilities that are exploited by intentional and unintentional attacks.
CO6	Understand password management

Course Content

Unit-1 Introduction 8 hours
Model of Spread Spectrum digital communication system, direct sequence spread spectrum signal, error rate, performance of the decoder, processing gain and jamming margin, uncoded DSSS signals, applications of DSSS signals in anti-jamming, Code division multiple access and multipath channels, effect of pulsed interference on DSSS systems, Generation of PN sequences using m sequence and Gold sequences, narrowband interference in DSSS systems, acquisition and tracking of DSSS system.
Unit-2

Basic concepts of Frequency Hopping, slow and fast frequency hopping, performance of FHSS in AWGN Channel, FHSS in CDMA system, Time hopping and hybrid Spread spectrum system, acquisition and tracking of FH SS systems.
Unit-3
Classical encryption techniques, Symmetric cipher model, cryptography and cryptanalysts, Substitution techniques, transposition techniques.
Unit-4
Block cipher principle, data encryption standard (DES), strength of DES, differential and linear cryptanalysts, block cipher design principles, Finite fields, simplified advanced encryption standard (S-AES), multiple encryption and triple DES, Block cipher modes of operation, stream ciphers and RC4 algorithm.
Unit-5
Prime numbers, Fermat and Euler's theorem, Chinese remainder theorem, discrete algorithms, principles of public key cryptosystems, RSA algorithm, key management Diffie-Hellman key exchange, message authentication requirements and functions.
Unit-6
Intruders: Intrusion techniques, Intrusion detection,Statistical anomaly detection, Rule based intrusion detection, Distributed intrusion detection, Honey pot, Intrusion detection exchange format. password management: Password protection, password selection strategies.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1. Digital Communication by Simon Haykin, Wiley.1 st edition ISBN 978-1-1185-4405-1,

2. Cryptography and Network Security by W. Stallings 5th Ed., PHI ISBN-10: 0136097049 ISBN-13: 978-0136097044.

3. Cryptography and secure Communications by M.Y. Rhee, Mc Graw Hill, ISBN-10: 0071125027; ISBN-13: 978-0071125024.

4. Communication System Security by LidongChen,Guang Gong, ISBN 9781439840368-CAT# K11870.

Name of The Course	Microwave Engineering			
Course Code	BECE3006			
Prerequisite	Electromagnetic field theory			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. Concept of scattering parameters used to characterize devices and system behavior.
2. The high frequency behavior of circuit and network elements as well as the analysis and the design of active and passive microwave devices.

Course Content:

CO1	Illustrate the basic concepts of microwave transmission lines.
CO2	Identify and use microwave guides and components.
CO3	Apply the conceptual knowledge of microwave solid state technology and traveling wave tube techniques
CO4	Distinguish between microwave solid state and technology and traveling wave tube techniques
CO5	Demonstrate and evaluate the microwave measurement techniques.
CO6	Analyze the application of Microwaves in various fields

Unit-1 Introduction 8 hours
Microwave frequency, Applications of Microwave, microwave transmission line, Introduction to Micro strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL.
Unit-2Microwave waveguides and components 8 hours
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant (TE10) mode, Power Transmission, Power losses, Excitation of modes, Circular Waveguides: TE, TM modes, Microwave cavities (Resonators), Scattering matrix- The transmission matrix, Passive microwave devices: Microwave Hybrid Circuits, E Plane Tee, H plane Tee and Magic Tee , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Isolators, Circulators.
Unit-3Microwave waveguides and components 8 hours
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant (TE10) mode, Power Transmission, Power losses, Excitation of modes, Circular Waveguides: TE, TM modes, Microwave cavities (Resonators), Scattering matrix- The transmission matrix, Passive microwave devices: Microwave Hybrid Circuits, E Plane Tee, H plane Tee and Magic Tee , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Isolators, Circulators.
Unit-4Microwave linear-beam tubes (O TYPE) and microwave crossed-field tubes 8 hours
Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, Multicavity Klystron Amplifiers, Beam-Current Density, Output Current Output Power of Two-Cavity Klystron, Reflex Klystrons, Velocity Modulation, Power Output and Efficiency, Helix Traveling-Wave Tubes (TWTs), Slow-Wave structures, Amplification Process, Convection Current, Axial Electric Field, Wave Modes, Gain Consideration, Microwave Crossed-Field Tubes , Magnetron Oscillators, Cylindrical Magnetron, Coaxial Magnetron, Tunable Magnetron , Backward wave Oscillators
Unit-5Microwave Measurements 8 hours
Introduction, Microwave Measurements devices: Slotted line carriage, Tunable detectors, VSWR Meter, microwave power measurements techniques, frequency measurement, wavelength measurements, Impedance and Refection coefficient measurements, VSWR, Insertion and attenuation measurements: Power ratio method, RF substitution method, VSWR measurements (Low and High)
Unit-6 Applications of Microwave 6 hours

Introduction to the applications of Microwave in communication, Remote Sensing, Spectroscopy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested Reading

1.D.M.Pozar, “Microwave engineering”, John Wiley, 3/e, 2005

2.Samuel Y.Liao, “Microwave Devices and Circuits”, 3/e, PHI, New Delhi,1987.

3.ober.E.Collin, “Foundations of Microwave Engineering”, John Wiley, 3/e, 2001

4.Annapurna Dasand S,.K.Das, “Microwave Engineering”, Tata Mc Graw-Hill, New Delhi, 2000

5. R.Chatterjee, “Microwave Engineering”, Affiliated East west Press PVT Ltd, 2001

6. O.P.Gandhi, “Microwave Engineering”, Pergamon Press, NY, 1983

Name of The Course	Mobile Computing			
Course Code				
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and principles in mobile computing technology. This course includes wireless networking, GSM & GPRS technology, data management, routing algorithm and security issues in mobile computing. The course provides opportunities for the students to understand and analyze the functions of various components associated with the above technologies, the major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications. This course also provides an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

Course Outcomes

CO1	**Apply the knowledge of wireless and mobile communications systems**
CO2	**Examine the MAC issues and demonstrate wireless networking principles, for various applications**
CO3	**Describe GSM architecture, operation and services offered by GSM networks**

CO4	**Understand GPRS architecture, operation and services offered by GPRS networks**
CO5	**Analyze the performance of various routing protocols and security issues associated with mobile computing**
CO6	**Security Issues and Recent Trends**

Reference Books:

1. Jochen Schiller, *Mobile Communications*, Second Edition, Pearson Education, 2003.
2. Asoke K Talukder and Roopa R. Yavagal, *Mobile Computing – Technology, Applicationsand Service Creation*; TMH Pub., New Delhi, 2006
3. C D M Cordeiro, D. P. Agarwal, *Adhoc and Sensor Networks: Theory and applications*, World Scientific, 2006.

Course Content:

Unit-1 Introduction 8 hours
Introduction of mobile computing, overview of wireless telephony: cellular concept, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, Multiple access techniques like Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA).
Unit-2 Wireless Networking 8 hours
Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.
Unit-3 GSM 8 hours
GSM Architecture, GSM Entities ,Call Routing in GSM, GSM Addresses and Identifiers, Network Aspects in GSM , GSM Frequency Allocation, Authentication and Security, Mobile Computing over SMS, Short Message (SMS) , Value Added Services through SMS, Accessing the SMS Bearer
Unit-4 GPRS 8 hours
GPRS andpacket Architecture GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS , Application for GPRS, Limitation of GPRS, Billing and Charging in GPRS, MMS , GPRS. Applications, Spread – Spectrum Technology, Data management and various issues in mobile computing environment.
Unit-5 Routing Protocols 8 hours
Routing Protocols: Adhoc Network Routing Protocols, Destination Sequenced Distance Vector Algorithm, Cluster Based Gateway Switch Routing, Dynamic Source Routing, Adhoc on-demand Routing, Location Aided Routing, Zonal Routing Algorithm.
Unit 6- Security Issues and Recent Trends
Mobile Computing Security Issues, Authentication, Encryption, Cryptographic Tools: Hash, Message Authentication Code (MAC), Digital Signature, Certificate. Secure Socket Layer (SSL).Recent trends on mobile computing and future networks

Name of The Course	Mobile Ad Hoc Networks				
Course Code	BECE3204				
Pre-requisite	Wireless Communication				
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

1. To gain an in-depth understanding the concepts of wireless ad-hoc networks.
2. To learn and understand the current and emerging trends in Wireless Networks.
3. Design ad-hoc network for the heterogeneous environment
4. "Hands-on experience in designing and implementing ad hoc network functionality using network simulation tools and Pocket PCs"

Course Outcomes

CO1	Explain the architecture, organization and operation of ad-hoc networks
CO2	Construct ad-hoc network anywhere on temporary basis
CO3	Design ad-hoc network for the heterogeneous environment
CO4	Have an understanding of the principles of mobile ad hoc networks (MANETs)
CO5	Distinguish between infrastructure-based networks
CO6	Explain 5G technologies

Text Book (s)

1. "C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", 1st Edition, Prentice Hall, PTR, 2006, ISBN 9788131706886"
2. C. K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", 1st Edition, Pearson, 2007, ISBN 9788131715109
3. Mobile Ad Hoc Networking by Stefano Basagni ,Marco Conti , Silvia Giordano , Ivan Stojmenovic
4. Mobile and Wireless Communication Networks by Guy Pujolle IFIP 19th World Computer Congress

Reference Book (s)

1. "Charles E. Perkins, "Ad Hoc Networking", 1st Edition, Pearson, 2008, ISBN 9788131720967"
2. Mohammed Ilyas, "The Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems", 1st Edition, CRC press, 2004, ISBN 9780849319686.
3. "Mobile Ad-hoc and Sensor Networks: Second International Conference, MSN 2006, Hong Kong,China, December 13-15, 2006, Proceedings"

4. Mobile Agents in Networking and Distributed Computing by Jiannong Cao, Sajal Kumar

Unit-1 Introduction to Wireless Ad Hoc Networks 9 hours
Introduction to cellular and ad hoc wireless networks, applications of ad hoc networks, issues in ad hoc wireless networks – medium access scheme, routing, multicasting, transport layer protocols, pricing scheme, quality of service provisioning, self organization, security, address and security discovery, energy management, scalability, deployment considerations, ad hoc wireless Internet.
Unit-2Medium Access Control Protocol 9 Hours
Issues in Designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms, Other MAC protocols.
Unit-3 Routing Protocol 9 Hours
Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols.
Unit-4Multicasting Protocol 8 Hours
"Design issues and operation, Architecture Reference Model, classification, Tree-based and Mesh-Based Protocols, Energy-Efficient Multicasting, Multicasting with Quality of Service Guarantee.Quality of Service: Issues and challenges in providing QoS, Classification of QoSsolutions."
Unit-5Energy Management 6 Hours
Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.
Unit 6 Recent Trends and Technologies
New Generation Technology for Best QOS and 5G Technology.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Information Theory and Coding			
Course Code				
Pre-requisite	Analog and Digital Communication			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

The student will be able

1. To understand the fundamental concept of entropy and information as they are used in communications.

2. To identify the implications and consequences of fundamental theories and laws of information theory and coding with reference to the application in modern communication and computer systems.
3. To design different encoders using the different coding schemes like Huffman Coding, Shannaon Fano Coding, Cyclic codes, etc.,

Course Outcomes

CO1	Understand the concept of information and entropy
CO2	To design different encoders using the different coding schemes
CO3	Apply error control techniques
CO4	To calculate syndrome using cylic code
CO5	To apply compression techniques to text and images.
CO6	Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information

Text Book (s)

5. "C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, 1st Edition, Prentice Hall, PTR, 2006, ISBN 9788131706886"
6. C. K. Toh, “Ad Hoc Mobile Wireless Networks: Protocols and Systems”, 1st Edition, Pearson, 2007, ISBN 9788131715109
7. Mobile Ad Hoc Networking by Stefano Basagni ,Marco Conti , Silvia Giordano , Ivan Stojmenovic
8. Mobile and Wireless Communication Networks by Guy Pujolle IFIP 19th World Computer Congress

Reference Book (s)

5. "Charles E. Perkins, “Ad Hoc Networking”, 1st Edition, Pearson, 2008, ISBN 9788131720967"
6. Mohammed Ilyas, “The Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, 1st Edition, CRC press, 2004, ISBN 9780849319686.
7. "Mobile Ad-hoc and Sensor Networks: Second International Conference, MSN 2006, Hong Kong,China, December 13-15, 2006, Proceedings"
8. Mobile Agents in Networking and Distributed Computing by Jiannong Cao, Sajal Kumar

Unit-1 Basics of information theory 9 hours
Basics of information theory: Information,Entropy, Information rate, Joint and conditional entropies, Mutual information - Discrete memoryless channels ,BSC, BEC, Channel capacity, Shannon limit.
Unit-2 Techniques of coding 9 Hours

Techniques of coding: classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding, Line coding.
Unit-3 Error control coding 9 Hours
Error control coding: block and cyclic codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes
Unit-4Cyclic codes 8 Hours
Cyclic codes - Syndrome calculation, Encoder and decoder, CRC, Convolutional codes: Introduction, code tree, trellis, state diagram,Encoding ,Decoding
Unit-5Compression Techniques 6 Hours
Principles, Text compression, Static Huffman Coding, Dynamic Huffman coding, Arithmetic coding, Image Compression, Graphics Interchange format, Tagged Image File Format, Introduction to JPEG standards.
Unit 6
Application of coding techniques in data compression,audio and Video Coding.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Wireless Sensor Networks			
Course Code	BECE3203			
Pre-requisite	Computer Networks			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To identify communication protocols employed in WSNs
2. To explain usefulness of OSI model for Communication System Design
3. To select the appropriate technology to implement a WSN.
4. To design a WSN

Course Outcomes

CO1	Know Basics challenges and technologies in Wireless Sensors Network.
CO2	Understand Various Architectures and Protocols of Wireless network.
CO3	Know Various Topology and Tools of Wireless Network.
CO4	Analyze the problems related to sensor networks.
CO5	Different communication protocols and their usefulness in different applications

CO6	Perform case studies

Text Book (s)

1. Holger Karl & Andreas Willig, "" Protocols And Architectures for Wireless Sensor Networks"" , John Wiley, 2005"
2. "Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach"", Elsevier, 2007"
3. Yang, Shuang-Hua , "Wireless Sensor Networks"
4. Fahmy, Hossam Mahmoud Ahmad, "Wireless Sensor Networks"

Reference Book (s)

1. "KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007"
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003
3. “Wireless Sensor Networks: Technology, Protocols and Applications” by KazemSohrab
4. "Fundamentals of Wireless Sensor Networks: Theory and Practice (WSE)” by WaltenegusDargie and Christian Poellabauer"

Unit-1 Overview Of Wireless Sensor Networks 4 hours
Overview of Wireless Sensor Networks, Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor
Unit-2 Architectures 9 Hours
"Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts."
Unit-3 Networking Sensors 9 hours
"Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing,Geographic Routing."
Unit-4 Infrastructure Establishment 9 hours
"Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control."
Unit-5 Sensor Network Platforms And Tools 9 Hours
"Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming."
Unit 6 Applications of WSN 8 hours
Applications of WSN: WSN Applications - Home Control – Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Optical Communication				
Course Code	BECE3016				
Pre-requisite	Optoelectronics, Electromagnetic Field Theory				
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

1. Discuss the technology developments in Optical Communication with major emphasis on related theory/analysis of technical characteristics of Optical Fibre/Components, Systems and Network nodes to enable the design and selection of proper Functional modules/Building blocks intended for practical network application
2. Impart practical network knowledge based on Optical Communication Network Evolution viz. SONET in terms of Network Elements/Architecture, Network Management,Protection(Reliability),Synchronization
3. Introduce all- optical signal processing based on Optical components and related network functions based on Multi wavelength Optical layers, with Assignment& Routing algorithms along with associated Network architecture. Introduce advanced topics on Photonic packet switching, Optical Transport Network(OTN).

Course Outcomes

CO1	Recall basic laws of optical physics. Distinguish between the various modes of operation of Optical fibers. Identify the various causes for signal degradation. Calculate the various types of losses occurring in transmission of energy.
CO2	Categorize the types of sources of light on basis of physical construction and principle of operation and describe the various phenomenon involved in the conversion of electrical energy into light energy.
CO3	Explain the operation of optical receiver. Identify the various effects introducing noise in the system and evaluate the performance of digital receiver by calculating the probability of error.
CO4	Define and apply the Wavelength Division Multiplexing. (WDM) principles and concepts.
CO5	Discuss the basic applications of optical amplifiers like Erbium Doped Fiber Amplifier (EDFA). Look into the widely used networks like SONET/SDH.
CO6	Understand the practically used optical networks

Text Book (s)

1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, Singapore, 3rd edition, 2000

2. Rajiv Ramaswami, Kumar N. Sivaranjan, "Optical Networks A practical perspective", 2nd edition, Elsevier, 2004

Reference Book (s)

1. Djafar K. Mynbaev, Lowell L. Scheiner, "Fiber-Optic Communications Technology", 1st edition, Pearson Education, 2001

2. John Powers, "An Introduction to Fiber optic Systems", 2nd edition, IrwinMcGraw Hill, 1999

3. J.Gowar, "Optical Communication System", 2nd edition, Prentice Hall of India, 2001

Unit-1 Introduction to Optical Fiber Communication 9 hours
Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication. Fiber materials, Photonic Crystal Fibers. Spectral characteristics. Optical Fiber wave guide: Structure, Single and Multimode operation; Attenuation, Material and wave guide dispersion
Unit-2 Optical Sources and Transmission Characteristics of Optical Fibers 9 Hours
Light Emitting Diode; principle, structures, power and efficiency, coupling to fibers. Laser diodes; principle, double hetero structure, gain and index guiding, distributed lasers. Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion
Unit-3 Optical Detectors and Optical Receiver 7 Hours
Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors. Optical Receiver Operation, eye diagrams, signal to noise ratio
Unit-4 Point-to-point link and Wavelength Division Multiplexing 7 hours
Building blocks; Multiplexing; Intensity Modulation/Direct Detection system; Principle of Regeneration; WDM link, Optical amplifiers; EDFA, SOA, Raman amplifier, Fabry-Perot filters. Dispersion compensation and management, Link analysis and Bit-Error-Rate calculation.
Unit-5 WDM Concepts and Optical Network 8 Hours
LAN, MAN, WAN; Topologies: bus, star, ring; WDM concepts, overview of WDM operation principles, WDM standards, Ethernet; FDDI; Telecom networking: SDH/SONET. Different forms of access networks: Telephony; ISDN; Cable TV; Broadcast and Switched Networks; HFC networks; FTTC and FTTH networks; All optical networks
Unit 6 Practical Optical Networks 6hours
Intelligent Optical Network (ION), FDDI, FTTH, Business -Drivers for Next Generation Optical Networks.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

2. VLSI Basket

Name of The Course	Digital System design using VHDL				
Course Code	BECE3104				
Prerequisite	Digital Design				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1.To gain an in-depth understanding of VHDL and to realize different circuits using it both sequential and combinational

2.To learn the concept of memories and how they are designed using VHDL.

3. To gain an understanding of applications of VHDL in PLDs and Field Programmable Logic Arrays (FPGAs).

Course Outcomes

CO1	Explain VHDL as a programming language.
CO2	Design the combinational and sequential logic circuits using VHDL.
CO3	Design Programmable logic devices(PLDs) and Networks of Arithmetic operations.
CO4	Gain proficiency with VHDL software package and utilize software package to solve problems on a wide range of digital logic circuits.
CO5	Explain VHDL as a programming language.
CO6	Illustrate the latest trends adapted in Digital System Design

Continuous Assessment Pattern:

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit I:Introduction 7 Hours
Introduction to Hardware Description Languages (HDL) And HDL Based Design, VHDL- Variables, Signals And Constants, Arrays, VHDL Operators, VHDL Functions, VHDL Procedures, Packages And Libraries, VHDL Description Of Combinational Networks, Modeling Flip-Flops Using VHDL, VHDL Models For A Multiplexer, Compilation And Simulation Of VHDL Code, Modeling A Sequential Machine, VHDL Model For A Counter.
Unit II:VHDL Synthesis and Models 8 Hours
Attributes, Transport and Inertial delays, Operator overloading, Multivalued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and TEXTIO. Introduction to data path and control path synthesis.
Unit III:Digital Design with State Machine Charts 7 Hours

State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines, Asynchronous state machine based design.
Unit IV: Programmable Logic devices (PLDs): 9Hours
Designing with programmable logic devices: Read-only memories (ROM, EPROM, EEPROM/FLASH), Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner. Design of networks for arithmetic operations: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, and Design of a binary divider.
Unit V:Field Programmable Gate Arrays (FPGA) 8 Hours
"Xilinx 3000 series FPGAs, Designing with FPGAs, Xilinx 4000 series FPGAs, using a one-hot state assignment, Altera complexprogrammable logicdevices (CPLDs), Altera FELX 10K series COLDs. Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations."
Unit-6 Latest Trends in Digital System Design 7 Hours
Deep Learning with INT8 optimization on Xilinx Devices, Xilinx ISE Design Suite - FPGA, Complex programmable logic devices (CPLDs), Altera FELX 10K series CPLDs. Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations”

3. IoT Basket

Name of The Course	**Introduction to IoT and its Applications**			
Course Code	**BECE4501**			
Prerequisite	**Microprocessor and Microcontrollers**			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

Students will understand the concepts of Internet of Things and develop IoT based systems for various applications.

Course Outcomes

CO1	**Understand the concepts of Internet of Things**
CO2	**Analyze basic protocols in wireless sensor network**
CO3	**Realize various domain specific IoT applications and be able to analyse their performance**
CO4	**Implement basic IoT applications using embedded platform**

CO5	**Recognise the various data acquisition units and Actuators and their effective utilization in developing IoT Architectrures.**
CO6	**Recognize the latest trends in IoT based system development**

Text Books &Reference Books:

1. RajkumarBuyya, Amir VahidDastjerdi, "Internet of Things Principles and Paradigms " Copyright © 2016 Elsevier Inc.
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. 2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen
3. API Features and Arduino Projects for Linux Programmers", Apress, 2014.
4. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

Course Content:

Unit-1 Introduction to IoT 7 hours
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related, Standardization, Recommendations on Research Topics.
Unit-2 Network & Communication aspects 7 hours
Background/Related Work – OpenIoT Architecture for IoT/Cloud Convergence - Scheduling Process and IoT Services Lifecycle - Scheduling and Resource Management - Validating Applications and Use Cases - Future Research Directions
Unit-3 Challenges in IoT 7 hours
Introduction - Background and Related Work - Device/Cloud Collaboration Framework - Powerful Smart Mobile Devices - Runtime Adaptation Engine - Privacy-Protection Solution - Applications of Device/Cloud Collaboration - Context - Aware Proactive Suggestion - Semantic QA Cache - Image and Speech Recognition.- Future Work
Unit-4 Domain specific applications of IoT 7 hours
Principles, Architectures, and Applications: Introduction - Motivating Scenario - Definitions and Characteristics. - Reference Architecture - Applications - Research Directions and Enablers.- Commercial Products - Case Study
Unit-5 Developing IoT based Systems 7 hours
Introduction - Scenario - Architecture Overview- Sensors - The Gateway - Data Transmission
Unit 6 Recent Trends in IoT 7 Hours
Introduction of Blockchain, Big data, *SaaS(*Software- As-a-Service), IoT based Smart Homes, Smart Cities, IoT based Healthcare systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Automation and Robotics			
Course Code	EEC501			
Pre-requisite	IoT, Electronic System Design			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To provide the student with basic knowledge and skills associated with robot control.
2. Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Demonstrate an ability to perform kinematics and inverse kinematics analysis of robot systems.
4. Demonstrate knowledge of robot controllers.
5. To develop the student's knowledge in various robot structures and their workspace.

Course Outcomes

CO1	Explain Basic Robotic model & its applications.
CO2	Differentiate types of control and the standardization for some robotic system. K4
CO3	Critically evaluate robots for particular applications.
CO4	Analyze particular industrial applications and evaluate possible solutions in terms of automated dedicated/flexible) or mixed manual/automated systems.
CO5	Realize the design problem and preliminary consideration of Industrial automation.

Text Book (s)

1. Mikell P Grover et. al. "Industrial Robots: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 1980, ISBN 9781259006210.
2. Robert J. Schilling, "Fundamentals of Robotics-Analysis and Control", PHI Learning, 2009, ISBN 9788120310476 (Unit-II and Unit-III)

Reference Book (s)

1. K.S. Fu, Ralph Gonzalez, C.S.G. Lee, "Robotics: control, sensing, vision and Intelligence", 1st Edition,TataMcgraw-Hill, 2008, ISBN 9780070265103

Unit-1INTRODUCTION ROBOTICS 9 hours
Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magneto-astrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors –ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems.
Unit-2ROBOT CONTROL 8 Hours
Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.
Unit-3END EFFECTORS 8 Hours
End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation-continuous path motion-interpolated motion-straight line motion.
Unit-4ROBOT MOTION ANALYSIS 7 Hours
Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates-Homogeneous transformations and rotations and Robot dynamics
Unit-5ROBOT APPLICATIONS 6 Hours
Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

4. Signal Processing Basket

Name of The Course	Neural Networks and Fuzzy Control				
Course Code	EEC506				
Pre-requisite	Control Systems				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. Get the exposure to Artificial Neural Networks & Fuzzy Logic.

2. Understand the importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines
3. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers
4. Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application

Course Outcomes

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
CO3	Understanding of fuzzy relation rule and aggregations
CO4	Understand concept of classical and fuzzy sets, fuzzification and defuzzification
CO5	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem
CO6	Effectively use modern software tools to solve real life problems using a soft computing approach and evaluate various soft computing approaches for a given problem.

Unit-1Introduction to Artificial Neural Network9 hours
Artificial neural networks and their biological motivation – Terminology – Models of neuron –Topology – characteristics of artificial neural networks – types of activation functions – learning methods – error correction learning – Hebbian learning – Perceptron – XOR Problem –Perceptron learning rule convergence theorem – Adaline.
Unit-2Feed-forward and Recurrent Neural Networks12 Hours
"Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network."
Unit-3Fuzzy Logic & Fuzzy Sets 9 Hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.
Unit-4Fuzzy Relations & Aggregations 9 Hours
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit-5Fuzzy Optimization and Neuro Fuzzy Systems 6 Hours
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Unit VI:Recent trends and Applications 5 hours
Recent trends in Soft computing, Neuro-Fuzzy Systems, SVM, Application of Fuzzy Logic in Medicine, Economics, Industry etc.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Suggested reading

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications.
5. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI, 1996."
6. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill, 2007.
7. "Kosko, B, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, PrenticeHall, NewDelhi, 2004"
8. "Timothy J Ross, “Fuzzy Logic with Engineering Applications”,John Willey and Sons, West Sussex, England, 2005."

Name of The Course	Soft Computing			
Course Code	BECE4401			
Pre-requisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Outcomes

CO1	Identify and describe soft computing techniques and their roles in building intelligent machines
CO2	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
CO3	Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications

CO4	Comprehend the fuzzy logic and reasoning to handle uncertainty and solve engineering problems, genetic algorithms to combinatorial optimization problems and neural networks to pattern classification and regression problems
CO5	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
CO6	Effectively use modern software tools to solve real life problems using a soft computing approach and evaluate various soft computing approaches for a given problem.

Course Overview & Objectives

This course will cover fundamental concepts used in Soft computing. The concepts of Fuzzy logic (FL) will be covered first, followed by Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices.

Course Content

Unit I: Introduction to Artificial Neural Network 9 hours
Introduction Soft computing, Soft vs Hard computing,Techniques in Soft Computing,overview of biological Neuro-system, Artificial neural networks,characteristics and terminology of ANN, Models of neuron, Topology,types of activation functions;Perceptron: XOR Problem, Perception learning rule convergence theorem; Adaline.
Unit II: Feedforward and Recurrent Neural Networks 9 hours
Architecture of neural network: single layer artificial neural network, multilayer ANN, Learning, Types of Learning: Supervised, Unsupervised and Reinforcement Learning, Perceptron learning Algorithm, back propagation learning methods, back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator, Bi-directional associative memory – Hopfield neural network, K mean Clustering Algorithm
Unit III: Fuzzy Logic & Fuzzy Sets 8 hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.
Unit IV: Fuzzy Relations & Aggregations 9 hours
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule-based Model: Mamdani Model, TSK mode, Defuzzification: MOM, COA
Unit V: Genetic algorithm: 9 hours
Genetic Algorithm: An Overview, Implementation of GAfundamentals, basic genetic concepts, working principle,Population initialization, Fitness function, encoding, Operators of GA: Selection, Crossover/Recombination, Mutations, Mutation Operators, Applications Areas of GA
Unit VI:Recent trends and Applications 5 hours
Recent trends in Soft computing, Neuro-Fuzzy Systems, SVM, Application of Fuzzy Logic in Medicine, Economics, Industry etc.

Text Books

1. Ross, Timothy J. *Fuzzy logic with engineering applications*. John Wiley & Sons, 2009.
2. Yegnanarayana, B. *Artificial neural networks*. PHI Learning Pvt. Ltd., 2004.
3. Goldberg, David E., and John H. Holland. *Genetic algorithms in Search, Optimization & Machine Learning*. Pearson Education ,2009

Reference Books

1. Zurada, Jacek M. *Introduction to artificial neural systems,* West St. Paul, 1992.
2. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. *Neural network design*. Boston: Pws Pub., 1996.
3. Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice Hall PTR, 1994.
4. Passino, Kevin M., and Stephen Yurkovich. *Fuzzy control*. Vol. 42. Menlo Park, CA: Addison-Wesley, 1998.

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B.Tech. Electrical Engineering

Scheme: 2019-2020

Vision

To be known globally as a premier Department offering value-based education in Electrical Engineering through interdisciplinary research and innovation.

Mission

- To provide high quality education in the field of *Electrical Engineering.*
- Establish state-of-the-art facilities for design and simulation.
- To provide effective solution to the industries in Energy and allied areas through research and consultancy.
- Immunize the students with knowledge and experience in their field of specialization to contribute in the making of professional leaders.

Program Educational Objectives
Graduate shall

PEO1: Develop skills and proficiency in core areas of Electrical and related multidisciplinary Engineering fundamentals.
PEO2: Demonstrate technical competence to tackle problems in the field of industry using emerging technologies, innovation and entrepreneur skill.
PEO3: Pursue higher education, research and development in electrical engineering and allied areas of science and technology.

Program Specific Outcome
PSO1: Demonstrate their knowledge in analysis and design of industrial drives for utilizing renewable energy sources.
PSO1: Develop sustainable solutions for electrical engineering problems using Machine Learning, Artificial Intelligence and IoT.

Program Outcomes

- Engineering Knowledge : Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems
- Problem analysis : Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
- Design/development of solutions : Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations
- Conduct investigations of complex problems : Use research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions
- Modern tool usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling complex engineering activities with an understanding of limitations
- The engineer and society : Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

- Environment and sustainability : Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments
- Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
- Individual and team work : Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings
- Communication : Communicate effectively on complex engineering activities with the engineering community and with society at large such give and receive clear instructions
- Project management and finance : Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments
- Life-long Learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Curriculum

Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA101	Mathematics-1 (Multivariable Calculus)	3	1	0	3	20	30	50
2	BMA151	Exploration with CAS-I	0	0	2	1	50		50
3	BHS101	Professional Communication	2	0	0	2	20	30	50
4	BCS101	Fundamentals of Computer Programing	3	0	0	3	20	30	50
5	BCS151	Fundamentals of Computer Programing Lab - 1	0	0	2	1	50		50
6	BPH101	Engineering Physics	3	0	0	3	20	30	50
7	BPH151	Engineering Physics Lab	0	0	2	1	50		50
8	BME101	Elements of Mechanical Engineering	3	0	0	3	20	30	50
9	BME151	Workshop Practice	0	0	4	2	50		50
10						19			
		Total							
Semester II									
Sl No	Course Codee	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
	BMA201	Mathematics-II (Matrices and Differential Equations)	3	1	0	3	20	30	50
	BMA251	Exploration with CAS-II	0	0	2	1	50		50
	BHS251	Professional Communication Lab	0	0	2	1	50		50
	BCS251	Fundamentals of Computer Programming Lab - 2	0	0	2	1	50		50
	BCH101	Engineering Chemistry	3	0	0	3	20	30	50
	BCH151	Engineering Chemistry Lab	0	0	2	1	50		50
	BEC101	Basic Electrical and Electronics Engineering	3	0	0	3	20	30	50
	BEC151	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50		50
	BOC251	Engineering Clinic-1	0	0	2	1	50		50
	BLE101	Psychology and Sociology	2	0	0	2	20	30	50
		Total							
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE2010	Digital Electronics	3	0	0	3	20	30	50
2	MATH2001	Functions of complex variables and Transforms	3	0	0	3	20	30	50
3	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	30	50
4	BTEE2006	Electrical Machine-1	3	0	0	3	20	30	50

5	BTEE2002	Network Analysis and Synthesis	3	0	0	3	20	30	50
6	BECE2016	Signals and Systems	3	0	0	3	20	30	50
7	BEE02T2003	Design and Engineering	2	0	0	2	20	30	50
8	BTEE2003	Network Analysis and Synthesis Lab	0	0	2	1	50		50
9	BEE02P2003	Engineering Clinic-1	0	0	2	1	50		50
10	SLBT2021	English Proficiency and Aptitude Building - 3	0	0	4	2	50	-	50
11	BTEE2007	Electrical Machine Lab-1	0	0	2	1	50		50
12	ENVS1004	Environmental Science and Engineering (Mandatory Audit Course)	2	0	0	0	20	30	50
		Total				25			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MATH2004	Probability and Stochastic Processes	3	0	0	3	20	30	50
2	BEEE3002	Control Systems	3	0	0	3	20	30	50
3	BECE2015	Electronic Devices and Circuits	3	0	0	3	20	30	50
4	BTEE2008	Fundamentals of Power Systems	3	0	0	3	20	30	50
5	BTEE3015	Power Plant Engineering	3	0	0	3	20	30	50
6	BEEE2001	Electrical Measurement and Instrumentation	3	0	0	3	20	30	50
7	BEE02P2007	Engineering Clinic-2 (IOT based Tinker CAD)	0	0	2	1	50		50
8	BEE02P2010	Electronic Devices and Circuits Lab	0	0	2	1	50		50
9	BEE02P2009	Measurement and Control Systems Lab	0	0	2	1	50		50
10	BEE02P2008	Logical and Critical Reasoning	0	0	2	1	50		50
		Total				22			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE3004	Microcontroller and Embedded system	3	0	0	3	20	30	50
2	BTEE3004	Electrical Machine-2	3	0	0	3	20	30	50
3	BTEE3009	Power System Analysis	3	0	0	3	20	30	50
4	BTEE3011	Power Electronics	3	0	0	3	20	30	50
5	********	Program Elective-I	3	0	0	3	20	30	50
6	********	Program Elective-II	2	0	0	2	20	30	50
7	BEE02P3001	Engineering Clinic-3(Industrial Internship)	0	0	2	1	50		50
8	BEE02P3002	Effective Leadership and Decission Making Skills	0	0	2	1	50		50

9	BECE3005	Microcontroller and Embedded Systems Lab	0	0	2	1	50		50
10	BEE01T3003	Database Management System	0	0	2	1	50		50
11	BEE02T3004	Finance for Electrical Engineers	2	0	0	1	20	30	50
12	BTEE3005	Electrical Machine Lab-2	0	0	2	1	50		50
		Total				23			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	SLBT3002	Campus to Corporate program	0	0	4	2	50		50
2	BEE02T3005	High Voltage Engineering	3	0	0	3	20	30	50
3	BEE02T3006	Power System protection	3	0	0	3	20	30	50
4	BTEE4005	Professional Ethics and Values	2	0	0	0	20	30	50
5	********	Program Elective-III	3	0	0	3	20	30	50
6	********	Program Elective-IV	3	0	0	3	20	30	50
7	BTEE4013	Electrical Machine Design	3	0	0	3	20	30	50
8	BEE02P3008	Design and Innovation Project	0	0	2	1	50		50
9	BEE02P3007	Power System protection Lab	0	0	2	1	50		50
10	GERN1001/JAPA1001/FREN1001	Forign Language - 1 (German, Japneese, French) *any one	0	0	2	0	50		50
11	BEE02P3008	Machine Learning Using Python Programming	0	0	2	1	50		50
		Total				20			
Semester VII									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEEE4001	Smart Grid and Energy management	3	0	0	3	20	30	50
2	********	Program Elective-V	3	0	0	3			
3	********	Program Elective-VI	3	0	0	3			
4	********	Open Elective-1	3	0	0	3	20	30	50
5	********	Open Elective-2	3	0	0	3	20	30	50
6	BEE02T4001	Electrical Design, Estimation and Energy Audit	3	0	0	3	20	30	50
7	BTEE3008	PLC/SCADA Lab	0	0	2	1	50		50
8	BEE03P4003	Industrial Internship	0	0	0	0	50		50
9	BEE02P4005	Technical Seminar	0	0	2	0	50		50
10	BEE02P4002	Capstone Design Phase-I	0	0	10	2	50		50
11	GERN/JAPA/FREN 1002	Forign Language - 2 (German, Japneese, French) *Optional	0	0	2	0	50		50
		Total				21			
Semester VIII									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEE02P4003	Capstone Design phase - II	0	0	18	6	50		50
2	BEE02P4004	Industrial Internship & Technical Seminar	0	0	0	6	50		50

		Total				12			

List of Program Electives

Control Engineering

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BTEE3019	Advanced Control System	3	0	0	3	20	30	50
2	BTEE3020	Industrial Automation and Control	3	0	0	3	20	30	50
3	BEE02T5001	Industrial Instrumentation and Automation	3	0	0	3	20	30	50
4	BEEE5005	Power System Operation and Control	3	0	0	3	20	30	50
5	BEEE5004	Digital Control	3	0	0	3	20	30	50
6	BEE03T5002	Automation and Robotics	3	0	0	3	20	30	50

Power Engineering

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEE03T5011	Power System Equipments	3	0	0	3	20	30	50
2	BTEE3023	Power Quality	3	0	0	3	20	30	50
3	BTEE4001	Electric Drives	3	0	0	3	20	30	50
4	BTEE4010	FACTS and HVDC	3	0	0	3	20	30	50
5	BEE02T5003	Electrical and Hybrid Vehicle	3	0	0	3	20	30	50
6	BTEE4009	Power System Deregulation	3	0	0	3	20	30	50

Energy Engineering

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEEE2018	Non-conventional Energy Resources	3	0	0	3	20	30	50
2	BTEE4011	Energy Assessment and Audit	3	0	0	3	20	30	50
3	BTEE5102	Utilization of Electrical Energy and Traction System	3	0	0	3	20	30	50
4	BEE03T5010	Power Electronics applications in Renewable Energy	3	0	0	3	20	30	50
5	BTEE5202	Special Electrical Machine	3	0	0	3	20	30	50
6	BEE02T5004	Energy Modelling Simulation Using MATLab	3	0	0	3	20	30	50

Processing and Computing Techniques

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BTEE4012	Machine learning	3	0	0	3	20	30	50
2	BEE02T5005	Image Processing using MATLab	3	0	0	3	20	30	50

3	BEE02T5006	Introduction to Scilab and its applications	3	0	0	3	20	30	50
4	BEE02T5008	Human Computer Interface	3	0	0	3	20	30	50
5	BECE3020	Digital Signal Processing	3	0	0	3	20	30	50
6	BECE4401	Soft Computing	3	0	0	3	20	30	50
7	BTEE4015	Neural Networks and Fuzzy Control	3	0	0	3	20	30	50
8	BEE02T5007	Neural Networks and Deep Learning Algorithms	3	0	0	3	20	30	50

	List of Open elective (Engineering courses) Proposed								
	Basket 1								
Sl. No.	Course Code	Course Title					Assessment Pattern		
		Basket 1	L	T	P	C	IA	MTE	ETE
1	BOE601	Human Computer Interface	3	0	0	3	20	50	100
2	BOE602	Introduction to cyber Physical Systems	3	0	0	3	20	50	100
3	BOE603	Selected Topics in Signal Processing	3	0	0	3	20	50	100
4	BOE604	Selected Topics in Communication Engineering	3	0	0	3	20	50	100
5	BOE605	Autonomous Vehicles	3	0	0	3	20	50	100
6	BOE606	Data Science	3	0	0	3	20	50	100
7	BOE607	Computer Vision	3	0	0	3	20	50	100
8	BOE608	Artificial Intelligence	3	0	0	3	20	50	100
9	BOE609	Cyber Security	3	0	0	3	20	50	100
10	BOE610	Energy Management	3	0	0	3	20	50	100
11	BOE611	Estimation and Costing	3	0	0	3	20	50	100
12	BOE612	Data Envelopment Analysis	3	0	0	3	20	50	100
13	BOE613	Operation Management	3	0	0	3	20	50	100
14	BOE614	Construction Engineering	3	0	0	3	20	50	100
16	BOE615	Disaster Management	3	0	0	3	20	50	100
16	BOE616	Bioinformatics	3	0	0	3	20	50	100
Basket-2									
1	BOE701	Remote Sensing and GIS	3	0	0	3	20	50	100
2	BOE702	Automotive Electronics	3	0	0	3	20	50	100
3	BOE703	Sensors & Actuators	3	0	0	3	20	50	100
4	BOE704	IoT and Smart Cities	3	0	0	3	20	50	100

5	BOE705	Web Design and Management	3	0	0	3	20	50	100
6	BOE706	Principles of Telemedicine	3	0	0	3	20	50	100
7	BOE707	Mobile Application Development	3	0	0	3	20	50	100
8	BOE708	Business Analytics	3	0	0	3	20	50	100
9	BOE709	Cloud Computing	3	0	0	3	20	50	100
10	BOE710	Block Chain	3	0	0	3	20	50	100
11	BOE711	Augmented / Virtual Reality	3	0	0	3	20	50	100
12	BOE712	Digital Forensics	3	0	0	3	20	50	100
13	BOE713	Operations Research	3	0	0	3	20	50	100
14	BOE714	Renewable Energy	3	0	0	3	20	50	100
15	BOE715	Interior Design	3	0	0	3	20	50	100
16	BOE716	Landscaping	3	0	0	3	20	50	100
17	BOE717	Biology for Engineers	3	0	0	3	20	50	100

Detailed Syllabus

Semester 3

Name of The Course	Electromagnetic Field Theory				
Course Code	BECE2012				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcomes:

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.
CO6	Understand the application of Electromagnetism in Daily Life

Reference Books

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
4. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999Syllabus

Course Content:

UNIT I STATIC ELECTRIC FIELDS 9 Hours
Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co- ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges – Electric field due to continuous charge distribution – Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet.Electric Scalar Potential – Relationship between potential and electric field – Potential due to infinite uniformly charged line – Potential due to electrical dipole – Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications
UNIT II: STATIC MAGNETIC FIELDS 8Hours
The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circ ular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.
UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9 Hours
Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials-Definition of Capacitance – Capacitance of various geometries using Laplace's equation– Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability – magnetic boundary conditions

UNT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS 8 Hours
Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form. Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.
UNIT V: ELECTRO MAGNETIC WAVES 9 Hours
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. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization, Brewster angle.
UNIT VI Applications of Electromagnetism
Household Application, Industrial Application, Magnetic Levitation Trains, Communication System, medical Systems

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Network Analysis and Synthesis				
Course Code	BTEE2002				
Prerequisite	Basic Electrical and Electronics Engineering				
Corequisite	Signals and systems				
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

4. To learn the concepts of network analysis in electrical and electronics engineering.
5. To learn linear circuit analysis, graph theory and network theorems.
6. Analyze two port networks using Z, Y, ABCD and h parameters

Course Outcomes

CO1	Apply the knowledge of graph theory with basic circuital laws and simplify the network using reduction techniques
CO2	Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO3	Infer and evaluate transient response, Steady state response, network functions
CO4	Evaluate two-port network parameters and explain the inter-relationship among parameters for network analysis.
CO5	Synthesize one port network using Foster and Cauer Forms and
CO6	Examine active filter configurations for possible applications in network theory.

Text Book (s)

1. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. A C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007,
3. D.RoyChoudhary, "Networks and Systems" Wiley Eastern Ltd.
4. A.Chakrabarti, "Circuit Theory" DhanpatRai& Co
5. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.

Reference Book (s)

1. Hayt, W., Engineering Circuit Analysis, Tata McGraw□Hill (2006)
2. Hussain, A., Networks and Systems, CBS Publications (2004).
3. Sudhakar, A., Circuits and Networks, Tata McGraw□Hill (2006).
4. Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).

Course Content:

Unit-1GraphTheory 6 hours
Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set,Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.

Unit-2Network Theorems (Applications to ac networks) 9 hours
Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman'stheorem, compensation theorem, Tellegen's theorem.
Unit-3Network Functions and Transient analysis 11 hours
Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.
Unit-4Two Port Networks 10 hours
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.
Unit-5Network Synthesis & Filters 9 hours
Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance,
Unit-6 Filters
Passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Network Analysis and Synthesis Lab			
Course Code	BTEE2003			
Prerequisite	Basic Electrical Engineering lab			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:

After the completion of course the students will

1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
2. To study the transient response of series and parallel A.C. circuits.
3. To study the concept of coupled circuits and two port networks.
4. To study the two port networks.

Course Outcomes

CO1	To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
CO2	To study the transient response of series and parallel A.C. circuits.
CO3	To study the concept of coupled circuits and two port networks.
CO4	To study the two port networks.
CO5	To introduce the concept of short circuit and open circuit.

Network Analysis and Synthesis Lab

1	To verify Thevenin's theorem in a.c.
2	To verify Norton's theorem in a.c.
3	To verify Superposition theorem in a.c.
4	To verify the Maximum Power Transfer Theorem.
5	Determination of Z-parameters of a two-port network.
6	To verify and determination of y-parameters of a parallel connected two-port network.
7	Determination of h-parameters of a two-port network.
8	To verify and determination of ABCD-parameters of a cascade interconnected two-port network.
9	Determination of characteristics impedance of a symmetrical T-network using S/C and O/C test.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Electrical Machine-I			
Course Code	BTEE2006			
Prerequisite	Basic Electrical Engineering			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To acquaint the students with the principle of operation and performance of transformers and DC machines.
2. To familiarize students with the parameter estimation of electrical machines
3. To learn the mathematical models and equations related to electrical machines.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles of electric machines
CO2	Analyse the electrical machines performance.
CO3	Test and estimate the parameter of the electrical machine.
CO4	Analysis the numerical problems associated with transformer and DC machines.
CO5	Make use of application of the subject topic with industries and day to day life
CO6	Understand of the special purpose transformer for measurement and its application

Text Book (s)

1. I.J. Nagrath& D.P. Kothari, "Electrical Machines", Tata McGraw Hill.
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khana Publisher.
3. P S Bimbhra, "Electrical Machinery", Khana Publisher.

Reference Book (s)

1. A. E. Fitzgerald, C. Kingsley, and S. D. Umans, *Electric Machinery*, 6th ed., New York: McGraw-Hill, 2003.
2. Vincent Del Toro, "Electrical Machine and Power System", PHI.

Course Content:

Unit-1Introduction
Flow of Energy in Electromechanical Devices, Magnetic Circuit, Analogy b/w Electric and magnetic Ckt, B-H Curve, Hysteresis and eddy current losses, Mutual Coupling with dot convention, Energy in magnetic systems(defining energy & Co-energy) , Singly Excited Systems and Doubly excited Systems, Generated emf in machines; torque in machines with cylindrical air gap.
Unit-2 Single Phase Transformer
Construction- Core and Shell type, Basic principle of Operation, Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, polarity test. Auto Transformer: Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications.
Unit-3 Three Phase Transformers
Construction, three phase transformer phasor groups and their connections, open delta connection, choice of transformers for three phase circuits, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers.
Unit-4 D.C. Machines
Construction of DC Machines, Armature winding, Emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Methods of improving commutation, Performance Characteristics of D.C. generators, Voltage Regulation, Parallel operation of DC generator (shunt, series and compound machine).
Unit-5 D.C. Machines (Contd.)
Performance Characteristics of D.C. motors, Starting of D.C. motors ; 3 point and 4 point starters, Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test), Electric braking
Unit 6: Special Purpose Transformer
Instrument Transformer Current Transformer and Potential Transformer, Earthing Transformer

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-I lab				
Course Code	BTEE2007				
Prerequisite	Basic Electrical Engineering lab				
Corequisite					
Antirequisite					
	L	T	P	C	
	0	0	2	1	

Course Objectives:
After the completion of course the students will

1. This lab gives the chance to get friendship with Electrical machines.
2. To acquaint the students with the principle of operation and performance of transformers and DC machines.
3. To familiarize the students with the parameter estimation of electrical machines.
4. To compare the mathematical models and equations related to electrical machines.
5. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of electric machines.
CO2	Analysis the electrical machine performance through experiments.
CO3	Estimate the parameter of the transformer, DC machines.
CO4	Test the transformer, DC machines with various loads.
CO5	Make use of application of the subject topic with industries and day to day life.

List of Experiments of Electrical Machine –I

1	Efficiency and regulation of single phase transformer by Sumpner's back to back test.
2	Efficiency of DC shunt motor by Swinburne's test
3	Open circuit and short circuit test on single phase transformer.
4	3-phase to 2-phase conversion with two single phase transformers by Scott connection.
5	Speed control of DC motor by Armature and Field Control.
6	Load characteristics of DC shunt generator and plot load voltage Vs load current.
7	Magnetization characteristics of DC shunt generator.
8	Losses and efficiency of DC machine by Hopkinson's test.
9	Load characteristics of DC compound generator and plot load voltage Vs load current.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Signals and Systems			
Course Code	BECE2016			
Pre-requisite	Engineering Mathematics			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:
This subject is about the mathematical representation of signals and systems. The most important representations we introduce involve the *frequency domain* – a different way of looking at signals and systems, and a complement to the time-domain viewpoint. Indeed engineers and scientists often think of signals in terms of frequency content, and systems in terms of their effect on the frequency content of the input signal. Some of the associated mathematical concepts and manipulations involved are challenging, but the mathematics leads to a new way of looking at the world.
Course Outcomes:

CO1	Understand various types of signals, classify, analyze and perform various operations on them.
CO2	Classify the systems and realize their responses
CO3	Analyze the response of continuous time systems using Fourier transforms
CO4	Use Laplace and Z transform techniques as tool for System analysis
CO5	Analyze the continuous and discrete time system functions
CO6	Understand the application of Sampling Theorem, Multirate Signal Processing and their applications in real-world problems

Text Book:

1. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi, ISBN 1259083349, 9781259083341
2. Signals and Systems by Oppenheim &WilskyMillman

Course Content:

Unit-1 Introduction 8 hours
Signals and systems as seen in everyday life, and in various branches of engineering and science. Types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; Basic Signals: unit impulse, unit step, unit ramp, exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit-2 Classification of Systems 8 hours
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit-3 Fourier Series and Transforms 8 hours
Continuous-time Fourier series: Periodic signals and their properties, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, Definition, conditions of existence of FT, properties, magnitude and phase spectra, Parseval's theorem, Inverse FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit-4 Laplace Transforms and Z Transforms 8 hours
One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping
Unit-5 Analysis of LTI systems 8 hours
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter
Unit -6: **Multirate Signal Processing** 8 hours
Sampling and data reconstruction process, Multirate Signal Processing, Sampling, Sampling rate conversion, introduction to compressive sensing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Design and Engineering			
Course Code	BEE02T2003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	2	0	0	2

Course Objectives:

The purpose of this course is to excite the student on creative and innovative design and its significance, aware of the processes involved in design, understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design and get an exposure as to how to engineer a design.

Course Outcomes

CO1	Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
CO2	To understand the production based on the market demand
CO3	Aware of the product oriented and user oriented aspects that make the design a success.
CO4	Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course
CO5	Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.
CO6	Will be able to design the Product centred and user centred design.

Text Book (s)

1. Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design – [Part 3 – Chapters 17 to 27], ISBN13: 978-0124158917 ISBN-10: 0124158919
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design – A Project based introduction – Wiley, ISBN-978-1-118-32458-5
3. Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
4. Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
5. Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
6. Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India

Reference Book (s)

1. E-Book (Free download): http://opim.wharton.upenn.edu/~ulrich/designbook.html
2. .http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

Course Content:

Unit I:Introduction to design 11 lecture hours Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength. How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement;
Unit II: Market Survey Market survey customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs.
Unit III: Design process 9 lecture hours Design process- Different stages in design and their significance; Defining the design space; Analogies and "thinking outside of the box"; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of "Complex is Simple". Design for function and strength. Design detailing- Material selection, Design visualization- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications.
Unit IV: Prototype 8 lecture hours Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling; manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design
Unit V: Design Monitoring 7 lecture hours Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length.
Unit VI: Design Attributes 4 lecture hours Product centred and user centred design. Product centred attributes and user centred attributes. Bringing the two closer.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Semester 4

Name of The Course	Control systems			
Course Code	BEEE3002			
Prerequisite	Signals and Systems			
Corequisite	None			
Antirequisite	None			
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand and develop the Mathematical Modelingof dynamic systems using classical and state-space techniques.
2. To apply analytical /graphical techniques in time/frequency domain to determine stability.

3. To understand and use applications of feedback control theory to a variety of real world problems.

Course Outcomes

CO1	Understand mathematics modeling of control systems sand solve it using transfer function, block diagram and signal flow diagram reduction techniques.
CO2	Design and analyze control system engineering problems in time response of first and second order systems.
CO3	Analyze the concept and stability of servo systems using algebraic stability criteria with necessary conditions.
CO4	Understand and analyze the stability analysis using the polar, inverse polar, Bode, and Nyquist stability criterion of control systems
CO5	Understand and design of lead, lag and lead-lag compensator of the control process in time and frequency domains.
CO6	Analysis of the state space systems and its application

Text Book (s)

1. Nagrath& Gopal, "Control System Engineering", 4th Edition, New age International
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.

Reference Book (s)

1. B.C. Kuo&FaridGolnaraghi, "Automatic Control System" Wiley IndiaLtd, 2008.
2. D.RoyChoudhary, "Modern Control Engineering", Prentice Hall of India.

Course Content:

Unit-1Introduction
Feedback Control: Open loop and closed control system, servomechanism, Physical examples. Transfer functions of linear time-invariant systems, Block diagram algebra, and Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.
Unit-2
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: Error analysis. P, PI, PD, PID controllers, design considerations for higher order systems, performance indices.
Unit-3
Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis, Routh-Hurwitz criteria and limitations, root locus concepts, construction of root locus. Design of controllers using root-locus. Pole placement with state feedback, controllability.
Unit-4
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-5
Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs in time domain and frequency domain. Review of state variable technique:
Unit -6
Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electronics Devices and Circuits			
Course Code	BECE2015			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. Apply concepts of semiconductor devices to design and analyze circuits.
2. To prepare students to know the characteristics of different semiconductor devices.

Course Outcomes

CO1	Realize the transistor biasing methods and Design analog electronic circuits using discrete components

CO2	Design common amplifier circuits and analyze the amplitude and frequency responses
CO3	Design various analog circuits to analyze their responses
CO4	Understand the principle of operation of different Oscillator circuits.
CO5	Understand the principle of operation of various amplifier circuits
CO6	Understand the recent trends and practical applications of electronic devices

Text Book (s)

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', 2nd Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634637, 9780070634633

2. David A.Bell, 'Electronic Devices and Circuits', Prentice Hall of India Private Limited, New Delhi, 2003, ISBN 013253147X, 9780132531474

Reference Book (s)

1.Theodre F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004 ISBN 8177588877, 9788177588873.

2. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6th Edition, PHI 2009, ISBN 0132454793, 9780132454797

Course Content:

Unit-1 Introduction 8 hours
BJT and BJT Biasing .Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, Cascode amplifier. HF & LF compensation of RC coupled amplifier. Multistage Amplifiers.
Unit-2FET and FET Biasing8 hours
FET and FET Biasing. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. Small signal analysis of FET Amplifiers. High Frequency analysis of FET Amplifiers, VMOS & CMOS Concepts.
Unit-3Feedback amplifiers 8 hours
The feedback concept – Transfer gain with feedback – general characteristics and advantages of negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions
Unit-4Oscillators 8 hours
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators.
Unit-5Tuned amplifiers 8 hours
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization. Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.
Unit-6 Recent trends and Application 8 hours
Trend of Energy Saving in Electronic Devices, Application of oscillators- springs and damping, shock absorber in cars, Pendulum

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Fundamental of Power systems			
Course Code	BTEE2008			
Prerequisite	Basic Electrical			
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

1. To develop solid foundation for further study of power system courses.
2. To develop the analytical skills for solving problems related to power system.
3. To familiarize students of the basics of power system components, transmission

parameters and losses in the transmission line etc.

Course Outcomes

CO1	Exposure to the modeling of individual power system components like transmission lines and generators
CO2	To understand the overhead transmission line parameters importance and its calculation procedure
CO3	Analyze the overhead transmission line performance
CO4	Analyze the corona phenomena, interference and insulator application and transmission lines
CO5	Apply the knowledge of transmission line design in analysis of mechanical strength of the towers.
CO6	Estimate EHVC and HVDC transmission line parameters and their neutral grounding

Text Book (s)

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
2. AsfaqHussain, "'Power System", CBS Publishers and Distributors.

Reference Book (s)

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill
2. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Course Content:

Unit-1 Power System Components 6 hours
Single line Diagram of Power system Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator Calculation of single and Three phase Power Choice of transmission voltage Transmission line types of conductors and resistance Skin effect Proximity effect Kelvin's law
Unit-2: Over Head Transmission Lines 6 hours
Calculation of inductance single phase, three phase and double circuit Transmission line Calculation of capacitance single phase, three phase and double circuit Transmission line
Unit-3: Over Head Transmission Lines Performance
Transmission line classification Representation and performance of short Transmission line Representation and performance of medium nominal T and Nominal Pi Transmission line Representation and performance of long Transmission line Surge impedance loading Ferranti effect
Unit: 4 Corona and Interference 9 hours Phenomenon of corona and its formation Calculation of potential gradient Corona loss, factors affecting corona and methods of reducing corona Electrostatic and electromagnetic interference with communication lines Type of insulators and their applications Potential distribution over a string of insulators String efficiency and Methods of equalizing the potential
Unit-5 Mechanical Design of transmission line 9 hours
Catenary curve of transmission line Sag and tension Affect due to ice and wind on sag, Types of insulated cables and its construction Dielectric stress and Insulation resistance Capacitance measurement of a single phase and three phase cables Dielectric loss and loss triangle
Unit-6 Neutral grounding and HVDC/HVAC 9 hours Necessity and its methods of neutral grounding Earthing transformer and Grounding practices. Design consideration of EHV transmission lines Choice of voltage Number of circuits Conductor configuration Insulation design and Selection of ground wires Introduction to EHV AC and HVDC transmission Their comparison Use of bundle conductors Kinds of DC links Use of HVDC system in AC transmission system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Plant Engineering			
Course Code	BTEE3015			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

Power plant engineering or power station engineering is a division of power engineering, and is defined as the engineering and technology

required for the production of central station electric power. The field is focused on the generation of power for industries and communities, not for household power production. The field is an interdisciplinary field, using the theoretical base of both mechanical and electrical engineering. The engineering aspect of power plant management has evolved with technology and has become progressively more complicated. The introduction of nuclear technology and the progression of other existing technologies have allowed power to be created in more ways and on a larger scale than was previously possible.

Course Outcomes

CO1	Analyze different types of steam cycles and estimate efficiencies in a steam power plant.
CO2	Understand the basic components of coal base thermal power plants.
CO3	Define the performance characteristics and components of such power plants.
CO4	Estimate different efficiencies associated with power generation system systems.
CO5	Calculate present worth depreciation and cost of different types of power plants.
CO6	Estimate the cost of producing power per kW.

Text/ Reference Books:

1. S.N. Singh, "Electric Power Generation, Transmission& distribution." PHI Learning.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. Power system Voltage stability - C.W. Taylor , Mc. Graw Hill, 1994.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.

Syllabus

Unit-I	Coal based Thermal Power Plants	5 Hours
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate,		
Unit II	Component of Thermal Power Plant	5 Hours
Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.		
Unit-III	Diesel, Gas Turbine and Combined Cycle Power Plants	7 Hours
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-IV	Nuclear Power Plants	8 Hours
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-V	Power from Renewable Energy	8 Hours
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-VI	Energy, Economic and Environmental issues of Power Plants	7 Hours
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.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Measurements and Instrumentation			
Course Code	BEEE2001			
Prerequisite	Basic Electrical and Electronics Engineering			
Corequisite	EMFT			
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To know the necessity of different measuring instruments and their design principle

2. To understand the working principle of different measuring instruments and technical solutions to handle different errors.
3. To learn the architecture and working principle of advanced measuring instrument and their applications.

Course Outcomes

CO1	Apply physical principles to study the construction and working principle of different analog instruments and analyze the errors takes place in measurements.(K3- Apply)
CO2	Apply the physical principle to study the working of instrument transformers and measurement of speed, frequency and power factor. (K3- Apply)
CO3	Model the solar and wind energy system for standalone and grid integration system. (Apply-KL-3)
CO4	Demonstrate the principle of operation of other renewable energy sources(ocean thermal, geo-thermal and micro hydro power) also importance of its role. (Understanding-KL-2)
CO5	Understand the basic working principle of digital instruments. (Understanding-KL-2)
CO6	Examine the waveforms using analyzers and oscilloscopes. (K3- Apply)

Text Book (s)

1. A Course in Electrical and Electronics Measurement and Instrumentation, "A K Shawney", Publisher: Dhanpat Rai & Co
2. Electrical Measurements and Measuring Instruments, E.W Golding, F.C Widdis, Publisher: Reem Publications
3. Electronic Instrumentation and Measurements- David A Bell, Oxford University Press, 2006

Reference Book (s)

1. Basic Electrical Measurements: M B Stout
2. Electronic Instrumentation: H S Kalsi, Tata-Mc-Graw Hill Publication, Second Edition.

Course Content:

Unit-1Philosophy of Measurement & Analog Measurement of Electrical Quantities 9 hours
Unit& dimensions, standards, Errors, Characteristics of Instruments and measurement system, basics of statistical analysis. PMMC instrument, DC ammeter, DC voltmeter, Ohm meter, Moving Iron instrument, Electrodynamic Wattmeter, errors and remedies, Three Phase Wattmeter, Power in three phase system, Energy meter.
Unit-2Measurement: Instrument Transformer 6 hours
Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.
Unit-3Measurement of Parameters 9 hours
Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges-Wheatstone, Kelvin, Maxwell, Hay's, Anderson, Owen, Heaviside, Campbell, Schering, Wien bridges, Wagner Earthing device, Q Meter.
Unit-4AC Potentiometer & Magnetic Measurement 7 hours
Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement. Ballistic Galvanometer, Flux meter.
Unit-5Digital Measurement of Electrical Quantities 5 hours
Concept of digital measurement, Digital voltmeter, Frequency meter, Power Analyzer and Harmonics Analyzer, Electronic Multimeter.
Unit-6 Cathode Ray Oscilloscope 5 hours
CRT, wave form display, time base, dual trace oscilloscope, Measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Sampling Oscilloscope, DSO, DSO applications.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Semester 5

Name of The Course	Microcontroller and Embedded Systems			
Course Code	BECE3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

Microcontrollers are the most useful electronic chips which are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. Students learn CPU architecture, memory management, bus concepts, bus arbitration techniques, interfacing of systems using AD/DA, serial I/O devices, interrupt control devices, including design, construction, and testing of dedicated microcontroller systems.

Course Outcomes

CO1	Demonstrate the internal organization and operation of microcontrollers.
CO2	Analyse the design issues in the embedded system.
CO3	Design Microcontroller based application.
CO4	Program 8051 for application specific solution.
CO5	Analyse the different programming methods for controller and their issues.
CO6	Illustrate the latest trends adapted in designing microcontroller based system

Course Content:

Unit I: Introduction 08 Hours
Introduction to Microprocessors, Microcontrollers and system design – Assembly and High-Level language programming – System Development Environment: assembler, compiler and integrated development environment.
Unit II: 8051 Microcontroller 08 Hours
Introduction to single chip Microcontrollers,8051-architecture – 8051 assembly language programming, addressing modes – Instruction sets- interrupts, timers and serial communication.
Unit III: Embedded applications 08 Hours
Programming the interrupts, timers and serial communication – system design with 8051. Application **of Microcontrollers** in data acquisition systems, process control, signal processing, data communication and distributed computing and networking..
Unit IV: Embedded programming 08 Hours
Programming in Assembly Language (ALP) Vs. High level language – C program elements, Macros and Functions – Use of pointers– use of function calls – NULL pointers – multiple function calls in a cyclic order in the **main function** pointers –C program compilers – Cross compiler – optimization of memory codes.
Unit V: Embedded System design 08 Hours
Introduction, Embedded System project management – Embedded system design and Co-Design Issues in System Development process – Design cycle in the development phase for an embedded system – Uses of Target system or its emulator and In-Circuit Emulator
Unit VI: Recent trends in Micro controller
Machine learning on tiny ML processor, introduction of mixed signal processor, DMA architecture

Suggested Reading.

1. Mohammad Ali Mazidi and Janice GillispieMaszidi "The 8051 Microcontroller andEmbedded Systems" Pearson education, 2003, ISBN- 9788131710265, 2ndEdition

2. Kenneth J. Ayla, "The 8051 Micro controller", Thomson learning, 3rd edition, 2004,ISBN-140186158X

3. Alan Clements, "Principles of Computer Hardware", OxfordUniversity Press, 3rd Edition,2003, ISBN-9780198564539

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-II			
Course Code	BTEE3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To acquaint the students with the principle of operation and performance of AC machines.
2. To familiarize students with the parameter estimation of electrical machines.
3. To learn the mathematical models and equations related to electrical machines.
4. To familiarize students with the other special machines.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles of three-phase Induction Motor.
CO2	Analysis the numerical problems and performance associated with AC machines.
CO3	Make use of application of the single phase IM with industries and day to day life.
CO4	Use special machine for different application.
CO5	Analysis the demanding and conventional Alternator performance.
CO6	Test and estimate the parameter of the Synchronous Motor.

Course Content:

Unit I: Three phase Induction Machine – I 08 Hours
Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator: Generator action, methods of excitation & applications.
Unit II:Three phase Induction Machine- II 08 Hours
Starting, Deep bar and double cage rotors, Speed Control (with and without emf injection in rotor circuit.), Electrical braking, operation on unbalanced supply voltage, effect of slot harmonics and space harmonics, merits, demerits and introduction of linear induction motor.
Unit III: Single phase Induction Motor 08 Hours
Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods of Single phase Induction Motor,
Unit IV: Fractional Motors
Repulsion motor, other Motors: Universal motor, Hysteresis motor, stepper motors, switched reluctance motor, BLDC, brushless dc motor
Unit V: Synchronous Machine I 08 Hours
Constructional features, EMF Equation, Armature winding, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient.
Unit V: Synchronous Machine II 08 Hours
Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics. Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, concepts of synchronous machine reactance, Synchronizing, Electrical braking, Hunting & damping, synchronous condenser.

Suggested Reading

1. I.J. Nagrath& D.P. Kothari, "Electrical Machines", Tata McGraw Hill.
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khana Publisher.
3. P S Bimbhra, "Electrical Machinery", Khana Publisher.
4. Theodre F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004.
5. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6th Edition, PHI 2009, ISBN 0132454793, 9780132454797

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Analysis			
Course Code	BTEE3009			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Modeling and solution on digital computers is the only practical approach to systems analysis and planning studies for modern day power system with its large size, complex and integrated nature.
2. This course has been designed to fulfill this need by integrating the basic principles of power system analysis illustrated through the simplest system structure with analysis techniques for practical size systems.

3. The digital computer being an indispensable tool for power system analysis, computational algorithms for various system studies such as load flow, fault level analysis, stability etc have been included in the syllabus. Students should be encouraged to build computer programs for these studies using algorithms provided.

Course Outcomes

CO1	Understand fundamental concepts relating to the analysis of electrical power systems
CO2	Understand the fault condition inside transmission line and the generating system.
CO3	Analyse of load flow equations and representation of power system components
CO4	Understand the importance of power swing equation in power system stability
CO5	Apply the knowledge in power system stability analysis during abnormal conditions.
CO6	Understand the basic concepts of travelling waves over transmission lines.

Course Content:

Unit I: Representation of Power System Components 08 Hours
Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System. Symmetrical components: Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks. Symmetrical fault analysis, Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.
Unit II: Unsymmetrical faults 08 Hours
Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Z-bus using singular transformation and algorithm, computer method for short circuit calculations.
Unit III: Load Flow Analysis 08 Hours
Introduction, bus classifications, nodal admittance matrix (bus y), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method, Comparison of load flow methods.
Unit IV: Power System Stability-1 08 Hours
Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion,
Unit V: Power System Stability-2 08 Hours
Synchronizing power coefficient, critical clearing angle and critical clearing time. Factors affecting steady state and transient stability and methods of improvement.
Unit VI: Traveling Waves 08 Hours
Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipment's and line against traveling waves.

Suggested Reading

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition.
2. Asfaq Hussain, "'Power System", CBS Publishers and Distributors.
3. H.Saadat, Power System Analysis, Tata McGraw-Hill Publishing Company Limited, Edition 2008.
4. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill.
5. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Electronics			
Course Code	BTEE3011			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. The field of power electronics encompasses the application of fundamental concepts in several disciplines: electronic devices and circuits, variable speed drives and control systems.

2. The use of electric cars, electric trains and electric subway trains can substantially reduce urban pollution problems.

3. Students learn power electronics devices like thristors, MOSFET, IGBT, GTO etc., various phase controlled single phase and three phase rectifiers with performance factors, dual converters, principle of dc to dc conversion, class A,B,C,D,E,F choppers, commutation techniques, comprehensive treatment of dc to ac inverters, ac voltage converters and cycloconverters.

Course Outcomes

CO1	Understand the operation of switching power devices eg. thyristors, transistors and TRIAC.
CO2	Implement configurations of thyristor based choppers.
CO3	Apply and develop configurations of thyristor based Single phase controlled rectifiers
CO4	Apply and develop configurations of thyristor based Three phase controlled rectifiers
CO5	Apply and develop configurations of thyristor based ac voltage controllers, cycloconverters
CO6	Implement different configurations of thyristor based inverters.

Course Content:

Unit I: Power semiconductor Devices 08 Hours
Introduction, Characteristics and specifications of switches, Power Diodes, Power Transistors: Operation. Steady state and switching characteristic, Power MOSFETs: Operation and characteristics, Insulated Gate Bipolar transistor: structure, working, latch-up, characteristics, Thyristors: Operation, charateristics, two-transistor model, Turn-on methods, Switching characteristic, Rating and protection, Commutation techniques of thyristor, Series and parallel operation of thyristors, Gate turn off thyristor.
Unit II: DC-DC Converters 08 Hours
Principles of step-down chopper, step down chopper with R-L load Principle of step-up chopper, and operation with RL load, classification of choppers, Buck, Boost and Buck-Boost converter.
Unit III: Single Phase Controlled Converters 05 Hours
Single-phase half wave converter with R, RL and RLE loads, Effect of freewheeling diode, Performance parameters, Single-phase full wave converter, midpoint and bridge converter, Effect of source inductance on single-phase converter, Single phase dual converter,
Unit IV: Three Phase Controlled Converters05 Hours
Three phase half wave converter with R and RL loads, Three-phase full converter, Performance parameters, Effect of source inductance on three-phase converters, Three-phase dual converter.
Unit IV: AC Voltage Controllers 08 Hours
Principle of on-off and phase control, Single-phase two SCRs in anti parallel with R and RL load, Triac with R and RL load, Three-phase ac voltage controllers, Cycloconverters: Basic principle of operation, Single phase to single phase, three-phase to single-phase cycloconverters, Three phase to three phase cycloconverters
Unit V: Inverters 08 Hours
Single phase voltage source inverter, Three-phase bridge inverters, 180 degree conduction, 120 degree conduction, Voltage control of inverters,

Pulse-width modulated inverters, Harmonics reduction techniques, Single phase and three phase current source inverters.

Suggested Reading

1. M. H. Rashid," Power Electronics: Circuits, Devices & Applications", Prentice Hall of India, Ltd. 3rd Edition, 2004.
2. V. R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford, University Press, 2007.
3. M. D. Singh & K. B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company, 1989.
4. M. S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004.
5. Chakrabarti& Rai, "Fundamentals of Power Electronics &Drives" Dhanpat Rai & Sons.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Finance for Electrical Engineers			
Course Code	BEE02T3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

- For any developing country, innovation, entrepreneurship and intellectual property rights hold the key to the entry in the league of developed countries. Equipped with the scientific knowledge and the right training, the engineer is an important building block of a nation.
- Economics and its impact on science and technology have to be well understood by the engineers to ensure success of any technological venture.

Course Outcomes

CO1	Understand basics of industrial finance and economy.
CO2	Analyze the various concept of cost.
CO3	Analyze the market types and lay supply
CO4	Apply various technique to build budget for electrical project.
CO5	Analyze various financial techniques.
CO6	Understand the basic financial installation cost of renewable power plant

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit I: Introduction 08 Hours
Various Definition of Economics, Nature of Economics problem, relation between science, engineering, technology & economics, Meaning of demand, law of demand, elasticity of demand, practical importance & applications of the concept of elasticity of demand.
Unit II: Capital Budgeting 08 Hours
Meaning of production and factor of production – Land, Labour, Capital, Entrepreneur & organizations – their characteristics, law of variable proportion, return to scale,Cost Analysis-various concept of cost, cost function, short & long run cost, concept of revenue, break-even analysis.
Unit III: Management of Working Capital 08 Hours
Meaning of market-type of market-perfect competition, Monopoly, Oligopoly, Monopolistic competition (Main feature of these market) Meaning of supply and law of supply; Role of demand & supply in price determination imperfect competition.
Unit IV: Budgeting Control Technique 08 Hours
Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.

Unit V: Financial management 08 Hours
Financial management: Financial management, accounting concepts. Financial statement analysis. Financial investment analysis. Financial decisions. Managing components of working capital investment & financing decisions.
Unit VI: Renewable Power Plant
Analysis of installation cost based on rating of Renewable power plant

Suggested Reading

1. Financial Management and Accounting – P. K. Jain, S. Chand & Co.
2. Modern micro economic theory – H.L. Ahuja, S.Chand.
3. Advance economic theory – M.L. Jhingan, Konark publication.
4. Engineering economics – Sullivan, Wicks, Koelling – Pearsons.
5. Financial management by Rajiv shrivastava and Anil Mishra – Oxford publication

Name of The Course	Electrical Machine-II lab			
Course Code	BTEE3005			
Prerequisite	Electrical Machine-I and BEEE Lab			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:
After the completion of course the students will

1. This lab gives the chance to get friendship with Electrical machines.
2. To acquaint the students with the principle of operation and performance of AC machines.
3. To familiarize the students with the parameter estimation of AC machines.
4. To compare the mathematical models and equations related to AC machines.
5. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of Single and three phase Induction machines and three phase Synchronous machines.
CO2	Analysis the AC machines performance through experiments
CO3	Estimate the parameter of the Induction machines and Synchronous machines
CO4	Test Induction and Synchronous machines with various loads
CO5	Make use of application of the subject topic with industries and day to day life

List of Experiments:

1	Perform no load and blocked rotor test on a single phase induction motor.
2	Determine performance characteristic of a three phase squirrel cage induction motor.
3	No load and blocked rotor test on three phase induction motor.
4	Load test on three phase squirrel cage induction motor.
5	Break test on three phase induction motor.
6	Separation of no load losses of three phase induction motor.
7	Perform open and short circuit test on a 3-phase alternator
8	Regulation of a three phase alternator by ZPF and ASA method.
9	Determination of Xd and Xq of a Salent pole synchronous machine.
10	Determine the characteristic of field current with armature current of the synchronous machine

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Microcontroller and Embedded Systems Lab			
Course Code	BECE3005			
Prerequisite	Digital Electronics			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:

To Introduce ALP concepts, features and Coding methods
1. Write ALP for arithmetic and logical operations in 8051
2. Differentiate Serial and Parallel Interface
3. Interface different I/Os with Microcontroller

Course Outcomes:

After the completion of course the students will

CO1	Demonstrate ability to handle arithmetic operations using assembly language programming
CO2	Demonstrate ability to handle logical operations using assembly language programming
CO3	Demonstrate ability to handle string instructions using assembly language programming
CO4	Demonstrate ability to handle sorting operations and using assembly language programming
CO5	Develop microcontroller based designs of Real Time Systems.

List of Experiments:

1	Basic arithmetic and Logical operations
2	Code conversion, decimal arithmetic and Matrix operations.
3	Square and Cube program, Find 2‘s complement of a number
4	Unpacked BCD to ASCII
5	Counters and Time Delay Peripherals and Interfacing Experiments
6	Traffic light controller
7	Stepper motor control
8	Digital clock
9	Key board and Display
10	Serial interface and Parallel interface
11	A/D and D/A interface and Waveform Generation 8051 kits

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Semester 6

Name of The Course	High Voltage Engineering
Course Code	BEE02T3005
Prerequisite	
Co-requisite	
Anti-requisite	

L	T	P	C
3	0	0	3

Course Objectives

1. The course imparts knowledge about voltage break down of solid, liquid and gaseous materials used in electrical engineering field.
2. Students will learn generation of high voltages and currents.
3. Students will learn the measurement and testing of high voltages and currents.

Course Outcomes

CO1	Understand the significance high voltage engineering and its implementation in power System
CO2	Overcome upon the challenges associated with generation and measurement of high voltages and currents
CO3	To analyze Generation of High Voltages and Currents drivers and its benefits.
CO4	To analyze measurement of High Voltages and Currents drivers and its benefits
CO5	Understand about Non-Destructive Testing Sources.
CO6	Understand about the High Voltage Testing.

Course Content:

Unit I: Break Down In Gases 08 Hours
Ionization processes, Townsend’s criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen’s law, break down in non-uniform field, breakdown in vacuum.
Unit II: Break Down In Liquid Dielectrics 08 Hours
Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid. Break Down In Solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics.
Unit III: Generation of High Voltages and Currents 05 Hours

Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.
Unit IV: Measurement of High Voltages and Currents 05 Hours
Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements, factor, partial discharge measurements.
Unit V: Non-Destructive Testing 07 Hours
Measurement of direct current resistively, measurement of dielectric constant and loss.
Unit VI: High Voltage Testing08 Hours
Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

Suggested Reading

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill
2. Subir Ray,' An Introduction to High Voltage Engineering' Prentice Hall of India.
3. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
4. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers.
5. R. S. Jha, "High Voltage Engineering", DhanpatRai& sons.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Protection			
Course Code	BEE02T3006			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To introduce the students the principles of different protection schemes.
2. To develop students with an understanding of the characteristics, advantages and defects of different protection methods.
3. To prepare the students to design/coordinate protection schemes for given requirements.

Course Outcomes

CO1	Illustrate the principle of switchgear and protection schemes.
CO2	Choose right relays or circuit breakers for protection of electrical equipments
CO3	Design the ratings for relays or circuit breakers according to the requirement.
CO4	Understand the differential protection scheme and its application in protection of alternator and transformer
CO5	Examine protection of power system with various protection relays
CO6	Discuss about operation of circuit breakers.

Course Content:

Unit I: Introduction to protection system 08 Hours
Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology. Relays: Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.
Unit II: Relay application and characteristics 08 Hours
Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay. Static Relays: Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.
Unit III: Protection of transmission line 08 Hours
Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. Testing of Circuit Breaker: Classification, testing station and equipment's, testing procedure, direct and indirect testing.

Unit IV: Differential Protection 05 hours
Types of fault on transformers and motors, and its differential protection scheme
Unit V: Circuit Breaking 05 Hours
Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. Testing Of Circuit Breaker: Classification, testing station and equipment's, testing procedure, direct and indirect testing.
Unit VI: Apparatus protection 08 Hours
Circuit Breaker: Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.Types of faults on alternator, stator and rotor protection, Types of fault on transformers and motors

Suggested Reading

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
3. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
4. T.S.M Rao,"Power System Protection: Static Relays with Microprocessor Applications", Tata Macgraw Hill.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine Design				
Course Code	BTEE4013				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

The goal of this course is to provide advanced knowledge and understanding about the construction and design of the electrical machines. The course provides to the students the basis and the methodologies to a correct design of the electrical machines (transformers, rotating AC machines and DC machines). Innovative tools and techniques will be used for the design optimization of the electrical machine for industrial, automotive and aerospace applications. The applying knowledge and understanding capabilities will allow at the graduate to approach the problem linked to the design of the electrical machines.

Course Outcomes

CO1	Identify different components, parameters, materials, equations used in designing for electric machines and transformers.
CO2	Understand the dimension designing of transformer components based on equation and cooling methods.
CO3	Concepts of Induction motor and solve the problems related to design.
CO4	understand the design of various parts of DC machines
CO5	design concepts of synchronous machines and know about
CO5	Apply the computer aided design on an electrical machine.

Course Content:

Unit I: Introduction08 Hours
Basic design principles and approaches, Electrical Engineering Materials, Choice of specific Magnetic and electric loading, output equations and output coefficients, Main dimensions. Ratings, Heating, cooling and temperature rise, Standard specification.
Unit II: Transformer 08 Hours
Output Equation, Main Dimensions, Magnetic circuit, core construction and design, winding types, insulation, Loss allocation and estimation, Reactance, Temperature rise and method of cooling.
Unit III: Induction Machine 08 Hours
Output Equation, Main Dimensions, 3 phase: Rating specifications, length of air gap, standard frame sizes, choice of specific loadings, Design of stator windings, Rotor design – slots and

windings, calculations of equivalent circuit parameters. Operating characteristics.
Unit IV: DC machine 08 Hours
Output Equation, Main Dimensions, Magnetic circuit and Magnetization curve, Selection of poles, Design of armature, Commutator and brushes, performance prediction.
Unit V: Synchronous Machine 08 Hours
Output Equation, Main Dimensions, choice of specific loadings, Magnetization characteristic, Armature design, Field winding design, Design of damper winding.
Unit VI: Computer assisted design
Computer assisted design of transformer, Induction, dc and synchronous machines.

Suggested Reading

1. A K Sawhney; A Course in Electrical Machine Design; Dhanpat Rai & Co.
2. Clayton A E & Hancock N N : The Performance and Design of Direct Current Machines ; CBS Publishers and Distributors .
3. "DESIGN OF ROTATING ELECTRICAL MACHINES", JUHA PYRHONEN, TAPANI JOKINEN.
4. "PM MOTOR TECHNOLOGY: DESIGN AND APPLICATIONS", J.F. GIERAS, M. WING.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Semester 7

Name of The Course	Smart Grid and Energy Management
Course Code	BEEE4001
Prerequisite	Power System Analysis and Power Electronics
Corequisite	
Antirequisite	

	L	T	P	C
	3	0	0	3

Course Objectives:

A smart grid is an electrical grid which includes a variety of operational and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid.

1. To make use of the Smart grid with the coming future.
2. To analyze the global policies about the smart grid.
3. To develop and design the Advanced Metering infrastructure (AMI).
4. To estimate the Power Quality issues of Grid connected Renewable Energy Sources.

Course Outcomes

CO1	To learn about the Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid.
CO2	Understand about the International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives
CO3	To analyze Advanced Metering infrastructure (AMI) drivers and its benefits.
CO4	Understand about the Power Quality issues of Grid connected Renewable Energy Sources.
CO5	Understand about the IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter.
CO6	To analyze the conventional grid integrated with renewable energy sources

Text/ Reference Books:

1. A. S boyer, SCADA:supervisory Control and Data Acquisition, The Instrumentation system and Automation Society,4 th Edition 2009.
2. Vehbi C. Güngör, Dilan Sahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.

3. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids.
4. Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press.
5. B.G. Liptac Instrument Engineering Handbook,Volume 3:process Software and Digital Networks,CRC Press, 4 th Edition 2011.

Syllabus

Unit-I	Introduction to Smart Grid	8 Hours
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.		
Unit-II	Smart Grid Technologies	8 Hours
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation , Wide area monitoring, Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).		
Unit-III	Smart Meters and Advanced Metering Infrastructure	8 Hours
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.		
Unit-IV	Power Quality Management in Smart Grid	06 Hours
Power Quality & EMC in Smart Grid, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit..		
Unit-V	High Performance Computing for Smart Grid Applications	07 Hours
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad band over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.		
UnitVI	Integration with renewable energy sources	04 Hours
Power Quality issues of Grid connected Renewable Energy Sources,		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Design, Estimation and Energy Audit				
Course Code	BEE02T4001				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. The effective use of energy to maximize profits (minimize costs) and enhance competitive positions, it is necessary to conserve energy. Hence it is necessary to study energy auditing methods and energy saving opportunities in electrical system.

Course Objectives

On completion of the following units of syllabus contents, the students must be able to

- Draw conventional symbols for various electricalinstallations.
- To quote the relevant IE rules for a given electrical installation, earthingand clearance of service lines.
- Familiarize the types ofwiring.
- List the points to be considered for selectionwiring.
- Determine the size of wire for internalwiring.
- Explain the necessity and types ofearthing.
- Estimate the quantity of materials required forearthing.

- Differentiate between neutral and earthwire.
- Estimate the quantity of materials required for domestic and industrialwiring.
- Explain the concept and types of Energy of energyaudit.
- Explain the energy saving opportunities in Transformer, Induction motor, lighting and DG system.
- Explain the roll of power factor controller in energy saving system.
- Explain the roll of sensors in energy saving system.
- Explain the energy efficient technologies in electrical system.

Course Outcomes

CO1	Identification of different types of electrical symbols and various electrical wiring systems
CO2	Identification of needs earthing and its procedure.
CO3	Illustrate the estimation of components required for Industrial and Domestic application
CO4	Understand energy audit and energy management system
CO5	Identify the types of tariff that are benefit for consumers and methods of improving power factor
CO6	Understand different technologies used for Energy efficient Technologies in Electrical System

Text Books:

1. K.B.Raina&S.K.Battacharya, Electrical Design Estimating And Costing, New age International
2. General Aspect Of Energy Management And Energy Audit, Bureau of energy efficiency, New Delhi
3. Energy Efficiency In Electrical Utilities, ,Bureau of energy efficiency, New Delhi

Reference books:

1. Surjit Singh, Electrical Design Estimating and Costing, Dhanpat Rai & Company
2. Surjit Singh, Electrical Engineering Design and Drawing, Dhanpat Rai & Company

Syllabus

Unit-I	System of Internal Wiring and Earthing	8 Hours
Need of electrical symbols – List of symbols – Brief study of important Indian Electricity Rules 1956 - Methods of representation for wiring diagrams – Looping back system and Joint box system and tree system of wiring - Types of internal wiring – Service connection (Overhead and Underground) - Protection of electrical installation against overload, short circuit and earth fault – protection against electric shock – Effects of electric shock – Recommended first aid for electric shock - Treatment for electric shock - Construction and working of ELCB – Overview of Busbar, Trunking and Cable tray.		
Unit-II	Earthing System	6 hours
Necessity – General requirements of Earthing – Earthing and Soil Resistivity – Earth electrodes – Methods of earthing- Plate earthing - Pipe earthing - Rod earthing – Soil Resistivity – Methods of improving earth resistance - Size of earth continuity conductor - Difference between Neutral and Earth Wires. Safety signs showing type of PPE to be worn, Prohibition Signs, Warning Signs, Mandatory Signs, Advisory or Safe ConditionSigns		
Unit-III	Domestic and Industrial Estimation	07 Hours
General requirements of electrical installations for Residential, Commercial and Industrial – Lighting and power sub- circuits – Diversity factor for sub circuits - Location of outlets, control switches, main board and distribution boards – Permissible voltage drops and size of wires - Steps to be followed in preparing electrical estimate. Estimate the quantity of material required in Electrical Installation for 1. Small residential building/Flat 2. Factory Lightingscheme 3. Computer centre having 10 computers, a/c unit, UPS, light and fan. 4. Street Light service having 12 lamp lightfitting 5. Workshop with one number of 3Φ, 15hp inductionmotor. 6. Small Workshop with 3 or 4Machines.		
Unit-IV	Energy Audit	8 Hours
Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach- Understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments.		

Unit-V	Energy Management of Electrical System	8 Hours
Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.		
Unit-VI	Energy efficient Technologies in Electrical System	8 Hours
Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology.		

Name of The Course	PLC/SCADA LAB			
Course Code	BEEE3008			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
0	0	2	1	

Course Objectives: Students will be able to design and program basic PLC circuits for entry-level PLC applications. Students will be able to design and program a small, automated l production line. Apply the knowledge of PLC/SCADA in engineering specialization to the solution of complex engineering problems.
Students are trained for to create ladder diagrams from process control descriptions. Students work in team to formulate solution for Electrical System using hardware and software tools. Students understand PLC functions, Data Handling Function, apply PLC Timers and Counters for the control of industrial processes.

Course Outcomes

CO1	Identify different components of PLC.
CO2	Understand working of PLC, I/O modules of PLC
CO3	Able to create ladder diagrams from process control descriptions.
CO4	Ability to apply PLC timers and counters for the control of industrial processes
CO5	Able to use different types PLC functions, Data Handling Function.

Text/ Reference Books:

1. Programmable Logic Controllers — Principle and Applications by John W Webb and Ronald A Reiss Filth edition, PHI
2. Programmable Logic Controllers — Programming Method and Applications by JR Hackworth and ED Hackworth — Jr-Pearson, 2004.

List of Experiments

1. Study hardware and software used in PLC
2. To study PLC Input and output symbols
3. Implementation of Logic Gates
4. Implementation of DOL starter
5. Implementation of on-delay timer
6. Implementation of off-delay timer
7. Implementation of up-down counter
8. Implementation of PLC Arithmetic Instructions
9. Implementation of PID Controller

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Technical Seminar			
Course Code	BEE02P4005			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
0	0	2	0	

Course Objectives:
Objective

- To develop institute-industry interaction
- To know the industry practices
- To understand cutting edge technology in the chosen area

Course Outcomes

CO1	Identify the Literature Survey
CO2	Do the Formulation of the Problem / Project
CO3	Do Mathematical Modeling and do Programs in MATLAB / PSPICE.
CO4	Do compilations / Simulation and Synthesis.
CO5	Do testing and write Dissertations/Reports.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Capstone Design Phase –I			
Course Code	BEE02P4002			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	10	2

Course Objectives:

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Work in team to formulate solution for Electrical System using hardware or software tools.
- Analyze & research about the work to be implemented with resources available from internet & other sources.
- Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Course Outcomes

CO1	Develop creative solutions to problems and conceive innovative approaches in developing and designing of electrical system.
CO2	Prepare high quality engineering documents and present a clear and coherent presentation of these to a range of technical and nontechnical audiences.
CO3	Acquire and evaluate research regarding new knowledge development within the electronic engineering discipline and its social, cultural, environmental and legal context.
CO4	Demonstrate a responsible, ethical and professional attitude regarding the role of engineers in society, including situations involving potentially adverse environmental and cultural impacts.
CO5	Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Semester 8

Name of The Course	Capstone Design Phase-II			
Course Code	BEE02P4003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	18	6

Course Objectives:

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Work in team to formulate solution for Electrical System using hardware or software tools.
- Analyze & research about the work to be implemented with resources available from internet & other sources.
- Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Course Outcomes

CO1	Identify project goals and constraints
CO2	Acquire knowledge about the project through previous works in the current field
CO3	Formulate the methodologies to obtain experimental results
CO4	Plan for the resource requirements
CO5	Obtain the experimental results based on the methodologies formulated.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Industrial Internship & Technical Seminar				
Course Code	BEE02P4004				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	0	0	0	6	

Course Objectives:

Objective

- To develop institute-industry interaction
- To know the industry practices
- To understand cutting edge technology in the chosen area

Course Outcomes

CO1	Identify the Literature Survey
CO2	Do the Formulation of the Problem / Project
CO3	Do Mathematical Modeling and do Programs in MATLAB / PSPICE.
CO4	Do compilations / Simulation and Synthesis.
CO5	Do testing and write Dissertations/Reports.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Basket- (Control Engineering)

Name of The Course	Advanced Control System			
Course Code	BTEE3019			
Prerequisite	Control System			
Co-requisite	Signal Systems			
Anti-requisite				
L	T	P	C	
3	0	0	3	

Course Objectives

1. Introduce the fundamentals and concepts of Control systems
2. Understanding and predicting system behavior in state space and non-linear systems.
3. Design and analysis of closed loop control systems.
4. Analyse higher order control systems with appropriate state space models.

Course Outcomes

CO1	Apply linear algebra to complex real world problems in order to obtain models that are expressed using state space equations.
CO2	Understand the basic Canonical Forms in state space domain.
CO3	Analyze the system behavior based on the mathematical model of that system where the model may be expressed in state-space domain
CO4	Design and analysis of closed loop control systems.
CO5	Design controllers using the concept of state feedback and pole placement technique.
CO6	Write a report that effectively communicates the results of an analysis or design.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: State Space Analysis of Control Systems 8 Hours
State Variables; State-Space Representation of Electrical and Mechanical and Electromechanical Systems; State Space Representation of Nth Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors;
Unit II: Canonical Form
Transformation to Diagonal Canonical Form; Jordan Canonical Form; Controllability Canonical Form; Observabilty Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition; State Diagram; Solution of the Time-Invariant State Equation; State Transition Matrix and its

Properties; Transfer Matrix; Transfer Matrix of Closed Loop systems.
Unit III: Controllability and Observability 8 Hours
Concept of Controllability and Observability; Kalman's Theorems on Controllability; and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.
Unit IV: State feedback controller 8 Hours
Design of state feedback controller using pole placement technique, Ackerman's formula.
Unit V: Lyapunov Stability Analysis 8 Hours
Stability of Equilibrium State in the Sense of Liapunov; Graphical Representation of Stability; Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function; Second Method of Liapunov; Stability Analysis of Linear Systems; Krasovski's Theorem; Liapunov Function Based on Variable Gradient Method.
Unit VI: Describing Function Analysis of Nonlinear Control System and Phase Plane Analysis 8 Hours
Introduction to Nonlinear Systems, Describing Functions for Common Types of Nonlinearities, Describing Function Analysis, Stability and Limit Cycles, ntroduction : Analytical Methods for constructing Trajectories, Classification of Singular Points; Limit Cycles; Phase-Place Analysis of Linear control system.

Suggested Reading

1. Nagrath and Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuoand FaridGolnaraghi, "Automatic Control System" Wiley India Ltd, 2008.
4. D.RoyChoudhary, "Modern Control Engineering", Prentice Hall of India.
5. Norman S. Nise, Control System Engineering 4th edition, Wiley Publishing Co.
6. E Slotine, Weiping Li, Applied Nonlinear Control, Prentice-Hall.
7. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, "Design of Feedback Control Systems"Oxford University Press.

Name of The Course	Industrial Automation and Control			
Course Code	BTEE3020			
Prerequisite	Control System			
Co-requisite	Power System Analysis			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. This course introduces the various types of controllers and their principles
2. Knowledge of sequence control, PLCs and Ladder logic is also imparted
3. Applications of industrial automation systems including identification of system requirements, equipment integration, motors, controllers, and sensors.
4. Coverage of set-up, maintenance, and testing of the automated system

Course Outcomes

CO1	Describe the properties and applications of open- and closed-loop process control systems and distinguish between their dynamics.
CO2	Summarize the operation of the different controller modes and their practical limitations; determine their response to standard inputs.
CO3	Understand the open loop and closed loop transient response using Ziegler-Nichols method. Frequency response method.
CO4	Outline the criteria determining the selection of control valves for specific purposes.
CO5	Explain various special control structures in process control.
CO6	Identify the applications of PLC's to industrial processes and design PLC programs to solve sequential control problems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

50	-	50	100

Course Content:

Unit I: Process Dynamics 8 Hours
Dynamic Elements in Control Loops, Open- and closed-loop properties of processes; Process lags; Dead-time; Stability of control systems; Block diagrams and process line diagrams to explain the operation of control systems. Dynamic behaviors of first order, second order, and higher order systems. Interacting and non-interacting systems.
Unit II: Controller Principles 5 Hours
Process characteristics. Control system parameters. Discontinuous, continuous, and composite modes of control action (P, PI, PD & PID). Analog and Digital Controllers, General features. Electronic controllers, pneumatic controllers and hydraulic controllers, and Design considerations.
Unit III: Process loop Tuning 5 Hours
Open loop transient response method. Ziegler-Nichols method. Frequency response method.
Unit IV: Control Valves 7 Hours
Valve types and characteristics; Factors influencing valve selection; Valve sizing; Valve petitioners; Installed systems: control valve characteristics, pipe pressure drops and pump characteristics.
Unit V: Special Control Structures 7 Hours
Feed forward and Ratio Control, Predictive Control, Control of Systems with Inverse Response Special Control Structures : Cascade Control, Overriding Control, Selective Control, Split Range Control.
Unit VI: Introduction to Sequence Control, PLCs & Relay Ladder 8 Hours
Discrete state process control, characteristics of the system, discrete state variables, process specifications and event sequence description, ladder diagram – ladder diagram elements and examples, programmable controller – relay sequencers, programmable logic controller, architecture, operation and programming, types of PLC.

Suggested Reading

1. Process Control Instrumentation Technology, C. D. Johnson, Prentice Hall, (2002).
2. M. Gopal, Control Systems – Principles & Design, 2nd Edition, TMH, 2002.
3. Bela G. Liptak, Process Control, Instrument Engineer's Handbook, 3rd Edition, Chilton Book
4. Company, 1970.
5. D.RoyChoudhary, "Modern Control Engineering", Prentice Hall of India.
6. George Stephenopoulos, Chemical Process Control, PHI, 1999.
7. Kirk and Rimbol, Instrumentation, D.B. Taraporewala Sons and Co. Pvt. Ltd., 1996
8. Douglas M. Considine, Process/Industrial Instruments and Control Handbook, 4thEdition,McGraw Hill International Edition, 1974.
9. Introduction to Programmable Logic Controllers, G. Dunning, Delmar Thomson Learning, 2002

Name of The Course	Industrial Instrumentation and Automation				
Course Code	BEE02T5001				
Prerequisite	Electrical Instrumentation				
Co-requisite					
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

1. To impart knowledge about Industrial instrumentation and automation

Course Outcomes

CO1	Select instruments and transducers for various physical variables
CO2	Design various signal conditioning systems for transducers.
CO3	Analyze dynamic responses of various systems.
CO4	Get the concepts of virtual instrumentation
CO5	Understand the programming realization of SCADA
CO6	Understand the programming realization of PLC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Introduction to Process Control - block diagram of process control loop, definition of elements. Sensor time response - first and second order responses. Review of Transducers: Characteristics and Choice of transducer-factors influencing choice of transducer.
Unit II: Applications of Transducers 8 Hours
Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement :Hotwire anemometer, constant resistance Constant current type Eddy current sensors, Variable reluctance tachometers Phase measurement :Analog and digital phase detectors Nano Instrumentation
Unit III: Signal conditioning 8 Hours
Signal conditioning circuits-Instrumentation amplifiersUnbalanced bridge. Bridge linearization using op amp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimization.
Unit IV: Micro Electromechanical system (MEMS) 8 Hours
Advantages and Applications, MEMS micro sensors and actuators, Manufacturing process: Bulk micro machining and surface micromachining, MEMS accelerometers Virtual instrumentation system: architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming.
Unit V: SCADA 5Hours
Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC
Unit VI: PLC 5Hours
Introduction to Sequence Control, PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming-realization of AND, OR logic, concept of latching,

Suggested Reading

1. Curtis D Johnson ," Process Control Instrumentation Technology", PHI, 1986
2. Doeblin E.O, 'Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992
3. DVS. Murty, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt Ltd New Delhi ,2013
4. MadhuchhandaMitra, SamarjitSengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt Ltd., 2009
5. Mickell. P. Groover 'Automation, Production and computer integrated manufacturing' Prentice Hall of India, 1992
6. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi
7. Robert B. Northrop, 'Introduction to instrumentation and measurements', CRC, Taylor and Francis 2005.

Name of The Course	Power System Operation and Control			
Course Code	BEEE5005			
Prerequisite	Power System Analysis			
Co-requisite	Fundamentals of Power System			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Introduce the fundamentals concepts of operation of Modern power systems.
2. Understand various Load driving parameters and various forecasting methods.
3. Introduce the concepts of Unit Commitment and Online economic dispatch.
4. Understand and analyze control relationship between real power vs frequency and reactive power vs voltage.

Course Outcomes

CO1	Identify various load driving parameters and review various forecasting methods for efficient power system operation
CO2	Analyze the relationship between various power system variables in terms of mathematical modeling

CO3	Model the steady state and dynamic performance of power system control.
CO4	Apply the knowledge of Unit Commitment and economic Dispatch to solve numerical problems based on real time situations.
CO5	Explain various functional aspects of SCADA/ECC along with various operating states of power system.
CO6	Understand the application of power System estimation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
System load – variation, load characteristics – load curves and load-duration curves, load factor, diversity factor, load forecasting, simple techniques of forecasting, basics of power system operation and control, reserve margin, load-frequency control, voltage control.
Unit II: Real Power – Frequency Control 8 Hours
Speed governing mechanism and modelling, speed-load characteristics, load sharing, control area concept, LFC control of a single-area system, static and dynamic analysis, integration of economic dispatch control with LFC, two-area system – modelling – static analysis of uncontrolled case, tie line with frequency bias control of two-area system.
Unit III: Economic Load Dispatch8 Hours
Economic dispatch problem – cost of generation, incremental cost curve, co-ordination equations, solution by direct method and λ- iteration method, unit Commitment problem – constraints, solution methods – Priority-list methods – forward dynamic programming approach (Numerical problems only in priority-list method using full-load average production cost).
Unit IV: Reactive Power – Voltage Control8 Hours
Reactive power control, excitation systems – modelling, static and dynamic analysis, stability compensation, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformers, tap setting of OLTC transformer and MVAR injection of switched capacitors.
Unit V: Computer control of power systems 8 Hours
Need of computer control of power systems, concept of energy control centre (or) load dispatch centre and the functions, system monitoring, data acquisition and control, system hardware configuration,
Unit VI Power System Estimation
SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states (Normal, alert, emergency, in-extremis and restorative).

Suggested Reading

1. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., 2003.
2. D.P. Kothari and I.J. Nagrath, „Modern Power System Analysis", Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
3. Chakrabarti&Halder, "Power System Analysis: Operation and Control", PHI, 2004 Edition.
4. L.L. Grigsby, „The Electric Power Engineering, Hand Book", CRC Press & IEEE Press, 2001.
5. Olle. I. Elgerd, "Electric Energy Systems theory: An introduction", Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

Name of The Course	Digital Control			
Course Code	BEEE5004			
Prerequisite	Control System			
Co-requisite	Advanced Control System			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. The purpose of this course is to provide basic concepts of Digital control systems.
2. The main goal of the course is to teach the students how to select and design digital controller for different systems.

3. This course is also to learn microprocessors and microcontrollers based digital control systems.
4. This also provides knowledge of effect of quantization on signals in digital control systems.

Course Outcome

CO1	Analyze and design SISO systems through Z-transform.
CO2	Analyze and design of MIMO systems through state space analysis.
CO3	Understand the Controller design using transformation techniques.
CO4	Analyze system's stability.
CO5	Discuss Microprocessor and DSP based control.
CO6	Discuss the quantization effect on the digital control system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Overview of design approaches, continuous versus digital control, sampling process, effect of sampling rate. Calculus of difference equations. Z-transform. Signal flow graphs.
Unit II: Design of State space systems 8 Hours
Controllability, Observability, Discretization of continuous transfer functions; Digital filter properties.
Unit III: Controller design using transformation techniques
Z-plane specifications. Design in the w domain. PID controller. Deadbeat controller. Root Locus design.
Unit IV: State space methods 8 Hours
Pole placement design, stabilization and all stabilizing controllers. Observer design. Infinite time optimal regulator, Stability and tracking in SD systems.
Unit V: Quantization effects 8 Hours
Limit cycles and dither. Sample rate reduction. Multi-rate sampled data system and stability studies. Design of digital controller using fast output sampling.
Unit VI: Microprocessor and DSP control 8 Hours
Mechanization of control algorithms. Iterative computation via parallel, direct, canonical, cascade realization; Effects of computing time. Systems with time delay. Case studies

Suggested Reading

1. K. Ogata, “Discrete-time control sytems”, PHI, 2005.
2. B.C. Kuo, “Digital Control System”, Oxford University press, 1995
3. Norman S. Nise," Control systems Engineering", John Wiley and Sons, 4th Edition, 2004.
4. G. F. Franklin, J. David Powell and MichealWorkman,“Digital Control of Dynamic Systems“, Pearson Education, 3rd Edition,2003.
5. M.Gopal, “Digital Control Engineering”, New Age Publishers, 2008.

Name of The Course	Automation and Robotics			
Course Code	BEE03T5002			
Prerequisite	Control Systems			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To identify potential areas for automation and justify need for automation.

Course Outcomes

CO1	Select suitable major control components required to automate a process or an activity
CO2	Study the various parts of robots and fields of robotics.
CO3	Understand the fundamentals of automated assembly systems
CO4	Study the various kinematics and inverse kinematics of robots.
CO5	Study the control of robots for some specific applications.
CO6	Design real time robotics systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data.
Unit II: Automated Production lines 1 8 Hours
Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems,
Unit III: Automated Production lines 2
Fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies
Unit IV: Industrial Robotics 8 Hours
Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.
Unit V: Spatial descriptions and transformations8 Hours
Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space
Unit VI: Robot programming 8 Hours
Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications

Suggested Reading

1. Automation, Production systems, and computer integrated manufacturing-MikellP.Groover 3rd edition, Pearson 2009
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

Basket- (Power Engineering)

Name of The Course	Power System Equipments				
Course Code	BTEE3017				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:
Power Engineering is concerned with the generation, transmission, distribution and utilization of electrical energy. Large power systems are interconnected physical networks of many different types of equipment and apparatus: synchronous generators for generating electricity, power transformers for changing the voltage levels, overhead transmission lines, underground cables, metering and control equipment, switchgear for connection/disconnection, high-voltage insulators, etc. Because of operating conditions (different voltage and power levels) each equipment type in turn comprises many different designs.

Course Outcomes

CO1	Identify various designs of transmission line and overhead line
CO2	Explain various Substation equipments Protection & Control theories

CO3	Explain various necessities of power system earthing
CO4	Identify various basic concepts about Surge Protection & Insulation Co-ordination
CO5	Identify various basic concepts about Insulation Co-ordination
CO6	Introduce reliability of transmission & distribution Systems

Text/ Reference Books:

1. Power System Analysis & Design by B.R. Gupta –S.Chand.
2. Sub Station Design and Equipment – Gupta &Satnam (Dhanpat Rai & Sons).
3. Transmission & Distribution – Westinghouse.
4. P. Gill, Electrical Power Equipment Maintenance and Testing, 2nd ed., CRC Press, 2008.
5. F. Kussy, and J. Warren, Design Fundamentals for Low Voltage Distribution and Control, Marcel Dekker, 1987.
6. Syllabus

Unit-I	Transmission Line Design & Overhead Line Design	8 Hours
Types of Insulator, String Efficiency, Improvement of voltage distribution, Improvement of String Efficiency, Line Supports, Types of Steel Towers, Cross Arms, Equivalent span, Conductor configurations, Spacing & Clearance, Sag & Tension calculations, Erection conditions, Factors affecting Sag, Sag Template, Catenary, Vibration of conductors & prevention, Selection of conductor size, Cross arm, No. Of circuits, Selection of ground wire.		
Unit-II	Electrical Substation &Earthing	8 Hours
Types of Substation, Layout and Bus Bar schemes, Voltage level, Substation equipments Protection & Control Substation Earthing, Tolerance limits of body currents, Soil resistivity, Earth resistance, Tolerable & Actual Step & Touch Voltages, Design of EarthingGrid, Tower Footing Resistance, Measurement of soil & earth resistivity		
Unit-III	Power System Earthing	6 Hours
Ground versus isolated neutral, Solidly and effectively grounded system Resistance and Impedance Grounding, Resonant Grounding, Reactance Grounding, Voltage Transformer Grounding, Zigzag Transformer Grounding, Grounding practice, Effect of grounding on system over voltages & protection over voltage and over voltage phenomenon in isolated and grounded neutral system.		
Unit-IV	Surge Protection	5 Hours
External and Internal over voltages mechanism of lighting discharge, wave shapes of stroke current line design based on direct stroke, over voltage protection, earth wire Rod gap T.F.R., Expulsion tube, surge diverter.		
Unit-V	Insulation Co-ordination	5Hours
General idea, Selection of B.I.L., International recommendation, Selection of arrester rating, Co-ordination of protector devices with apparatus insulation		
Unit-VI	Reliability of Transmission & Distribution Systems	7 Hours
Definition, Outage, Bath Tub Curve, Two State Model, Failure & Repair Rate, Probability Density Function, Probabilities of Survival & Failure, Mean Time to Failure, Mean Down Time, Reliability of Series & Parallel Systems, Two-State Fluctuating Enviornment, Approximate Method, Reliability Planning, Preparation of Reliability Models.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Quality
Course Code	BTEE3023
Prerequisite	
Corequisite	
Antirequisite	

	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the various power quality issues
2. To understand the concept of power and power factor in single phase and three phase systems supplying non linearloads
3. To understand the active compensation techniques used for power factor correction.
4. To understand the active compensation techniques used for load voltage regulation.

Course Outcomes

CO 1	Toacquireanin-depthknowledgeonvariouspowerqualityissueslikevoltage sag, interruption and harmonics.
CO 2	To learn about various aspects of power quality measurements and power quality
CO 3	Ability to understand and analyze power system operation, stability, control and protection.
CO 4	Introduce the importance of grounding on power quality.
CO 5	Learn to apply appropriate solution techniques for power quality mitigation based on the type of problem.
CO 6	Illustrate the latest trends adapted in power quality improvements.

Text Book (s)

1.Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
2.R. Dugan, M. McGranahan, S. Santoso, W. Beaty, Electric Power Systems Quality, 2nd Edition (McGraw-Hill, New York, NY, 2002).

Reference Book (s)

1. Heydt, Electric Power Quality, Stars in a Circle Publications, 1991. (optional)
2. Handbook of power quality, editor: Angelo Baggini, John Wiley & Sons, 2008.

Unit I:
Power and Voltage Quality: General, classes of Power Quality Problems, Power quality terms, Power frequency variations, the power quality evaluation procedure. formula, sensitivity, Reduction of effect of parameter variation and disturbance by using negative feedback.
Unit II:
Voltage sags and Interruptions: Sources of sags and Interruptions, Estimating Voltage sag performance. Fundamental Principles of Protection, Solutions at the end-user level, Evaluating Ride-through Alternatives, Motor-Starting Sags.
Unit III:
Fundamentals of Harmonics: Harmonic distortion, Voltage versus Current distortion, Harmonic indexes, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic Distortion. Considerations.
Unit IV :
Distributed Generation and Power Quality: Resurgence of DG, DG Technologies, Interface to the Utility System, Power Quality Issues, Operating Conflicts, DG on distribution Networks, Sitting DG distributed Generation, Interconnection standards.
Unit V:
Wiring and Grounding: Recourses, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solution to wiring and grounding problems.
Unit VI: Recent Technologies
Recent trends and technologies using to improve the power quality

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electric Drives			
Course Code	BEEE4001			
Prerequisite	Power Electronics			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To introduce the electric drives fundamentals including speed torque curves of motor and load, types of load.
2. To determine stability of drive system and select motor rating for any particular duty of application.

Course Outcomes

CO1	Demonstrate the basic of drive system and different types of loads.
CO2	Understand the motor dynamics and the rating of motor for different condition of load.
CO3	Analyse the types of breaking and select appropriate breaking to the working environment.
CO4	Analyse power circuit topology and control mechanism to control the speed of DC motor.
CO5	Apply various types of control mechanism to employ for variable speed drives.
CO6	Illustrate the latest trends adapted in Electrical drives

Text Book (s)

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House
2. S.K.Pillai, "A First Course on Electric Drives", New Age International.

Reference Book (s)

1. M.Chilkin, "Electric Drives", Mir Publishers, Moscow.
2. N.K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd

Course Content:

Unit-1Fundamentals of Electric Drive 8 hours
Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.
Unit-2Dynamics of Electric Drive 8 hours
Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric Drive, Selection of Motor Power rating, Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, Load equalization
Unit-3Electric Braking 8 hours
Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting, Energy relations during braking, dynamics during braking.
Unit-4Power Electronic Control of DC Drives 8 hours
Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current, Chopper control of separately excited dc motor and dc series motor.
Unit-5Power Electronic Control of AC Drives 8 hours
Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cycloconverter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self-controlled schemes. Special Drives: Switched Reluctance motor, Brushless dc motor
Unit 6: Recent Technologies
Recent trends and technologies using in electrical drives.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	FACTS and HVDC			
Course Code	BTEE4010			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

1. Apply concepts of transmission in HVDC Transmission
2. To prepare students to know the role of HVDC systems

Course Outcomes

CO1	Identify significance of DC over AC transmission system, types and application of HVDC links in practical power systems
CO2	To Analyze different converters viz.3,6 and 12 pulse converter
CO3	To Analyze AC/DC system interactions and know the operation and control of various MTDC systems.
CO4	Model AC/DC system and apply protection for HVDC system against transient overvoltage and over currents
CO5	To estimate Improvement of voltage stability
CO6	Illustrate the latest trends adapted in HVDC.

Text Book (s)

1. HVDC transmission by Adamson and Hingorani.
2. H.V.D.C.Transmission by J.Arillaga : Peter Peregrinus ltd., London UK 1983.

Reference Book (s)

1. Direct current Transmission, by . E.W. Kimbark ,Wiely Inter Science – NewYork. EHV-AC & HVDC transmission Engg. Practice" by S.Rao, Khanna Publishers.
2. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Unit I: H.V.D.C. Transmission**6 lecture hours**
H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Static Power Converters: 3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.
Unit II:
Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters. Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control, DC power flow control.
Unit III:
Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.
Unit IV : FACTS Introduction
The concept of flexible AC transmission - reactive power control in electrical power transmission lines, uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC).
Unit V: 7 lecture hours
Voltage control by STATIC VAR COMPENSATOR (SVC), THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC) And Static Synchronous Compensator (STATCOM): advantages of slope in dynamic characteristics, influence of SVC on system voltage. Applications: enhancement of transient stability and steady state, power transfer.
Unit VI: Recent Technologies
Recent trends and technologies using in HVDC.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical and Hybrid vehicle			
Course Code	BEE02T5003			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

1. To understand the electrical vehicle
2. To understand the hybrid vehicle

Course Outcomes

CO1 Understand basics of battery technology.
CO2 Understand scheme of HEV and full electric vehicle.
CO3 Analyse need of different motor drives for electric vehicle.
CO4 Apply new topologies to electric vehicle.
CO5 Evaluate performance parameters of electric vehicle.
CO6 Understand recent industrial power electronic applications for electric vehicle.

Text Books:

1. Sandeep Dharmeja, Electric Vehicle Battery Systems, 1st Edition, Newnes, 2001
2. K.T.Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, 1st Edition, John Wiley and Sons, 2011

Reference Books:

1. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001
2. Springer Books, Electrical Vehicle Integration into Modern Power Networks
3. A.T.P.So George C.Barney waterstones.com, International Journal of Elevator Engineering, United Kingdom
4. John Lowry, John Wiley and Sons, Electrical Vehicle Technology Explained-James Larminie, 1st Edition, 2003

Unit I: Introduction to Electric Vehicles
Electric vehicles (EV) development, past, present and future, comparison with IC engine driven vehicles.
Unit II: Storage Units
Batteries, fuel cells, ultracapacitors. Power converters in EV. Different types of motors used in EV and their torque-speed characteristics, motor control techniques,
Unit III: Vehicle Control 10 lecture hours
High performance and efficiency-optimized control, sensorless control. Electric vehicles modeling and their Characteristics.
Unit IV : Electric drive-trains
Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies - fuel efficiency analysis
Unit V: Hybrid Electric Vehicle
Fuel cell Vehicles, Hybrid Electric Vehicles (HEV), series, parallel and series-parallel (split) systems,
Unit VI: Recent Technologies
Recent industrial power electronic applications. Advanced topic on the subject

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Deregulation			
Course Code	BTEE4009			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the restructuring of electrical power systems
2. To understand the marketing in power sector

Course Outcomes

CO1	To provide in-depth understanding of operation of deregulated electricity market systems.
CO2	To Understand the Fundamentals of Economics
CO3	To examine topical issues in electrici ty markets and how these are handle d world-wide in various markets.
CO4	To train the students to analyze vari ous types of electricity market operat ional and control issues under congestion management.
CO5	To understand the operation of ancillary
CO6	To learn different pricing mechanism and power trading in restructured power system

Text Book (s)

1. L.Philipson and H. Lee Willis, “Understanding Electric Utilities and Deregulation”, Marcel Dekker 1998
2. KankarBhattacharya , Math Bollen and J.E. Daadler, “Operation of restructured Power Systems,” Kluwer 2001
3. M. Shahidepour and M. Alomoush, ”Restructured Electrical Power Systems”, Marcel Dekker 2001
4. Steven Stoft, “Power System Economics: Designing Markets for Electricity”, IEEE Press 2002
5. AshikurBhuiya, “Power System Deregulation: Loss Sharing in Bilateral Contracts and Generator Profit Maximization”, VDM Publishing 2008
6. Daniel S. Kirschen, Goran Strbac, “Fundamentals of Power System Economics”, WILEY 2004

Unit I: Restructuring Of Power Industry:
An Introduction: Introduction, reasons and objectives of restructuring/ deregulation of power industry, restructuring process, issues involved in restructuring/ deregulation.
Unit II: Fundamentals of Economics
Introduction, consumer behavior, supplier behavior, market equilibrium, short-run and long-run costs, various costs of production, perfectly competitive market
Unit III: Philosphy of market models:9 lecture hours
Introduction to philosophy of market models, market models based on contractual arrangements, comparison of various market models, electricity as a commodity market architecture
Unit IV: Transmission congestion management:10 lecture hours
Introduction, classification of congestion management methods, calculation of atc (available transfer capability), non-market methods, nodal pricing, inter-zonal/ intra-zonal congestion management, price area congestion management, capacity alleviation method

Unit V : Electricity market evolution:8 lecture hours
US and European electricity market evolution, PJM, NEMMCO, ERCOT, NORDIC Markets, comparison of power markets, towards standard market design (SMD)
Unit VI: Reforms in Indian power sector:7 lecture hours
Introduction, framework for Indian power sector, reform initiatives in India, The Electricity Act 2003, availability based tariff (ABT), open access issues, power exchange

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket-(Energy Engineering)

Name of The Course	Non-Conventional Energy Resources				
Course Code	BEEE2018				
Pre-requisite	Power system				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To have an overview of non-conventional energy sources.
2. To understand the need of alternate sources of energy.

Course Outcomes

CO1	Understand the different types of renewable energy sources and their utilities
CO2	Design models for generating energy through alternate energy sources (with the help of additional learning)
CO3	To understand the practical limitation and hence steps for continuous improvement through research.
CO4	Apply genetic algorithms to optimization problems
CO5	Design models for generating energy through alternate energy sources (with the help of additional learning)
CO6	Apply the fundamentals of energy systems in real time applications

Text Book (s)

1. 1. Renewable energy technologies - R. Ramesh, Narosa Publication
2. Non-conventional Energy Systems – Mittal, Wheelers Publication.

Reference Book (s)

3. John F Walker &Jekins. N, Wind Energy Technology., John Wiley and Sons, chichester, UK, 1997.
4. Van Overstra ,Mertens, R.P, Physics, Technology and use of Photovoltaics, Adam Hilger, Bristol, 1996.

Course Content:

Unit I:Energy Scenario: 6 lecture hours
Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of

India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds(PCF). Factors favoring and against renewable energy sources, IRP.
Unit II: Solar Energy 9 lecture hours
Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells , cell technologies,characteristics of PV systems, equivalent circuit, array design , building integrated PV system, its components , sizing and economics. Peak power operation. Standalone and grid interactive systems.
Unit III: Wind Energy 10 lecture hours
Wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating, Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.
Unit IV :Other energy sources 8 lecture hours
Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources. Hydro energy – feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion. (OTEC) systems – schemes, feasibility and viability.
Unit V: Energy storage and hybrid system configurations 7 lecture hours
Energy storage: Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel-energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.
Unit VI: Application of NCES
Grid integration of hybrid system, fuel cell integration in hybrid vehicles

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Energy Assessment and Audit			
Course Code	BTEE4011			
Pre-requisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To have an overview of energy audit.
2. To understand the need of energy assessment.

Course Outcomes

CO1	To prepare the students for successful career in the energy indus agencies; and in the academic and R &D institutions.
CO2	Toproducegraduatesstronginenergyresources,technologiesandn addressing the present and potential future energy problems
CO3	To produce energy professionals, who are sensitive to, and concerns ,and who can apply their specialized knowledge for t
CO4	Acquaintance with conservation of energy and its management
CO5	Identify the source of conservation of energy and energy plann
CO6	Know-How of energy efficient machinery systems, energy loss

Text Book (s)

1. Albert Thumann, Handbook of energy engineering ,"Abe Books , 1979
2.JamesWilsonBrownandShirleyHanse n,„InvestmentGradeEnergyAudit“,Gor dan&BreachScainPublishers,November 2000
3.Endreni, J., „Reliability modelling in Electric Power System“ John Wiley, 1980.

Reference Book (s)

1.Roy Billinton and Ronald Allan Pitam: Reliability Evaluation of Power Systems,1996
2.Wheel Wright and Makridakis: Forecasting methods and Applications, John Wiley, 1992.

Course Content:

Unit I: Energy Auditing

Introduction, Scope of Energy Audit, Types of Energy Audit, Detailed Energy Audit Methodology, Implementing Energy Efficiency Measures, Detailed Project Report (DPR), Measurement & Verification.
Unit II: Electrical System
Introduction, Main Components of Electrical System, Load Management, Power Factor, Electricity Tariff, Distribution Transformers, Voltage Drop Survey, Cable Losses, Inverter/UPS, Power Quality, Energy Auditing ApproachforElectricalDistributionSystemandTransformers,ENCONOpportunitiesinElectricalSystem.
Unit III: Electrical Motors
Introduction,TypesofMotors,SelectionofanElectricalMotor,MotorLoading,EnergyEfficiencyMotors,Power Factor Correction for Motors, Avoiding Idle Running of Motors, Efficient Belt Drives, Application of Variable Frequency Drive (VFD), Effect of Power Supply Quality on Motors
Unit IV :Pumping system-1
Introduction,PumpPerformanceCurves,SystemCurve,PumpPerformanceAssessment,Flow,Balance, Control Valve Operation (Throtiling), By-pass Valve Operation, Optimum Pipe Sizing, Impeller Trimming, Reducing Number of Stages, Variable Speed Operation,.
Unit V: Pumping System-2
Energy Auditing & Approach for Pumping System, ENCON OpportunitiesinPumpingSystem,DemoofEnergyEfficiencyPracticesinPumpLaboratory
Unit VI: Air Handling and Distribution System 7 lecture hours
Introduction, Ducting System Design, Fan Discharge and Inlet System, Filter Losses, Coil Losses, Fan Efficiency, ExcessAirFlow,ConstantAirVolume(CAV)versus VariableAirVolume(VAV),AirDistributionandBalancing, Fresh Air Control, Energy Auditing Approach in Air Handling & Distribution System,

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Utilization of Electrical Energy & Traction System
Course Code	BTEE5102

Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To develop the lighting schemes.
2. To develop the analytical skills for electric heating.

Course Outcomes

CO1	Understand with the process and application of electrical energy utilization system
CO2	Identify effective electrical system with various applications prospective.
CO3	Analyse effective control scheme with different electrical appliances.
CO4	Solve problems in the subject of utilization of electrical energy and traction system.
CO5	Design an effective control structure and save energy in utilization of electrical energy and traction system.
CO6	Understand the advancement in in traction system

Text Book (s)

1. H. Pratab. “Art & Science of Electric Energy’s” Dhanpat Rai & Sons.
2. G.K. Dubey, “Fundamentals of electric drives” Narosa Publishing house

Reference Book (s)

1. Pratab.”Modern electric traction” Dhanpat Rai & Sons. □
2. C.L. Wadhwa,”Generation, Distribution and Utilization of Electrical Energy, “New Age International Publishers.

Course Content:

Unit I: ELECTRIC HEATING
Advantage & methods of electric heating, resistance heating, electric arc heating, induction heating, dielectric heating.
Unit II: ELECTRIC WELDING 9 lecture hours
Electric arc welding, electric resistance welding, electric welding control, electrolyte process: principle of electro deposition, laws of electrolysis, application of electrolysis.

Unit III: ILLUMINATION 10 lecture hours
Various definition, laws of Illumination, requirement of good lighting, design of indoor lighting & outdoor lighting system, refrigeration system, domestic refrigerator, water cooler, types of air conditioning, window air conditioner.
Unit IV : ELECTRIC TRACTION – I 8 lecture hours
Types of electric traction, system of track electrification, traction mechanics-types of services, speed time curve and its simplification, average and schedule speeds, tractive effort specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence.
Unit V: ELECTRIC TRACTION – II 7 lecture hours
Salient features of traction drives, series-parallel control of dc traction drives (bridge traction) and energy saving, power electronic control of dc & ac traction drives, diesel electric traction.
Unit VI: Recent Trends
Recent advancement in traction system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power electronics application in renewable enrgy			
Course Code	BEE03T5010			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

To provide knowledge about various renewable energy technologies, their potential and applications

Course Outcomes

Text Books:

1. Title Power Electronics Hand book Author Rashid .M. H Publisher Academic press Edition 2001 and Reprints
2. Title Non-conventional energy sources Author Rai. G.D Publisher Khanna publishes Edition 1993 and Reprints
3. Title Solar energy utilization Author Rai. G.D Publisher Khanna publishes Edition 1993 and Reprints

Reference Books:

1. Title Wind energy system Author Gray, L. Johnson Publisher prentice hall linc Edition 1995 and Reprints 161
2. Title Non-conventional Energy sources Author B.H.Khan Publisher Tata McGraw-hill Publishing Company, New Delhi Edition 2nd Edition

Unit I: Introduction :
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.
Unit II: Electrical Machines for Renewable Energy Conversion :
Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.
Unit III : Power Converters :
Solar: Block diagram of solar photo voltaic system - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters-selection Of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.
Unit IV : Analysis of Wind Energy Systems :
Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system
Unit V: Analysis of PV Systems
solar system-Grid connection Issues -Grid integrated, Wind and PV solar hybrid system
Unit VI: Hybrid Renewable Energy Systems :
Need for Hybrid SystemsRange and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Special Electrical Machines
Course Code	BTEE5202
Prerequisite	
Corequisite	
Antirequisite	

	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the various machines
2. To understand the concept of special electrical machines and applications

Course Outcomes

CO1	Apply the knowledge of Commutator motors and circuits analysis of FHP Universal Commutator motors
CO2	Make use of application of the BLDC Motors with industries and day to day life
CO3	Analysis the demanding and appropriate drive performance for the Stepper motor.
CO4	Analysis the numerical problems associated with FHP Synchronous Motors
CO5	Test and estimate the parameter of the Special machine. Analysis the demanding and appropriate drive performance for the specific purpose.
CO6	Test and estimate the parameter of the LIM.

Text Book (s)

1. P.C. Sen, "Principles of Electric Machines and Power Electronics", 2nd Edition, Wiley India Ltd. 2007
2. E. Openshaw Taylor, "The Performance and Design of AC Commutator Motors", Wheeler Publishing, 1997
3. R. Krishnan, "Switched Reluctance Motor Drives", 1st Edition, CRC Press. 2001

Unit I: FHP Universal Commutator motors:
Principle of operation and performance characteristics of universal commutator motor without and with compensating windings, phasor diagrams and expressions for power and torque, speed-torque characteristics with DC and AC excitations.
Unit II: Introduction to Brushless DC Motor Drives (BLDC)
Salient features of various permanent magnet materials- B-H- Loop and demagnetization characteristics, Comparison of BLDC Vs conventional, BLDC Vs Synchronous motor, BLDC Vs induction motor. Operating principle of BLDC- Principle of hall sensor - unipolar BLDC and Bi-polar BLDC.
Unit III: Stepper motors:
Introduction, Multi-stack variable-reluctance stepping motors, Principles of operation , Aspects of design, Single stack variable-reluctance stepping motors, Hybrid stepping motors, Comparison of motor types, design of drive circuits, torque/rotor position characteristics.
Unit IV : Servomotors:
DC and AC servomotors, transfer function analysis, Synchronous
Unit V: Switched Motor Reluctance Drives
Introduction, Poles, phase and windings, Static torque production, Partition of energy and effects of saturation, Dynamic torque production, Converter circuits, Current regulation, Commutation, torque – speed characteristics, Shaft position sensing.
Unit VI: Linear Induction motors
Basic principle of operation and types. Field analysis & Propulsion force; equivalent circuit

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket- (Processing and Computing Techniques)

Name of The Course	Machine learning			
Course Code	BTEE4012			
Prerequisite	Python			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Get the exposure to Artificial Neural Networks & Fuzzy Logic.
2. Understand the importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines.
3. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.
4. Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

Course Outcomes

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Understand setup and solve typical machine learning problems, by implementation or by using simulation tools.
CO3	Design supervised learning models.
CO4	Design unsupervised learning models.
CO5	Understand the Convolution neural networks.
CO6	Develop machine learning algorithms for an application.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Data acquisition, pre-processing, feature extraction and processing, feature ranking/selection, feature reduction, model learning, evaluation, deployment. Matrix algebra, Bayes theory
Unit II: Supervised Learning 8 Hours
Decision trees, Inductive bias, Classification, Regression, Perceptron, Tree learning algorithms.
Unit III: Unsupervised Learning 8 Hours
Clustering, K-means algorithm, Univariate linear modeling function, Cost function and its minimization, Logistic regression, Softmax regression.
Unit IV: Neural Networks 6 Hours
Artificial neurons, Gradients and back propagation, Gradient decent,
Unit V: Convolution neural networks 6 Hours
Continuous convolution, discrete convolution, pooling. Recurrent neural networks. Deep neural networks
Unit VI: Advanced topic 6 Hours
Development of an application of machine learning in field of electrical engineering

Suggested Reading

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition.
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications.
5. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI, 1996.
6. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill, 2007.
7. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.
8. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, West Sussex, England, 2005.

Name of The Course	Digital Signal Processing			
Course Code	BECE2020			
Prerequisite	Signals and Systems			
Co-requisite	Network Theory			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Introduce to discrete time signal processing and characterization of random signals, filter design techniques, and imperfections caused by finite word length.
2. Learn how design FIR and IIR filters.
3. Learn the theory of digital signal processing and digital filter design, including hands-on experience with important techniques involving digital filter design and digital simulation experiments.
4. Introduce the fundamental principles and techniques of digital signal processing for understanding and designing new digital signal processing systems and for continued learning.

Course Outcomes

CO1	Apply digital signal processing fundamentals.

CO2	Comprehend if a DT system is linear, time-invariant, causal, and memory-less, High Pass, Low Pass, All Pass and able to apply Z and inverse Z transform on DT signal.
CO3	Acquire the knowledge of representation of discrete-time signals in the frequency domain, using DFT and FFT.
CO4	Design FIR and IIR filters to meet the specific magnitude and phase requirements.
CO5	Understand the concept of linear prediction and spectrum estimation.
CO6	Understand the concept of advance processor

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Sampling of Continuous Time Signals 8 Hours
Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.
Unit II: Sampling of Continuous Time Signals 8 Hours
Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.
Unit III: Transform Analysis of LTI Systems 8 Hours
Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase Overview of finite precision numerical effects, effects of coefficient quantization, Effects of round-off noise in digital filters, zero-input limit cycles in fixed point realizations of IIR digital filters.
Unit IV: Filter Design Techniques 8 Hours
Design of D-T IIR filters from continuous – time filters, design of FIR filters by windowing, Kaiser Window method, optimum approximations of FIR filters, FIR equiripple approximation.
Unit V: Fourier analysis of Signals Using DFT 8 Hours
DFT analysis of sinusoidal signals, time-dependent Fourier transforms: Block convolution, Fourier analysis of non – stationary and stationary random signals, spectrum analysis of random signals using estimates of the autocorrelation sequence.
Unit VI: Recent Trends in DSP
DSP architecture, Memory organization, Simulation

Suggested Reading

1. Oppenheim A.V., Schafer, Ronald W. & Buck, John R., "Discrete Time Signal processing",Pearson Education , 2nd Edition.
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms And Applications", Pearson Education, 4rd Ed., 2007.
3. Ramesh P., "Digital Signal Processing", SciTech Publication, 41FL Ed., 2008.
4. MitraSanjit K., "Digital Signal Processing: A Computer Based Approach", 3rd Ed., Tata McGraw-Hill, 2008.
5. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital SignalProcessing", PHI 2001.
6. Shaliwahan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw-Hill, 2nd Ed., 2000.

Name of The Course	Neural Networks and Fuzzy Control			
Course Code	BTEE4015			
Prerequisite	Control System			
Co-requisite	Advanced Control System			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. The objective of this course is to present sufficient background in both fuzzy and neural network so that students in future can pursue advanced soft computing methodologies.
2. This course combines knowledge, techniques, and methodologies from various sources, using techniques from neural networks and fuzzy set theory, as an extension, the course uses the Neuro Fuzzy models for the complex engineering problems.

Course Outcomes

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems
CO3	Understand the feed forward and Recurrent neural networks cocept.
CO4	Understanding of fuzzy relation rule and aggregations.
CO5	Understand concept of classical and fuzzy sets, fuzzification and defuzzification.
CO6	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Artificial neural networks and their biological motivation – Terminology – Models of neuron – Topology – characteristics of artificial neural networks – types of activation functions – learning methods – error correction learning – Hebbian learning – Perceptron – XOR Problem – Perceptron learning rule convergence theorem – Adaline.
Unit II: Feed forward Neural Networks 8 Hours
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications;
Unit III: Recurrent Neural Networks
Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network.
Unit IV: Fuzzy Logic & Fuzzy Sets 8 Hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.
Unit V: Fuzzy Relations & Aggregations 8 Hours
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, Defuzzification: MOM, COA
Unit VI: Fuzzy Optimization and Neuro Fuzzy Systems 8 Hours
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Suggested Reading

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition.
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications.
5. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI, 1996.
6. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill, 2007.

7. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.
8. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, West Sussex, England, 2005.

Name of The Course	Soft Computing			
Course Code	BECE4401			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Introduce the fundamentals of Soft Computing.
2. Apply Computing models to solve problems.
3. Get the exposure of soft computing, especially evolutionary computation, fuzzy logic, GA and neural networks
4. Become expert in calculating and comparing complexities of various searching and sorting algorithms.

Course Outcomes

CO1	Identify and describe Soft-Computing techniques and their roles in building intelligent machines
CO2	Apply Soft – Computing models & reasoning to handle uncertainty and solve engineering problems.
CO3	Recognize the feasibility of applying a soft computing methodology for a particular problem
CO4	Apply genetic algorithms to optimization problems
CO5	Identify the importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines.
CO6	Understand the recent development in electrical engineering using soft computing

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Artificial Neural Networks 8 Hours
Introduction, model of neuron, activation functions, important terminologies of ANN, Hebb's learning, Supervised learning, Unsupervised learning, reinforcement learning, Adaline, Perceptron, Back propagation networks, Adaptive Resonance Theory, Associative Memories, Applications.
Unit II: Fuzzy Logic & Fuzzy Sets 8 Hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers
Unit III: Fuzzy Relations & Aggregations 8 Hours
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit IV: Neuro-Fuzzy Systems 8 Hours
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks. Application of Fuzzy Logic: Medicine, Economics, Industry etc.
Unit V: Genetic algorithm 8 Hours
Genetic Algorithm: An Overview, GA in problem solving, Implementation of GA fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modelling: Inheritance operator, crossover, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method.
Unit VI: Recent development using soft computing
Recent development in electrical engineering using soft computing

Suggested Reading

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.

2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.
3. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.

4. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws
5. Pub., 1996.
6. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.

Name of The Course	Neural Networks and Deep Learning Algorithms				
Course Code	BEE0275007				
Prerequisite	Python/Javascript/Java/C++/Matlab)				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Course Outcomes

CO1	Use the backpropagation algorithm to calculate weight gradients in a feed forward neural network by hand
CO2	Understand the motivation for different neural network architectures and select the appropriate architecture for a given problem
CO3	Write a neural network from scratch in using PyTorch in Python, train it 119ntil convergence and test its performance given a dataset.
CO4	Understand how neural networks fit into the more general framework of machine learning, and what their limitations and advantages are in this context.
CO5	Implement deep learning algorithms and solve real-world problems.
CO6	Apply the deep learning techniques for data analysis.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques
Unit II: Feedforward neural network 5 Hours
Artificial Neural Network, activation function, multi-layer neural network.
Unit III: Training Neural Network and Conditional Random Field 8 Hours
Risk minimization, loss function, backpropagation, regularization, model selection, and optimization. Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.
Unit IV: Probabilistic Neural Network 5 Hours
Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.
Unit V: Deep Learning and Its tools 12 Hours
Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.Object recognition, sparse coding, computer vision, natural language processing. Deep Learning Tools: Caffe, Theano, Torch.
Unit VI: Demonstrate deep learning algorithm
Apply the deep learning techniques for data analysis in electrical engineering

Suggested Reading

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016..
7. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer , 2007.

Name of The Course	Human Computer Interface			
Course Code	BEE02T5008			
Prerequisite	Knowledge of C programming language/UNIX			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. This course provides an introduction to and overview of the field of human-computer interaction (HCI).
2. HCI is an interdisciplinary field that integrates theories and methodologies from computer science, psychology, design, and many other areas.
3. Course readings will span current theory and practice in interface specification, design and evaluation, as well as current and classic research papers in HCI.
4. Students will work on both individual assignments and a team project to design, implement and evaluate computer interfaces.

Course Outcomes

CO1	Describe and apply user-centered design methods to conduct formative and summative evaluations.
CO2	Explain and apply core theories and models from the field of HCI.
CO3	Design and implement useful, usable, and engaging graphical computer interfaces.
CO4	Discuss and critique research in the field of HCI.
CO5	Describe special considerations in designing user interfaces for wellness.
CO6	Develop Human Computer Interface applications

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Introduction and history of HCI, Project overview, IRB, UCD, Usability principles.
Unit II: Design 6 Hours
Human abilities, Predictive evaluation, Understanding users, request gathering, task analysis, DOET.
Unit III: Graphics Design 6 Hours
Graphics Design, Handling errors and help.
Unit IV: Prototype 6 Hours
Prototyping and UI software, User models and Predictive models.
Unit V: Universal esiign 6Hours
Universal design, Information visualization, Embodied agents, CSCW, Ubicom.
Unit VI: Application of Human Computer Interface
Case Study related to Human Computer Interface

Suggested Reading

1. Interaction Design: Beyond Human-Computer Interaction, Fourth Edition by Preece, Sharp & Rogers (2015).
2. About Face: The Essentials of Interaction Design, Fourth Edition by Cooper, Reimann, Cronin, &Noessel (2014).

Name of The Course	Introduction to Scilab and its applications			
Course Code	BEE0275006			
Prerequisite	MATLAB			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Scilab can help a student focus on the procedure for solving a problem instead of spending time and energy developing a matrix algebra library.

2. In fact, it is a calculator that is capable of matrix algebra computations.
3. Once the student is sure of having mastered the steps, they can be converted into functions and whole problems can be solved by simply calling a few functions.
4. Scilab is an invaluable tool as solved problems need not be restricted to simple examples to suit hand calculations.

Course Outcomes

CO1	To aware the students about SCILAB software environment.
CO2	Students will understand the basics of SCILAB software and its data class.
CO3	The course contents will enable the students to learn basic SCILAB programming for engineering application
CO4	Differentiate between Scilab and MATLAB
CO5	SCILAB Simulink for simulation, analysis and design of the system
CO6	Develop real time system for society needs.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
About SCILAB/MATLAB, SCILAB/MATLAB System, Starting and Quitting SCILAB/MATLAB, Entering Matrices sum and transpose, subscripts, colon Operator, magic Function
Unit II: Working with matrices 8 Hours
Generating Matrices, The load Function, M-Files, Concatenation, Deleting Rows and Columns, Linear Algebra, Arrays Multivariate Data, Scalar Expansion, Logical Subscripting, find Function, Variables Numbers, Operators Functions, Expressions.
Unit III: Command Window and Graphics8 Hours
The format Function, Suppressing Output, Entering Long Statements, Command Line Editing, Plotting Process, Editing Process, Preparing Graphs, Basic Plotting Functions, Mesh & Surface Plot, and Image Reading & Writing, Printing graphics.
Unit IV: Flow Control and data structure 8 Hours
If, else, and else if, switch and case, for, while, continue, break try – catch, return, Multidimensional Arrays, Cell Arrays, Characters and Text, Structures
Unit V: Scripts and Functions 8 Hours
Scripts, Functions, Global Variables, Passing String Arguments to Functions, eval Function, Function Handles, Vectorization , Pre allocation.
Unit VI: Application
Application of the Scilab in renewable energy

Suggested Reading

1. Introduction to SCILAB by RachnaVerma and Arvind Verma.
2. SCILAB—A Beginner's Approach by Anil Kumar Verma.
3. MATLAB & Its Applications in Engineering By: Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma.
4. A Guide to MATLAB: For Beginners & Experienced Users By: Kevin
5. R. Coombes, John E. Osborn, Garrett J. Stuck

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B. Tech in Electrical & Electronics Engineering

Scheme: 2019-2020

Vision

To be known globally as a premier Department offering value based education in Electrical and Electronics Engineering inculcating the spirit of interdisciplinary research and innovation.

Mission

- Create a strong foundation on fundamentals in the areas of Electrical and Electronics Engineering through outcome based teaching learning process.
- Establish state-of-the-art facilities for design and simulation.
- Provide opportunities to students to work on real world problems and develop sustainable ethical solutions.
- Involve the students in group activities, including those of professional bodies to develop leadership and communication skills.

Program Educational Objectives
Graduate shall

PEO-1: Electrical and Electronics Engineering graduates will have successful careers in core engineering, academia, research organizations.
PEO-2: The graduates will be well prepared to adapt usage of modern tools & emerging technologies and contribute to interdisciplinary research with innovative practices.
PEO-3: The graduates will be academically prepared to become leaders in their organizations, become professional engineers, as necessary, and will contribute effectively to the growth and development of their organization.
PEO-4: The graduates will engage in professional activities with ethical practices in the field of Electrical Engineering to enhance their own stature and simultaneously contribute to the profession and society at large.

Program Specific Outcome
PSO1: Electrical and Electronics Engineering students will be able to apply their knowledge for developing reliable electrical circuits and systems with proper protection.
PSO2: Electrical and Electronics Engineering students will be able to develop software based design and analysis of systems using MATLAB, SIMPOWER, PLC/SCADA etc
PSO 3: Creative design to produce and maintain quality of power supply and use of suitable instruments for energy audit and calibration.

Program Outcomes

- Engineering Knowledge : Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems
- Problem analysis : Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
- Design/development of solutions : Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations
- Conduct investigations of complex problems : Use research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions
- Modern tool usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling complex engineering activities with an understanding of limitations
- The engineer and society : Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

- Environment and sustainability : Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments
- Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
- Individual and team work : Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings
- Communication : Communicate effectively on complex engineering activities with the engineering community and with society at large such give and receive clear instructions
- Project management and finance : Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments
- Life-long Learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Curriculum

Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA101	Mathematics-1 (Multivariable Calculus)	3	1	0	3	20	30	50
2	BMA151	Exploration with CAS-I	0	0	2	1	50		50
3	BHS101	Professional Communication	2	0	0	2	20	30	50
4	BCS101	Fundamentals of Computer Programing	3	0	0	3	20	30	50
5	BCS151	Fundamentals of Computer Programing Lab - 1	0	0	2	1	50		50
6	BPH101	Engineering Physics	3	0	0	3	20	30	50
7	BPH151	Engineering Physics Lab	0	0	2	1	50		50
8	BME101	Elements of Mechanical Engineering	3	0	0	3	20	30	50
9	BME151	Workshop Practice	0	0	4	2	50		50
10						19			
		Total							
Semester II									
Sl No	Course Codee	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
	BMA201	Mathematics-II (Matrices and Differential Equations)	3	1	0	3	20	30	50
	BMA251	Exploration with CAS-II	0	0	2	1	50		50
	BHS251	Professional Communication Lab	0	0	2	1	50		50
	BCS251	Fundamentals of Computer Programming Lab - 2	0	0	2	1	50		50
	BCH101	Engineering Chemistry	3	0	0	3	20	30	50
	BCH151	Engineering Chemistry Lab	0	0	2	1	50		50
	BEC101	Basic Electrical and Electronics Engineering	3	0	0	3	20	30	50
	BEC151	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50		50
	BOC251	Engineering Clinic-1	0	0	2	1	50		50
	BLE101	Psychology and Sociology	2	0	0	2	20	30	50
		Total							
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE2010	Digital Electronics	3	0	0	3	20	30	50
2	MATH2001	Functions of complex variables and Transforms	3	0	0	3	20	30	50
3	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	30	50
4	BTEE2006	Electrical Machine-1	3	0	0	3	20	30	50

5	BTEE2002	Network Analysis and Synthesis	3	0	0	3	20	30	50
6	BECE2016	Signals and Systems	3	0	0	3	20	30	50
7	BEE02T2003	Design and Engineering	2	0	0	2	20	30	50
8	BTEE2003	Network Analysis and Synthesis Lab	0	0	2	1	50		50
9	BEE02P2003	Engineering Clinic-1	0	0	2	1	50		50
10	SLBT2021	English Proficiency and Aptitude Building - 3	0	0	4	2	50	-	50
11	BTEE2007	Electrical Machine Lab-1	0	0	2	1	50		50
12	ENVS1004	Environmental Science and Engineering (Mandatory Audit Course)	2	0	0	0	20	30	50
		Total				25			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MATH2004	Probability and Stochastic Processes	3	0	0	3	20	30	50
2	BEEE3002	Control Systems	3	0	0	3	20	30	50
3	BECE2015	Electronic Devices and Circuits	3	0	0	3	20	30	50
4	BTEE2008	Fundamentals of Power Systems	3	0	0	3	20	30	50
5	BTEE3015	Power Plant Engineering	3	0	0	3	20	30	50
6	BEEE2001	Electrical Measurement and Instrumentation	3	0	0	3	20	30	50
7	BEE02P2007	Engineering Clinic-2 (IOT based Tinker CAD)	0	0	2	1	50		50
8	BEE02P2010	Electronic Devices and Circuits Lab	0	0	2	1	50		50
9	BEE02P2009	Measurement and Control Systems Lab	0	0	2	1	50		50
10	BEE02P2008	Logical and Critical Reasoning	0	0	2	1	50		50
		Total				22			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE3004	Microcontroller and Embedded system	3	0	0	3	20	30	50
2	BTEE3004	Electrical Machine-2	3	0	0	3	20	30	50
3	BTEE3009	Power System Analysis	3	0	0	3	20	30	50
4	BTEE3011	Power Electronics	3	0	0	3	20	30	50
5	********	Program Elective-I	3	0	0	3	20	30	50
6	BEE03T3001	Engineering Economics and Management	3	0	0	3	20	30	50
7	BEE02P3001	Engineering Clinic-3(Industrial Internship)	0	0	2	1	50		50
8	BEE02P3002	Effective Leadership and Decission Making Skills	0	0	2	1	50		50

9	BECE3005	Microcontroller and Embedded Systems Lab	0	0	2	1	50		50
10	BTEE3002	Power Electronics Lab	0	0	2	1	50		50
11	BEE02T3004	Finance for Electrical Engineers	2	0	0	1	20	30	50
12	BTEE3005	Electrical Machine Lab-2	0	0	2	1	50		50
		Total				24			

Semester VI

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	SLBT3002	Campus to Corporate program	0	0	4	2	50		50
2	BECE3020	Digital Signal Processing	3	0	0	3	20	30	50
3	BEE02T3006	Power System protection	3	0	0	3	20	30	50
4	BTEE4005	Professional Ethics and Values	2	0	0	0	20	30	50
5	********	Program Elective-II	3	0	0	3	20	30	50
6	********	Program Elective-III	3	0	0	3	20	30	50
7	********	Open Elective -1	3	0	0	3	20	30	50
8	BEE02P3008	Design and Innovation Project	0	0	2	1	50		50
9	BEE02P3007	Power System protection Lab	0	0	2	1	50		50
10	GERN1001/JAPA1001/FREN1001	Forign Language - 1 (German, Japneese, French) *any one	0	0	2	0	50		50
		Total				19			

Semester VII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEEE4001	Smart Grid and Energy management	3	0	0	3	20	30	50
2	********	Program Elective-IV	3	0	0	3			
3	********	Program Elective-V	3	0	0	3			
4	BEEE2018	Non-Conventional Energy Resources	3	0	0	3	20	30	50
5	********	Open Elective-2	3	0	0	3	20	30	50
	BTEE4001	Electric Drive	3	0	0	3	20	30	50
6	BTEE3008	PLC/SCADA Lab	0	0	2	1	50		50
7	BEE03P4003	Industrial Internship	0	0	0	0	50		50
8	BEE02P4005	Technical Seminar	0	0	2	0	50		50
9	BEE02P4002	Capstone Design Phase-I	0	0	10	2	50		50
10	GERN/JAPA/FREN 1002	Forign Language - 2 (German, Japneese, French) *Optional	0	0	2	0	50		50
		Total				21			

Semester VIII

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEE02P4003	Capstone Design phase - II	0	0	18	6	50		50
2	BEE02P4004	Industrial Internship & Technical Seminar	0	0	0	6	50		50
		Total				12			

List of Program Electives

Control Engineering

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BTEE3019	Advanced Control System	3	0	0	3	20	30	50
2	BTEE3020	Industrial Automation and Control	3	0	0	3	20	30	50
3	BEE02T5001	Industrial Instrumentation and Automation	3	0	0	3	20	30	50
4	BEEE5005	Power System Operation and Control	3	0	0	3	20	30	50
5	BEEE5004	Digital Control	3	0	0	3	20	30	50
6	BEE03T5002	Automation and Robotics	3	0	0	3	20	30	50

Power Engineering

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEE03T5011	Power System Equipments	3	0	0	3	20	30	50
2	BTEE3023	Power Quality	3	0	0	3	20	30	50
3	BTEE4010	FACTS and HVDC	3	0	0	3	20	30	50
4	BEE02T5003	Electrical and Hybrid Vehicle	3	0	0	3	20	30	50
5	BTEE4009	Power System Deregulation	3	0	0	3	20	30	50
6	BEE02T3005	High Voltage Engineering	3	0	0	3	20	30	50

Energy Engineering

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BTEE4011	Energy Assessment and Audit	3	0	0	3	20	30	50
2	BTEE5102	Utilization of Electrical Energy and Traction System	3	0	0	3	20	30	50
3	BEE03T5010	Power Electronics applications in Renewable Energy	3	0	0	3	20	30	50
4	BTEE5202	Special Electrical Machine	3	0	0	3	20	30	50
5	BEE02T5004	Energy Modelling Simulation Using MATLab	3	0	0	3	20	30	50
6	BEE02T4001	Electrical Design, Estimation and Energy Audit	3	0	0	3	20	30	50

IOT

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEE03T5001	Introduction to IoT and its Applications	3	0	0	3	20	30	50
2	BEE03T5002	Automation and Robotics	3	0	0	3	20	30	50
3	BEE03T5003	Deep Learning Algorithms	3	0	0	3	20	30	50
4	BEE03T5004	Object Oriented Programming	3	0	0	3	20	30	50
5	BEE03T5005	Virtual Reality	3	0	0	3	20	30	50
6	BEE03T5006	Raspberry Pi and its applications	3	0	0	3	20	30	50
7	BEE03T5007	Introduction to Arduino programming and its applications	3	0	0	3	20	30	50
8	BEE03T5008	Cloud Computing	3	0	0	3	20	30	50
9	BEE03T5009	Python Programming							

	List of Open elective (Engineering courses) Proposed								
	Basket 1								
Sl. No.	Course Code	Course Title					Assessment Pattern		
		Basket 1	L	T	P	C	IA	MTE	ETE
1	BOE601	Human Computer Interface	3	0	0	3	20	50	100
2	BOE602	Introduction to cyber Physical Systems	3	0	0	3	20	50	100
3	BOE603	Selected Topics in Signal Processing	3	0	0	3	20	50	100
4	BOE604	Selected Topics in Communication Engineering	3	0	0	3	20	50	100
5	BOE605	Autonomous Vehicles	3	0	0	3	20	50	100
6	BOE606	Data Science	3	0	0	3	20	50	100
7	BOE607	Computer Vision	3	0	0	3	20	50	100
8	BOE608	Artificial Intelligence	3	0	0	3	20	50	100
9	BOE609	Cyber Security	3	0	0	3	20	50	100
10	BOE610	Energy Management	3	0	0	3	20	50	100
11	BOE611	Estimation and Costing	3	0	0	3	20	50	100
12	BOE612	Data Envelopment Analysis	3	0	0	3	20	50	100
13	BOE613	Operation Management	3	0	0	3	20	50	100
14	BOE614	Construction Engineering	3	0	0	3	20	50	100
16	BOE615	Disaster Management	3	0	0	3	20	50	100

16	BOE616	Bioinformatics	3	0	0	3	20	50	100
Basket-2									
1	BOE701	Remote Sensing and GIS	3	0	0	3	20	50	100
2	BOE702	Automotive Electronics	3	0	0	3	20	50	100
3	BOE703	Sensors & Actuators	3	0	0	3	20	50	100
4	BOE704	IoT and Smart Cities	3	0	0	3	20	50	100
5	BOE705	Web Design and Management	3	0	0	3	20	50	100
6	BOE706	Principles of Telemedicine	3	0	0	3	20	50	100
7	BOE707	Mobile Application Development	3	0	0	3	20	50	100
8	BOE708	Business Analytics	3	0	0	3	20	50	100
9	BOE709	Cloud Computing	3	0	0	3	20	50	100
10	BOE710	Block Chain	3	0	0	3	20	50	100
11	BOE711	Augmented / Virtual Reality	3	0	0	3	20	50	100
12	BOE712	Digital Forensics	3	0	0	3	20	50	100
13	BOE713	Operations Research	3	0	0	3	20	50	100
14	BOE714	Renewable Energy	3	0	0	3	20	50	100
15	BOE715	Interior Design	3	0	0	3	20	50	100
16	BOE716	Landscaping	3	0	0	3	20	50	100
17	BOE717	Biology for Engineers	3	0	0	3	20	50	100

Detailed Syllabus

Semester III

Name of The Course	Digital Electronics				
Course Code	BECE2010				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
2. To familiarize with the design of various combinational digital circuits using logic gates
3. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
4. To explain the various semiconductor memories and related technology
5. To introduce the electronic circuits involved in the making of logic gates

Course Outcomes

CO1	Design and analyze combinational logic circuits
CO2	Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
CO3	Understand Logic Families and Design memories
CO4	Design & analyze synchronous sequential logic circuits
CO5	Use HDL & appropriate EDA tools for digital logic design and simulation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit-1 Introduction 8 hours
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.
Unit-2MSI devices 8 hours
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.
Unit-3Sequential Logic Design 8 hours
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.
Unit-4Logic Families and Semiconductor Memories 8 hours
Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.
Unit-5 VLSI Design flow 8 hours
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Suggested Reading

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Name of The Course	Electromagnetic Field Theory				
Course Code	BECE2012				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
2. To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
3. To understand wave propagation in lossless and in lossy media
4. To be able to solve problems based on the above concepts

Course Outcomes:

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.
CO6	Understand the application of Electromagnetism in Daily Life

Reference Books

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
4. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999Syllabus

Course Content:

UNIT I STATIC ELECTRIC FIELDS 9 Hours
Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co- ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges – Electric field due to continuous charge distribution – Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet.Electric Scalar Potential – Relationship between potential and electric field – Potential due to infinite uniformly charged line – Potential due to electrical dipole – Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications
UNIT II: STATIC MAGNETIC FIELDS 8Hours
The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circ ular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.
UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9 Hours
Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials-Definition of Capacitance – Capacitance of various geometries using Laplace's equation– Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability – magnetic boundary conditions
UNT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS 8 Hours
Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.Displacement current – Ampere's circuital law in integral form –

Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form. Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.
UNIT V: ELECTRO MAGNETIC WAVES 9 Hours
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. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization, Brewster angle.
UNIT VI Applications of Electromagnetism
Household Application, Industrial Application, Magnetic Levitation Trains, Communication System, medical Systems

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Network Analysis and Synthesis			
Course Code	BTEE2002			
Prerequisite	Basic Electrical and Electronics Engineering			
Corequisite	Signals and systems			
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

7. To learn the concepts of network analysis in electrical and electronics engineering.
8. To learn linear circuit analysis, graph theory and network theorems.
9. Analyze two port networks using Z, Y, ABCD and h parameters

Course Outcomes

CO1	Apply the knowledge of graph theory with basic circuital laws and simplify the network using reduction techniques
CO2	Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO3	Infer and evaluate transient response, Steady state response, network functions
CO4	Evaluate two-port network parameters and explain the inter-relationship among parameters for network analysis.
CO5	Synthesize one port network using Foster and Cauer Forms and
CO6	Examine active filter configurations for possible applications in network theory.

Text Book (s)

6. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
7. A C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007,
8. D.RoyChoudhary, "Networks and Systems" Wiley Eastern Ltd.
9. A.Chakrabarti, "Circuit Theory" DhanpatRai& Co
10. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.

Reference Book (s)

5. Hayt, W., Engineering Circuit Analysis, Tata McGraw□Hill (2006)
6. Hussain, A., Networks and Systems, CBS Publications (2004).
7. Sudhakar, A., Circuits and Networks, Tata McGraw□Hill (2006).
8. Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).

Course Content:

Unit-1GraphTheory 6 hours
Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set,Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.
Unit-2Network Theorems (Applications to ac networks) 9 hours
Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman'stheorem, compensation theorem, Tellegen's theorem.
Unit-3Network Functions and Transient analysis 11 hours

Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.
Unit-4Two Port Networks 10 hours
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.
Unit-5Network Synthesis & Filters 9 hours
Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance,
Unit-6 Filters
Passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-I			
Course Code	BTEE2006			
Prerequisite	Basic Electrical Engineering			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

4. To acquaint the students with the principle of operation and performance of transformers and DC machines.
5. To familiarize students with the parameter estimation of electrical machines
6. To learn the mathematical models and equations related to electrical machines.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles of electric machines
CO2	Analyse the electrical machines performance.
CO3	Test and estimate the parameter of the electrical machine.
CO4	Analysis the numerical problems associated with transformer and DC machines.
CO5	Make use of application of the subject topic with industries and day to day life
CO6	Understand of the special purpose transformer for measurement and its application

Text Book (s)

4. I.J. Nagrath& D.P. Kothari, "Electrical Machines", Tata McGraw Hill.
5. P S Bimbhra, "Generalized Theory of Electrical Machines", Khana Publisher.
6. P S Bimbhra, "Electrical Machinery", Khana Publisher.

Reference Book (s)

3. A. E. Fitzgerald, C. Kingsley, and S. D. Umans, *Electric Machinery*, 6th ed., New York: McGraw-Hill, 2003.
4. Vincent Del Toro, "Electrical Machine and Power System", PHI.

Course Content:

Unit-1Introduction
Flow of Energy in Electromechanical Devices, Magnetic Circuit, Analogy b/w Electric and magnetic Ckt, B-H Curve, Hysteresis and eddy current losses, Mutual Coupling with dot convention, Energy in magnetic systems(defining energy & Co-energy) , Singly Excited Systems and Doubly excited Systems, Generated emf in machines; torque in machines with cylindrical air gap.
Unit-2 Single Phase Transformer
Construction- Core and Shell type, Basic principle of Operation, Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, polarity test. Auto Transformer: Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications.
Unit-3 Three Phase Transformers

Construction, three phase transformer phasor groups and their connections, open delta connection, choice of transformers for three phase circuits, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers.
Unit-4 D.C. Machines
Construction of DC Machines, Armature winding, Emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Methods of improving commutation, Performance Characteristics of D.C. generators, Voltage Regulation, Parallel operation of DC generator (shunt, series and compound machine).
Unit-5 D.C. Machines (Contd.)
Performance Characteristics of D.C. motors, Starting of D.C. motors ; 3 point and 4 point starters, Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test), Electric braking
Unit 6: Special Purpose Transformer
Instrument Transformer Current Transformer and Potential Transformer, Earthing Transformer

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-I lab			
Course Code	BTEE2007			
Prerequisite	Basic Electrical Engineering lab			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:

After the completion of course the students will

6. This lab gives the chance to get friendship with Electrical machines.
7. To acquaint the students with the principle of operation and performance of transformers and DC machines.
8. To familiarize the students with the parameter estimation of electrical machines.
9. To compare the mathematical models and equations related to electrical machines.
10. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of electric machines.
CO2	Analysis the electrical machine performance through experiments.
CO3	Estimate the parameter of the transformer, DC machines.
CO4	Test the transformer, DC machines with various loads.
CO5	Make use of application of the subject topic with industries and day to day life.

List of Experiments of Electrical Machine –I

1	Efficiency and regulation of single phase transformer by Sumpner's back to back test.
2	Efficiency of DC shunt motor by Swinburne's test
3	Open circuit and short circuit test on single phase transformer.
4	3-phase to 2-phase conversion with two single phase transformers by Scott connection.
5	Speed control of DC motor by Armature and Field Control.
6	Load characteristics of DC shunt generator and plot load voltage Vs load current.
7	Magnetization characteristics of DC shunt generator.
8	Losses and efficiency of DC machine by Hopkinson's test.
9	Load characteristics of DC compound generator and plot load voltage Vs load current.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Network Analysis and Synthesis Lab			
Course Code	BTEE2003			
Prerequisite	Basic Electrical Engineering lab			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:
After the completion of course the students will

5. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
6. To study the transient response of series and parallel A.C. circuits.
7. To study the concept of coupled circuits and two port networks.
8. To study the two port networks.

Course Outcomes

CO1	To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
CO2	To study the transient response of series and parallel A.C. circuits.
CO3	To study the concept of coupled circuits and two port networks.
CO4	To study the two port networks.
CO5	To introduce the concept of short circuit and open circuit.

Network Analysis and Synthesis Lab

1	To verify Thevenin's theorem in a.c.
2	To verify Norton's theorem in a.c.
3	To verify Superposition theorem in a.c.
4	To verify the Maximum Power Transfer Theorem.
5	Determination of Z-parameters of a two-port network.
6	To verify and determination of y-parameters of a parallel connected two-port network.
7	Determination of h-parameters of a two-port network.
8	To verify and determination of ABCD-parameters of a cascade interconnected two-port network.
9	Determination of characteristics impedance of a symmetrical T-network using S/C and O/C test.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Signals and Systems			
Course Code	BECE2016			
Pre-requisite	Engineering Mathematics			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:
This subject is about the mathematical representation of signals and systems. The most important representations we introduce involve the *frequency domain* – a different way of looking at signals and systems, and a complement to the time-domain viewpoint. Indeed engineers and scientists often think of signals in terms of frequency content, and systems in terms of their effect on the frequency content of the input signal. Some of the associated mathematical concepts and manipulations involved are challenging, but the mathematics leads to a new way of looking at the world.
Course Outcomes:

CO1	Understand various types of signals, classify, analyze and perform various operations on them.
CO2	Classify the systems and realize their responses
CO3	Analyze the response of continuous time systems using Fourier transforms
CO4	Use Laplace and Z transform techniques as tool for System analysis
CO5	Analyze the continuous and discrete time system functions
CO6	Understand the application of Sampling Theorem, Multirate Signal Processing and their applications in real-world problems

Text Book:

3. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi, ISBN 1259083349, 9781259083341
4. Signals and Systems by Oppenheim & Wilsky Millman

Course Content:

Unit-1 **Introduction** **8 hours**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; Basic Signals: unit impulse, unit step, unit ramp, exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit-2 Classification of Systems 8 hours
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit-3 Fourier Series and Transforms 8 hours
Continuous-time Fourier series: Periodic signals and their properties, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, Definition, conditions of existence of FT, properties, magnitude and phase spectra, Parseval's theorem, Inverse FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit-4 Laplace Transforms and Z Transforms 6 hours
One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping
Unit-5 Analysis of LTI systems 6 hours
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter
Unit -6: **Multirate Signal Processing** 6 hours
Sampling and data reconstruction process, Multirate Signal Processing, Sampling, Sampling rate conversion, introduction to compressive sensing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Design and Engineering			
Course Code	BEE02T2003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	2	0	0	2

Course Objectives:

The purpose of this course is to excite the student on creative and innovative design and its significance, aware of the processes involved in design, understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design and get an exposure as to how to engineer a design.

Course Outcomes

CO1	Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
CO2	To understand the production based on the market demand
CO3	Aware of the product oriented and user oriented aspects that make the design a success.
CO4	Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course
CO5	Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.
CO6	Will be able to design the Product centred and user centred design.

Text Book (s)

1. Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN13: 978-0124158917 ISBN-10: 0124158919
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction - Wiley, ISBN-978-1-118-32458-5
3. Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
4. Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
5. Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
6. Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India

Reference Book (s)

1. E-Book (Free download): http://opim.wharton.upenn.edu/~ulrich/designbook.html
2. .http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

Course Content:

Unit I:Introduction to design 11 lecture hours Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength. How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement;
Unit II: Market Survey Market survey customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs.
Unit III: Design process 9 lecture hours Design process- Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of “Complex is Simple”. Design for function and strength. Design detailing- Material selection, Design visualization- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications.
Unit IV: Prototype 8 lecture hours Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling; manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design
Unit V: Design Monitoring 7 lecture hours Design for “X”; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length.
Unit VI: Design Attributes 4 lecture hours Product centred and user centred design. Product centred attributes and user centred attributes. Bringing the two closer.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Semester IV

Name of The Course	Control systems			
Course Code	BEEE3002			
Prerequisite	Signals and Systems			
Corequisite	None			
Antirequisite	None			
	L	T	P	C
	3	0	0	3

Course Objectives:

4. To understand and develop the Mathematical Modelingof dynamic systems using classical and state-space techniques.
5. To apply analytical /graphical techniques in time/frequency domain to determine stability.

6. To understand and use applications of feedback control theory to a variety of real world problems.

Course Outcomes

CO1	Understand mathematics modeling of control systems sand solve it using transfer function, block diagram and signal flow diagram reduction techniques.
CO2	Design and analyze control system engineering problems in time response of first and second order systems.
CO3	Analyze the concept and stability of servo systems using algebraic stability criteria with necessary conditions.
CO4	Understand and analyze the stability analysis using the polar, inverse polar, Bode, and Nyquist stability criterion of control systems
CO5	Understand and design of lead, lag and lead-lag compensator of the control process in time and frequency domains.
CO6	Analysis of the state space systems and its application

Text Book (s)

3. Nagrath& Gopal, "Control System Engineering", 4th Edition, New age International
4. K. Ogata, "Modern Control Engineering", Prentice Hall of India.

Reference Book (s)

3. B.C. Kuo& Farid Golnaraghi, "Automatic Control System" Wiley IndiaLtd, 2008.
4. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

Course Content:

Unit-1Introduction
Feedback Control: Open loop and closed control system, servomechanism, Physical examples. Transfer functions of linear time-invariant systems, Block diagram algebra, and Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.
Unit-2
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: Error analysis. P, PI, PD, PID controllers, design considerations for higher order systems, performance indices.
Unit-3
Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis, Routh-Hurwitz criteria and limitations, root locus concepts, construction of root locus. Design of controllers using root-locus. Pole placement with state feedback, controllability.
Unit-4
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-5
Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs in time domain and frequency domain. Review of state variable technique:
Unit -6
Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electronics Devices and Circuits			
Course Code	BECE2015			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. Apply concepts of semiconductor devices to design and analyze circuits.
2. To prepare students to know the characteristics of different semiconductor devices.

Course Outcomes

CO1	Realize the transistor biasing methods and Design analog electronic circuits using discrete components
CO2	Design common amplifier circuits and analyze the amplitude and frequency responses

CO3	Design various analog circuits to analyze their responses
CO4	Understand the principle of operation of different Oscillator circuits.
CO5	Understand the principle of operation of various amplifier circuits
CO6	Understand the recent trends and practical applications of electronic devices

Text Book (s)

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', 2nd Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634637, 9780070634633

2. David A.Bell, 'Electronic Devices and Circuits', Prentice Hall of India Private Limited, New Delhi, 2003, ISBN 013253147X, 9780132531474

Reference Book (s)

1.Theodre F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004 ISBN 8177588877, 9788177588873.

2. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6th Edition, PHI 2009, ISBN 0132454793, 9780132454797

Course Content:

Unit-1 Introduction 8 hours
BJT and BJT Biasing .Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, Cascode amplifier. HF & LF compensation of RC coupled amplifier. Multistage Amplifiers.
Unit-2FET and FET Biasing 8 hours
FET and FET Biasing. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. Small signal analysis of FET Amplifiers. High Frequency analysis of FET Amplifiers, VMOS & CMOS Concepts.
Unit-3Feedback amplifiers 8 hours
The feedback concept – Transfer gain with feedback – general characteristics and advantages of negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions
Unit-4Oscillators 8 hours
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators.
Unit-5Tuned amplifiers 8 hours
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization. Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.
Unit-6 Recent trends and Application 8 hours
Trend of Energy Saving in Electronic Devices, Application of oscillators- springs and damping, shock absorber in cars, Pendulum

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Fundamental of Power systems				
Course Code	BTEE2008				
Prerequisite	Basic Electrical				
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

4. To develop solid foundation for further study of power system courses.
5. To develop the analytical skills for solving problems related to power system.
6. To familiarize students of the basics of power system components, transmission parameters and losses in the transmission line etc.

Course Outcomes

CO1	Exposure to the modeling of individual power system components like transmission lines and generators
CO2	To understand the overhead transmission line parameters importance and its calculation procedure
CO3	Analyze the overhead transmission line performance
CO4	Analyze the corona phenomena, interference and insulator application and transmission lines
CO5	Apply the knowledge of transmission line design in analysis of mechanical strength of the towers.
CO6	Estimate EHVC and HVDC transmission line parameters and their neutral grounding

Text Book (s)

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
2. AsfaqHussain, "'Power System", CBS Publishers and Distributors.

Reference Book (s)

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill
2. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Course Content:

Unit-1 Power System Components 6 hours
Single line Diagram of Power system Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator Calculation of single and Three phase Power Choice of transmission voltage Transmission line types of conductors and resistance Skin effect Proximity effect Kelvin's law
Unit-2: Over Head Transmission Lines 6 hours
Calculation of inductance single phase, three phase and double circuit Transmission line Calculation of capacitance single phase, three phase and double circuit Transmission line
Unit-3: Over Head Transmission Lines Performance
Transmission line classification Representation and performance of short Transmission line Representation and performance of medium nominal T and Nominal Pi Transmission line Representation and performance of long Transmission line Surge impedance loading Ferranti effect
Unit: 4 Corona and Interference 9 hours Phenomenon of corona and its formation Calculation of potential gradient Corona loss, factors affecting corona and methods of reducing corona Electrostatic and electromagnetic interference with communication lines Type of insulators and their applications Potential distribution over a string of insulators String efficiency and Methods of equalizing the potential
Unit-5 Mechanical Design of transmission line 9 hours
Catenary curve of transmission line Sag and tension Affect due to ice and wind on sag, Types of insulated cables and its construction Dielectric stress and Insulation resistance Capacitance measurement of a single phase and three phase cables Dielectric loss and loss triangle
Unit-6 Neutral grounding and HVDC/HVAC 9 hours Necessity and its methods of neutral grounding Earthing transformer and Grounding practices. Design consideration of EHV transmission lines Choice of voltage Number of circuits Conductor configuration Insulation design and Selection of ground wires Introduction to EHV AC and HVDC transmission Their comparison Use of bundle conductors Kinds of DC links Use of HVDC system in AC transmission system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Plant Engineering			
Course Code	BTEE3015			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

Power plant engineering or power station engineering is a division of power engineering, and is defined as the engineering and technology required for the production of central station electric power. The field is focused on the generation of power for industries and communities, not for household power production. The field is an interdisciplinary field, using the theoretical base of both mechanical and electrical engineering. The engineering aspect of power plant management has evolved with technology and has become progressively more complicated. The introduction of nuclear technology and the progression of other existing technologies have allowed power to be created in more ways and on a larger scale than was previously possible.

Course Outcomes

CO1	Analyze different types of steam cycles and estimate efficiencies in a steam power plant.
CO2	Understand the basic components of coal base thermal power plants.
CO3	Define the performance characteristics and components of such power plants.
CO4	Estimate different efficiencies associated with power generation system systems.
CO5	Calculate present worth depreciation and cost of different types of power plants.
CO6	Estimate the cost of producing power per kW.

Text/ Reference Books:

5. S.N. Singh, “Electric Power Generation, Transmission& distribution.” PHI Learning.
6. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
7. Power system Voltage stability - C.W. Taylor , Mc. Graw Hill, 1994.
8. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.

Syllabus

Unit-I	Coal based Thermal Power Plants	5 Hours
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate,		
Unit II	Component of Thermal Power Plant	5 Hours
Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.		
Unit-III	Diesel, Gas Turbine and Combined Cycle Power Plants	7 Hours
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-IV	Nuclear Power Plants	8 Hours
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-V	Power from Renewable Energy	8 Hours
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-VI	Energy, Economic and Environmental issues of Power Plants	7 Hours
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.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Measurements and Instrumentation			
Course Code	BEEE2001			
Prerequisite	Basic Electrical and Electronics Engineering			
Corequisite	EMFT			
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

4. To know the necessity of different measuring instruments and their design principle
5. To understand the working principle of different measuring instruments and technical solutions to handle different errors.
6. To learn the architecture and working principle of advanced measuring instrument and their applications.

Course Outcomes

CO1	Apply physical principles to study the construction and working principle of different analog instruments and analyze the errors takes place in measurements.(K3- Apply)
CO2	Apply the physical principle to study the working of instrument transformers and measurement of speed, frequency and power factor. (K3- Apply)
CO3	Model the solar and wind energy system for standalone and grid integration system. (Apply-KL-3)
CO4	Demonstrate the principle of operation of other renewable energy sources(ocean thermal, geo-thermal and micro hydro power) also importance of its role. (Understanding-KL-2)
CO5	Understand the basic working principle of digital instruments. (Understanding-KL-2)
CO6	Examine the waveforms using analyzers and oscilloscopes. (K3- Apply)

Text Book (s)

4. A Course in Electrical and Electronics Measurement and Instrumentation, "A K Shawney", Publisher: Dhanpat Rai & Co
5. Electrical Measurements and Measuring Instruments, E.W Golding, F.C Widdis, Publisher: Reem Publications
6. Electronic Instrumentation and Measurements- David A Bell, Oxford University Press, 2006

Reference Book (s)

9. Basic Electrical Measurements: M B Stout
10. Electronic Instrumentation: H S Kalsi, Tata-Mc-Graw Hill Publication, Second Edition.

Course Content:

Unit-1Philosophy of Measurement & Analog Measurement of Electrical Quantities 9 hours
Unit& dimensions, standards, Errors, Characteristics of Instruments and measurement system, basics of statistical analysis. PMMC instrument, DC ammeter, DC voltmeter, Ohm meter, Moving Iron instrument, Electrodynamic Wattmeter, errors and remedies, Three Phase Wattmeter, Power in three phase system, Energy meter.
Unit-2Measurement: Instrument Transformer 6 hours
Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.
Unit-3Measurement of Parameters 9 hours
Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges-Wheatstone, Kelvin, Maxwell, Hay's, Anderson, Owen, Heaviside, Campbell, Schering, Wien bridges, Wagner Earthing device, Q Meter.
Unit-4AC Potentiometer & Magnetic Measurement 7 hours
Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement. Ballistic Galvanometer, Flux meter.
Unit-5Digital Measurement of Electrical Quantities 5 hours
Concept of digital measurement, Digital voltmeter, Frequency meter, Power Analyzer and Harmonics Analyzer, Electronic Multimeter.
Unit-6 Cathode Ray Oscilloscope 5 hours
CRT, wave form display, time base, dual trace oscilloscope, Measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Sampling Oscilloscope, DSO, DSO applications.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Semester V

Name of The Course	Microcontroller and Embedded Systems			
Course Code	BECE3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

Microcontrollers are the most useful electronic chips which are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. Students learn CPU architecture, memory management, bus concepts, bus arbitration techniques, interfacing of systems using AD/DA, serial I/O devices, interrupt control devices, including design, construction, and testing of dedicated microcontroller systems.

Course Outcomes

CO1	Demonstrate the internal organization and operation of microcontrollers.
CO2	Analyse the design issues in the embedded system.
CO3	Design Microcontroller based application.
CO4	Program 8051 for application specific solution.
CO5	Analyse the different programming methods for controller and their issues.
CO6	Illustrate the latest trends adapted in designing microcontroller based system

Course Content:

Unit I: Introduction 08 Hours
Introduction to Microprocessors, Microcontrollers and system design – Assembly and High-Level language programming – System Development Environment: assembler, compiler and integrated development environment.
Unit II: 8051 Microcontroller 08 Hours
Introduction to single chip Microcontrollers,8051-architecture – 8051 assembly language programming, addressing modes – Instruction sets- interrupts, timers and serial communication.
Unit III: Embedded applications 08 Hours
Programming the interrupts, timers and serial communication – system design with 8051. Application **of Microcontrollers** in data acquisition systems, process control, signal processing, data communication and distributed computing and networking..
Unit IV: Embedded programming 08 Hours
Programming in Assembly Language (ALP) Vs. High level language – C program elements, Macros and Functions – Use of pointers– use of function calls – NULL pointers – multiple function calls in a cyclic order in the **main function** pointers –C program compilers – Cross compiler – optimization of memory codes.
Unit V: Embedded System design 08 Hours
Introduction, Embedded System project management – Embedded system design and Co-Design Issues in System Development process – Design cycle in the development phase for an embedded system – Uses of Target system or its emulator and In-Circuit Emulator
Unit VI: Recent trends in Micro controller
Machine learning on tiny ML processor, introduction of mixed signal processor, DMA architecture

Suggested Reading.

1. Mohammad Ali Mazidi and Janice GillispieMaszidi "The 8051 Microcontroller andEmbedded Systems" Pearson education, 2003, ISBN- 9788131710265, 2ndEdition

2. Kenneth J. Ayla, "The 8051 Micro controller", Thomson learning, 3rd edition, 2004,ISBN-140186158X

3. Alan Clements, "Principles of Computer Hardware", OxfordUniversity Press, 3rd Edition,2003, ISBN-9780198564539

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-II			
Course Code	BTEE3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

5. To acquaint the students with the principle of operation and performance of AC machines.
6. To familiarize students with the parameter estimation of electrical machines.
7. To learn the mathematical models and equations related to electrical machines.
8. To familiarize students with the other special machines.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles of three-phase Induction Motor.
CO2	Analysis the numerical problems and performance associated with AC machines.
CO3	Make use of application of the single phase IM with industries and day to day life.
CO4	Use special machine for different application.
CO5	Analysis the demanding and conventional Alternator performance.
CO6	Test and estimate the parameter of the Synchronous Motor.

Course Content:

Unit I: Three phase Induction Machine – I 08 Hours
Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator: Generator action, methods of excitation & applications.
Unit II:Three phase Induction Machine- II 08 Hours
Starting, Deep bar and double cage rotors, Speed Control (with and without emf injection in rotor circuit.), Electrical braking, operation on unbalanced supply voltage, effect of slot harmonics and space harmonics, merits, demerits and introduction of linear induction motor.
Unit III: Single phase Induction Motor 08 Hours
Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods of Single phase Induction Motor,
Unit IV: Fractional Motors
Repulsion motor, other Motors: Universal motor, Hysteresis motor, stepper motors, switched reluctance motor, BLDC, brushless dc motor
Unit V: Synchronous Machine I 08 Hours
Constructional features, EMF Equation, Armature winding, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient.
Unit VI: Synchronous Machine II 08 Hours
Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics. Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, concepts of synchronous machine reactance, Synchronizing, Electrical braking, Hunting & damping, synchronous condenser.

Suggested Reading

1. I.J. Nagrath & D.P. Kothari, "Electrical Machines", Tata McGraw Hill.
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khana Publisher.
3. P S Bimbhra, "Electrical Machinery", Khana Publisher.
4. Theodre F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004.
5. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6th Edition, PHI 2009, ISBN 0132454793, 9780132454797

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Analysis
Course Code	BTEE3009
Prerequisite	
Co-requisite	

Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. modeling and solution on digital computers is the only practical approach to systems analysis and planning studies for modern day power system with its large size, complex and integrated nature.

2. This course has been designed to fulfill this need by integrating the basic principles of power system analysis illustrated through the simplest system structure with analysis techniques for practical size systems.

3. The digital computer being an indispensable tool for power system analysis, computational algorithms for various system studies such as load flow, fault level analysis, stability etc have been included in the syllabus. Students should be encouraged to build computer programs for these studies using algorithms provided.

Course Outcomes

CO1	Understand fundamental concepts relating to the analysis of electrical power systems
CO2	Understand the fault condition inside transmission line and the generating system.
CO3	Analyse of load flow equations and representation of power system components
CO4	Understand the importance of power swing equation in power system stability
CO5	Apply the knowledge in power system stability analysis during abnormal conditions.
CO6	Understand the basic concepts of travelling waves over transmission lines.

Course Content:

Unit I: Representation of Power System Components 08 Hours
Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System. Symmetrical components: Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks. Symmetrical fault analysis, Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.
Unit II: Unsymmetrical faults 08 Hours
Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Z-bus using singular transformation and algorithm, computer method for short circuit calculations.
Unit III: Load Flow Analysis 08 Hours
Introduction, bus classifications, nodal admittance matrix (bus y), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method, Comparison of load flow methods.
Unit IV: Power System Stability-1 08 Hours
Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion,
Unit V: Power System Stability-2 08 Hours
Synchronizing power coefficient, critical clearing angle and critical clearing time. Factors affecting steady state and transient stability and methods of improvement.
Unit VI: Traveling Waves 08 Hours
Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipment's and line against traveling waves.

Suggested Reading

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition.
2. Asfaq Hussain, "'Power System", CBS Publishers and Distributors.
3. H.Saadat, Power System Analysis, Tata McGraw-Hill Publishing Company Limited, Edition 2008.
4. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill.

5. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Electronics			
Course Code	BTEE3011			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. The field of power electronics encompasses the application of fundamental concepts in several disciplines: electronic devices and circuits, variable speed drives and control systems.

2. The use of electric cars, electric trains and electric subway trains can substantially reduce urban pollution problems.

3. Students learn power electronics devices like thristors, MOSFET, IGBT, GTO etc., various phase controlled single phase and three phase rectifiers with performance factors, dual converters, principle of dc to dc conversion, class A,B,C,D,E,F choppers, commutation techniques, comprehensive treatment of dc to ac inverters, ac voltage converters and cycloconverters.

Course Outcomes

CO1	Understand the operation of switching power devices eg. thyristors, transistors and TRIAC.
CO2	Implement configurations of thyristor based choppers.
CO3	Apply and develop configurations of thyristor based Single phase controlled rectifiers
CO4	Apply and develop configurations of thyristor based Three phase controlled rectifiers
CO5	Apply and develop configurations of thyristor based ac voltage controllers, cycloconverters
CO6	Implement different configurations of thyristor based inverters.

Course Content:

Unit I: Power semiconductor Devices 08 Hours
Introduction, Characteristics and specifications of switches, Power Diodes, Power Transistors: Operation. Steady state and switching characteristic, Power MOSFETs: Operation and characteristics, Insulated Gate Bipolar transistor: structure, working, latch-up, characteristics, Thyristors: Operation, charateristics, two-transistor model, Turn-on methods, Switching characteristic, Rating and protection, Commutation techniques of thyristor, Series and parallel operation of thyristors, Gate turn off thyristor.
Unit II: DC-DC Converters 08 Hours
Principles of step-down chopper, step down chopper with R-L load Principle of step-up chopper, and operation with RL load, classification of choppers, Buck, Boost and Buck-Boost converter.
Unit III: Single Phase Controlled Converters 05 Hours
Single-phase half wave converter with R, RL and RLE loads, Effect of freewheeling diode, Performance parameters, Single-phase full wave converter, midpoint and bridge converter, Effect of source inductance on single-phase converter, Single phase dual converter,
Unit IV: Three Phase Controlled Converters05 Hours
Three phase half wave converter with R and RL loads, Three-phase full converter, Performance parameters, Effect of source inductance on three-phase converters, Three-phase dual converter.
Unit IV: AC Voltage Controllers 08 Hours
Principle of on-off and phase control, Single-phase two SCRs in anti parallel with R and RL load, Triac with R and RL load, Three-phase ac voltage controllers, Cycloconverters: Basic principle of operation, Single phase to single phase, three-phase to single-phase cycloconverters, Three phase to three phase cycloconverters

Unit V: Inverters	08 Hours
Single phase voltage source inverter, Three-phase bridge inverters, 180 degree conduction, 120 degree conduction, Voltage control of inverters, Pulse-width modulated inverters, Harmonics reduction techniques, Single phase and three phase current source inverters.	

Suggested Reading

6. M. H. Rashid," Power Electronics: Circuits, Devices & Applications", Prentice Hall of India, Ltd. 3rd Edition, 2004.
7. V. R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford, University Press, 2007.
8. M. D. Singh & K. B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company, 1989.
9. M. S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004.
10. Chakrabarti & Rai, "Fundamentals of Power Electronics &Drives" Dhanpat Rai & Sons.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The ourse	Finance for Electrical Engineers			
Course Code	BEE02T3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

- For any developing country, innovation, entrepreneurship and intellectual property rights hold the key to the entry in the league of developed countries. Equipped with the scientific knowledge and the right training, the engineer is an important building block of a nation.
- Economics and its impact on science and technology have to be well understood by the engineers to ensure success of any technological venture.

Course Outcomes

CO1	Understand basics of industrial finance and economy.
CO2	Analyze the various concept of cost.
CO3	Analyze the market types and lay supply
CO4	Apply various technique to build budget for electrical project.
CO5	Analyze various financial techniques.
CO6	Understand the basic financial installation cost of renewable power plant

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Course Content:

Unit I: Introduction	08 Hours
Various Definition of Economics, Nature of Economics problem, relation between science, engineering, technology & economics, Meaning of demand, law of demand, elasticity of demand, practical importance & applications of the concept of elasticity of demand.	
Unit II: Capital Budgeting	08 Hours
Meaning of production and factor of production – Land, Labour, Capital, Entrepreneur & organizations – their characteristics, law of variable proportion, return to scale,Cost Analysis-various concept of cost, cost function, short & long run cost, concept of revenue, break-even analysis.	
Unit III: Management of Working Capital	08 Hours
Meaning of market-type of market-perfect competition, Monopoly, Oligopoly, Monopolistic competition (Main feature of these market) Meaning of supply and law of supply; Role of	

demand & supply in price determination imperfect competition.
Unit IV: Budgeting Control Technique 08 Hours
Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.
Unit V: Financial management 08 Hours
Financial management: Financial management, accounting concepts. Financial statement analysis. Financial investment analysis. Financial decisions. Managing components of working capital investment & financing decisions.
Unit VI: Renewable Power Plant
Analysis of installation cost based on rating of Renewable power plant

Suggested Reading

1. Financial Management and Accounting - P. K. Jain, S. Chand & Co.
2. Modern micro economic theory – H.L. Ahuja, S.Chand.
3. Advance economic theory – M.L. Jhingan, Konark publication.
4. Engineering economics – Sullivan, Wicks, Koelling – Pearsons.
5. Financial management by Rajiv shrivastava and Anil Mishra – Oxford publication

Name of The Course	Electrical Machine-II lab			
Course Code	BTEE3005			
Prerequisite	Electrical Machine-I and BEEE Lab			
Corequisite				
Antirequisite				
L	T	P	C	
0	0	2	1	

Course Objectives:

After the completion of course the students will

1. This lab gives the chance to get friendship with Electrical machines.
2. To acquaint the students with the principle of operation and performance of AC machines.
3. To familiarize the students with the parameter estimation of AC machines.
4. To compare the mathematical models and equations related to AC machines.
5. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of Single and three phase Induction machines and three phase Synchronous machines.
CO2	Analysis the AC machines performance through experiments
CO3	Estimate the parameter of the Induction machines and Synchronous machines
CO4	Test Induction and Synchronous machines with various loads
CO5	Make use of application of the subject topic with industries and day to day life

List of Experiments:

1	Perform no load and blocked rotor test on a single phase induction motor.
2	Determine performance characteristic of a three phase squirrel cage induction motor.
3	No load and blocked rotor test on three phase induction motor.
4	Load test on three phase squirrel cage induction motor.
5	Break test on three phase induction motor.
6	Separation of no load losses of three phase induction motor.
7	Perform open and short circuit test on a 3-phase alternator
8	Regulation of a three phase alternator by ZPF and ASA method.
9	Determination of Xd and Xq of a Salent pole synchronous machine.
10	Determine the characteristic of field current with armature current of the synchronous machine

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Microcontroller and Embedded Systems Lab
Course Code	BECE3005

Prerequisite	Digital Electronics			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives:
To Introduce ALP concepts, features and Coding methods
1. Write ALP for arithmetic and logical operations in 8051
2. Differentiate Serial and Parallel Interface
3. Interface different I/Os with Microcontroller

Course Outcomes:

After the completion of course the students will

CO1	Demonstrate ability to handle arithmetic operations using assembly language programming
CO2	Demonstrate ability to handle logical operations using assembly language programming
CO3	Demonstrate ability to handle string instructions using assembly language programming
CO4	Demonstrate ability to handle sorting operations and using assembly language programming
CO5	Develop microcontroller based designs of Real Time Systems.

List of Experiments:

1	Basic arithmetic and Logical operations
2	Code conversion, decimal arithmetic and Matrix operations.
3	Square and Cube program, Find 2‘s complement of a number
4	Unpacked BCD to ASCII
5	Counters and Time Delay Peripherals and Interfacing Experiments
6	Traffic light controller
7	Stepper motor control
8	Digital clock
9	Key board and Display
10	Serial interface and Parallel interface
11	A/D and D/A interface and Waveform Generation 8051 kits

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Semester VI

Name of The Course	Digital Signal Processing			
Course Code	BECE2020			
Prerequisite	Signals and Systems			
Co-requisite	Network Theory			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

5. Introduce to discrete time signal processing and characterization of random signals, filter design techniques, and imperfections caused by finite word length.
6. Learn how design FIR and IIR filters.
7. Learn the theory of digital signal processing and digital filter design, including hands-on experience with important techniques involving digital filter design and digital simulation experiments.
8. Introduce the fundamental principles and techniques of digital signal processing for understanding and designing new digital signal processing systems and for continued learning.

Course Outcomes

CO1	Apply digital signal processing fundamentals.
CO2	Comprehend if a DT system is linear, time-invariant, causal, and memory-less, High Pass, Low Pass, All Pass and able to apply Z and inverse Z transform on DT signal.
CO3	Acquire the knowledge of representation of discrete-time signals in the frequency domain, using DFT and FFT.
CO4	Design FIR and IIR filters to meet the specific magnitude and phase requirements.
CO5	Understand the concept of linear prediction and spectrum estimation.
CO6	Understand the concept of advance processor

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Sampling of Continuous Time Signals 8 Hours
Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.
Unit II: Sampling of Continuous Time Signals 8 Hours
Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.
Unit III: Transform Analysis of LTI Systems 8 Hours
Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase Overview of finite precision numerical effects, effects of coefficient quantization, Effects of round-off noise in digital filters, zero-input limit cycles in fixed point realizations of IIR digital filters.
Unit IV: Filter Design Techniques 8 Hours
Design of D-T IIR filters from continuous – time filters, design of FIR filters by windowing, Kaiser Window method, optimum approximations of FIR filters, FIR equiripple approximation.
Unit V: Fourier analysis of Signals Using DFT 8 Hours
DFT analysis of sinusoidal signals, time-dependent Fourier transforms: Block convolution, Fourier analysis of non – stationary and stationary random signals, spectrum analysis of random signals using estimates of the autocorrelation sequence.
Unit VI: Recent Trends in DSP
DSP architecture, Memory organization, Simulation

Suggested Reading

1. Oppenheim A.V., Schafer, Ronald W. & Buck, John R., “Discrete Time Signal processing”,Pearson Education , 2nd Edition.
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms And Applications", Pearson Education, 4rd Ed., 2007.
3. Ramesh P., "Digital Signal Processing", SciTech Publication, 41FL Ed., 2008.
4. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", 3rd Ed., Tata McGraw-Hill, 2008.
5. Lawrence R. Rabiner, Bernard Gold, “Theory and Application of Digital SignalProcessing”, PHI 2001.
6. Shaliwahan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw-Hill, 2nd Ed., 2000.

Name of The Course	Power System Protection			
Course Code	BEE02T3006			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

4. To introduce the students the principles of different protection schemes.
5. To develop students with an understanding of the characteristics, advantages and defects of different protection methods.
6. To prepare the students to design/coordinate protection schemes for given requirements.

Course Outcomes

CO1	Illustrate the principle of switchgear and protection schemes.
CO2	Choose right relays or circuit breakers for protection of electrical equipments
CO3	Design the ratings for relays or circuit breakers according to the requirement.

CO4	Understand the differential protection scheme and its application in protection of alternator and transformer
CO5	Examine protection of power system with various protection relays
CO6	Discuss about operation of circuit breakers.

Course Content:

Unit I: Introduction to protection system 08 Hours
Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology. Relays: Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.
Unit II: Relay application and characteristics 08 Hours
Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay. Static Relays: Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.
Unit III: Protection of transmission line 08 Hours
Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. Testing of Circuit Breaker: Classification, testing station and equipment's, testing procedure, direct and indirect testing.
Unit IV: Differential Protection 05 hours
Types of fault on transformers and motors, and its differential protection scheme
Unit V: Circuit Breaking 05 Hours
Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. Testing Of Circuit Breaker: Classification, testing station and equipment's, testing procedure, direct and indirect testing.
Unit VI: Apparatus protection 08 Hours
Circuit Breaker: Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.Types of faults on alternator, stator and rotor protection, Types of fault on transformers and motors

Suggested Reading

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
3. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
4. T.S.M Rao,"Power System Protection: Static Relays with Microprocessor Applications", Tata Macgraw Hill.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Semester VII

Name of The Course	Smart Grid and Energy Management				
Course Code	BEEE4001				
Prerequisite	Power System Analysis and Power Electronics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

A smart grid is an electrical grid which includes a variety of operational and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid.

1. To make use of the Smart grid with the coming future.
2. To analyze the global policies about the smart grid.

3. To develop and design the Advanced Metering infrastructure (AMI).
4. To estimate the Power Quality issues of Grid connected Renewable Energy Sources.

Course Outcomes

CO1	To learn about the Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid.
CO2	Understand about the International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives
CO3	To analyze Advanced Metering infrastructure (AMI) drivers and its benefits.
CO4	Understand about the Power Quality issues of Grid connected Renewable Energy Sources.
CO5	Understand about the IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter.
CO6	To analyze the conventional grid integrated with renewable energy sources

Text/ Reference Books:

1. A. S boyer, SCADA:supervisory Control and Data Acquisition, The Instrumentation system and Automation Society,4 th Edition 2009.
2. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
3. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids.
4. Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press.
5. B.G. Liptac Instrument Engineering Handbook,Volume 3:process Software and Digital Networks,CRC Press, 4 th Edition 2011.

Syllabus

Unit-I	Introduction to Smart Grid	8 Hours
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.		
Unit-II	Smart Grid Technologies	8 Hours
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation , Wide area monitoring, Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).		
Unit-III	Smart Meters and Advanced Metering Infrastructure	8 Hours
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.		
Unit-IV	Power Quality Management in Smart Grid	06 Hours
Power Quality & EMC in Smart Grid, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit..		
Unit-V	High Performance Computing for Smart Grid Applications	07 Hours
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad band over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.		
UnitVI	Integration with renewable energy sources	04 Hours
Power Quality issues of Grid connected Renewable Energy Sources,		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Non-Conventional Energy Resources				
Course Code	BEEE2018				
Pre-requisite	Power system				
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

3. To have an overview of non-conventional energy sources.
4. To understand the need of alternate sources of energy.

Course Outcomes

CO1	Understand the different types of renewable energy sources and their utilities
CO2	Design models for generating energy through alternate energy sources (with the help of additional learning)
CO3	To understand the practical limitation and hence steps for continuous improvement through research.
CO4	Apply genetic algorithms to optimization problems
CO5	Design models for generating energy through alternate energy sources (with the help of additional learning)
CO6	Apply the fundamentals of energy systems in real time applications

Text Book (s)

1. 1. Renewable energy technologies - R. Ramesh, Narosa Publication
2. Non-conventional Energy Systems – Mittal, Wheelers Publication.

Reference Book (s)

1. John F Walker &Jekins. N, Wind Energy Technology., John Wiley and Sons, chichester, UK, 1997.
2. Van Overstra ,Mertens, R.P, Physics, Technology and use of Photovoltaics, Adam Hilger, Bristol, 1996.

Course Content:

Unit I:Energy Scenario: 6 lecture hours
Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds(PCF). Factors favoring and against renewable energy sources, IRP.
Unit II: Solar Energy 9 lecture hours
Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells , cell technologies,characteristics of PV systems, equivalent circuit, array design , building integrated PV system, its components , sizing and economics. Peak power operation. Standalone and grid interactive systems.
Unit III: Wind Energy 10 lecture hours
Wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating, Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.
Unit IV :Other energy sources 8 lecture hours
Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources. Hydro energy – feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion. (OTEC) systems – schemes, feasibility and viability.
Unit V: Energy storage and hybrid system configurations 7 lecture hours
Energy storage: Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel-energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.
Unit VI: Application of NCES
Grid integration of hybrid system, fuel cell integration in hybrid vehicles

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

20	30	50	100

Name of The Course	Electric Drives				
Course Code	BTEE4001				
Prerequisite	Power Electronics				
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

3. To introduce the electric drives fundamentals including speed torque curves of motor and load, types of load.
4. To determine stability of drive system and select motor rating for any particular duty of application.

Course Outcomes

CO1	Demonstrate the basic of drive system and different types of loads.
CO2	Understand the motor dynamics and the rating of motor for different condition of load.
CO3	Analyse the types of breaking and select appropriate breaking to the working environment.
CO4	Analyse power circuit topology and control mechanism to control the speed of DC motor.
CO5	Apply various types of control mechanism to employ for variable speed drives.
CO6	Illustrate the latest trends adapted in Electrical drives

Text Book (s)

3. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House
4. S.K.Pillai, “A First Course on Electric Drives”, New Age International.

Reference Book (s)

3. M.Chilkin, “Electric Drives”, Mir Publishers, Moscow.
4. N.K. De and Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd

Course Content:

Unit-1Fundamentals of Electric Drive 8 hours
Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.
Unit-2Dynamics of Electric Drive 8 hours
Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric Drive, Selection of Motor Power rating, Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, Load equalization
Unit-3Electric Braking 8 hours
Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting, Energy relations during braking, dynamics during braking.
Unit-4Power Electronic Control of DC Drives 8 hours
Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current, Chopper control of separately excited dc motor and dc series motor.
Unit-5Power Electronic Control of AC Drives 8 hours
Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cycloconverter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self-controlled schemes. Special Drives: Switched Reluctance motor, Brushless dc motor
Unit 6: Recent Technologies
Recent trends and technologies using in electrical drives.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	PLC/SCADA LAB

Course Code	BEEE3008			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	1

Course Objectives: Students will be able to design and program basic PLC circuits for entry-level PLC applications. Students will be able to design and program a small, automated l production line. Apply the knowledge of PLC/SCADA in engineering specialization to the solution of complex engineering problems.
Students are trained for to create ladder diagrams from process control descriptions. Students work in team to formulate solution for Electrical System using hardware and software tools. Students understand PLC functions, Data Handling Function, apply PLC Timers and Counters for the control of industrial processes.

Course Outcomes

CO1	Identify different components of PLC.
CO2	Understand working of PLC, I/O modules of PLC
CO3	Able to create ladder diagrams from process control descriptions.
CO4	Ability to apply PLC timers and counters for the control of industrial processes
CO5	Able to use different types PLC functions, Data Handling Function.

Text/ Reference Books:

3. Programmable Logic Controllers — Principle and Applications by John W Webb and Ronald A Reiss Filth edition, PHI
4. Programmable Logic Controllers — Programming Method and Applications by JR Hackworth and ED Hackworth — Jr-Pearson, 2004.

List of Experiments

10. Study hardware and software used in PLC
11. To study PLC Input and output symbols
12. Implementation of Logic Gates
13. Implementation of DOL starter
14. Implementation of on-delay timer
15. Implementation of off-delay timer
16. Implementation of up-down counter
17. Implementation of PLC Arithmetic Instructions
18. Implementation of PID Controller

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Technical Seminar			
Course Code	BEE02P4005			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	2	0

Course Objectives:
Objective

- To develop institute-industry interaction
- To know the industry practices
- To understand cutting edge technology in the chosen area

Course Outcomes

CO1	Identify the Literature Survey
CO2	Do the Formulation of the Problem / Project
CO3	Do Mathematical Modeling and do Programs in MATLAB / PSPICE.
CO4	Do compilations / Simulation and Synthesis.
CO5	Do testing and write Dissertations/Reports.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Capstone Design Phase –I			
Course Code	BEE02P4002			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	10	2

Course Objectives:

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Work in team to formulate solution for Electrical System using hardware or software tools.
- Analyze & research about the work to be implemented with resources available from internet & other sources.
- Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Course Outcomes

CO1	Develop creative solutions to problems and conceive innovative approaches in developing and designing of electrical system.
CO2	Prepare high quality engineering documents and present a clear and coherent presentation of these to a range of technical and nontechnical audiences.
CO3	Acquire and evaluate research regarding new knowledge development within the electronic engineering discipline and its social, cultural, environmental and legal context.
CO4	Demonstrate a responsible, ethical and professional attitude regarding the role of engineers in society, including situations involving potentially adverse environmental and cultural impacts.
CO5	Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Semester VIII

Name of The Course	Capstone Design Phase-II
Course Code	BEE02P4003
Prerequisite	
Corequisite	
Antirequisite	

	L	T	P	C
	0	0	18	6

Course Objectives:

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Work in team to formulate solution for Electrical System using hardware or software tools.
- Analyze & research about the work to be implemented with resources available from internet & other sources.
- Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electrical Engineering discipline.

Course Outcomes

CO1	Identify project goals and constraints
CO2	Acquire knowledge about the project through previous works in the current field
CO3	Formulate the methodologies to obtain experimental results
CO4	Plan for the resource requirements
CO5	Obtain the experimental results based on the methodologies formulated.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Industrial Internship & Technical Seminar
Course Code	BEE02P4004
Prerequisite	
Corequisite	
Antirequisite	

	L	T	P	C
	0	0	0	6

Course Objectives:

Objective

- To develop institute-industry interaction
- To know the industry practices
- To understand cutting edge technology in the chosen area

Course Outcomes

CO1	Identify the Literature Survey

CO2	Do the Formulation of the Problem / Project
CO3	Do Mathematical Modeling and do Programs in MATLAB / PSPICE.
CO4	Do compilations / Simulation and Synthesis.
CO5	Do testing and write Dissertations/Reports.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Basket- (Control Engineering)

Name of The Course	Advanced Control System			
Course Code	BTEE3019			
Prerequisite	Control System			
Co-requisite	Signal Systems			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Introduce the fundamentals and concepts of Control systems
2. Understanding and predicting system behavior in state space and non-linear systems.
3. Design and analysis of closed loop control systems.
4. Analyse higher order control systems with appropriate state space models.

Course Outcomes

CO1	Apply linear algebra to complex real world problems in order to obtain models that are expressed using state space equations.
CO2	Understand the basic Canonical Forms in state space domain.
CO3	Analyze the system behavior based on the mathematical model of that system where the model may be expressed in state-space domain
CO4	Design and analysis of closed loop control systems.
CO5	Design controllers using the concept of state feedback and pole placement technique.
CO6	Write a report that effectively communicates the results of an analysis or design.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: State Space Analysis of Control Systems 8 Hours
State Variables; State-Space Representation of Electrical and Mechanical and Electromechanical Systems; State Space Representation of Nth Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors;
Unit II: Canonical Form
Transformation to Diagonal Canonical Form; Jordan Canonical Form; Controllability Canonical Form; Observabilty Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition; State Diagram; Solution of the Time-Invariant State Equation; State Transition Matrix and its Properties; Transfer Matrix; Transfer Matrix of Closed Loop systems.
Unit III: Controllability and Observability 8 Hours
Concept of Controllability and Observability; Kalman's Theorems on Controllability; and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.
Unit IV: State feedback controller 8 Hours
Design of state feedback controller using pole placement technique, Ackerman's formula.
Unit V: Lyapunov Stability Analysis 8 Hours

Stability of Equilibrium State in the Sense of Liapunov; Graphical Representation of Stability; Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function; Second Method of Liapunov; Stability Analysis of Linear Systems; Krasovski's Theorem; Liapunov Function Based on Variable Gradient Method.
Unit VI: Describing Function Analysis of Nonlinear Control System and Phase Plane Analysis 8 Hours
Introduction to Nonlinear Systems, Describing Functions for Common Types of Nonlinearities, Describing Function Analysis, Stability and Limit Cycles, ntroduction : Analytical Methods for constructing Trajectories, Classification of Singular Points; Limit Cycles; Phase-Place Analysis of Linear control system.

Suggested Reading

1. Nagrath and Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuoand FaridGolnaraghi, "Automatic Control System" Wiley India Ltd, 2008.
4. D.RoyChoudhary, "Modern Control Engineering", Prentice Hall of India.
5. Norman S. Nise, Control System Engineering 4th edition, Wiley Publishing Co.
6. E Slotine, Weiping Li, Applied Nonlinear Control, Prentice-Hall.
7. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, "Design of Feedback Control Systems"Oxford University Press.

Name of The Course	Industrial Automation and Control			
Course Code	BTEE3020			
Prerequisite	Control System			
Co-requisite	Power System Analysis			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. This course introduces the various types of controllers and their principles
2. Knowledge of sequence control, PLCs and Ladder logic is also imparted
3. Applications of industrial automation systems including identification of system requirements, equipment integration, motors, controllers, and sensors.
4. Coverage of set-up, maintenance, and testing of the automated system

Course Outcomes

CO1	Describe the properties and applications of open- and closed-loop process control systems and distinguish between their dynamics.
CO2	Summarize the operation of the different controller modes and their practical limitations; determine their response to standard inputs.
CO3	Understand the open loop and closed loop transient response using Ziegler-Nichols method. Frequency response method.
CO4	Outline the criteria determining the selection of control valves for specific purposes.
CO5	Explain various special control structures in process control.
CO6	Identify the applications of PLC's to industrial processes and design PLC programs to solve sequential control problems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Process Dynamics 8 Hours
Dynamic Elements in Control Loops, Open- and closed-loop properties of processes; Process lags; Dead-time; Stability of control systems; Block diagrams and process line diagrams to explain the operation of control systems. Dynamic behaviors of first order, second order, and higher order systems. Interacting and non-interacting systems.
Unit II: Controller Principles 5 Hours
Process characteristics. Control system parameters. Discontinuous, continuous, and composite modes of control action (P, PI, PD & PID). Analog and Digital Controllers, General

features. Electronic controllers, pneumatic controllers and hydraulic controllers, and Design considerations.
Unit III: Process loop Tuning 5 Hours
Open loop transient response method. Ziegler-Nichols method. Frequency response method.
Unit IV: Control Valves 7 Hours
Valve types and characteristics; Factors influencing valve selection; Valve sizing; Valve petitioners; Installed systems: control valve characteristics, pipe pressure drops and pump characteristics.
Unit V: Special Control Structures 7 Hours
Feed forward and Ratio Control, Predictive Control, Control of Systems with Inverse Response Special Control Structures : Cascade Control, Overriding Control, Selective Control, Split Range Control.
Unit VI: Introduction to Sequence Control, PLCs & Relay Ladder 8 Hours
Discrete state process control, characteristics of the system, discrete state variables, process specifications and event sequence description, ladder diagram – ladder diagram elements and examples, programmable controller – relay sequencers, programmable logic controller, architecture, operation and programming, types of PLC.

Suggested Reading

1. Process Control Instrumentation Technology, C. D. Johnson, Prentice Hall, (2002).
2. M. Gopal, Control Systems – Principles & Design, 2nd Edition, TMH, 2002.
3. Bela G. Liptak, Process Control, Instrument Engineer's Handbook, 3rd Edition, Chilton Book
4. Company, 1970.
5. D.RoyChoudhary, "Modern Control Engineering", Prentice Hall of India.
6. George Stephenopoulos, Chemical Process Control, PHI, 1999.
7. Kirk and Rimbol, Instrumentation, D.B. Taraporewala Sons and Co. Pvt. Ltd., 1996
8. Douglas M. Considine, Process/Industrial Instruments and Control Handbook, 4th Edition,McGraw Hill International Edition, 1974.
9. Introduction to Programmable Logic Controllers, G. Dunning, Delmar Thomson Learning, 2002

Name of The Course	Industrial Instrumentation and Automation			
Course Code	BEE02T5001			
Prerequisite	Electrical Instrumentation			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To impart knowledge about Industrial instrumentation and automation

Course Outcomes

CO1	Select instruments and transducers for various physical variables
CO2	Design various signal conditioning systems for transducers.
CO3	Analyze dynamic responses of various systems.
CO4	Get the concepts of virtual instrumentation
CO5	Understand the programming realization of SCADA
CO6	Understand the programming realization of PLC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Introduction to Process Control - block diagram of process control loop, definition of elements. Sensor time response - first and second order responses. Review of Transducers: Characteristics and Choice of transducer-factors influencing choice of transducer.
Unit II: Applications of Transducers 8 Hours
Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential

pressure measurement Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement :Hotwire anemometer, constant resistance Constant current type Eddy current sensors, Variable reluctance tachometers Phase measurement :Analog and digital phase detectors Nano Instrumentation
Unit III: Signal conditioning 8 Hours
Signal conditioning circuits-Instrumentation amplifiersUnbalanced bridge. Bridge linearization using op amp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimization.
Unit IV: Micro Electromechanical system (MEMS) 8 Hours
Advantages and Applications, MEMS micro sensors and actuators, Manufacturing process: Bulk micro machining and surface micromachining, MEMS accelerometers Virtual instrumentation system: architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming.
Unit V: SCADA 5Hours
Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC
Unit VI: PLC 5Hours
Introduction to Sequence Control, PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming-realization of AND, OR logic, concept of latching,

Suggested Reading

1. Curtis D Johnson ," Process Control Instrumentation Technology", PHI, 1986
2. Doeblin E.O, 'Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992
3. DVS. Murty, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt Ltd New Delhi ,2013
4. MadhuchhandaMitra, SamarjitSengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt Ltd., 2009
5. Mickell. P. Groover 'Automation, Production and computer integrated manufacturing' Prentice Hall of India, 1992
6. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi
7. Robert B. Northrop, 'Introduction to instrumentation and measurements', CRC, Taylor and Francis 2005.

Name of The Course	Power System Operation and Control			
Course Code	BEEE5005			
Prerequisite	Power System Analysis			
Co-requisite	Fundamentals of Power System			
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. Introduce the fundamentals concepts of operation of Modern power systems.
2. Understand various Load driving parameters and various forecasting methods.
3. Introduce the concepts of Unit Commitment and Online economic dispatch.
4. Understand and analyze control relationship between real power vs frequency and reactive power vs voltage.

Course Outcomes

CO1	Identify various load driving parameters and review various forecasting methods for efficient power system operation
CO2	Analyze the relationship between various power system variables in terms of mathematical modeling
CO3	Model the steady state and dynamic performance of power system control.
CO4	Apply the knowledge of Unit Commitment and economic Dispatch to solve numerical problems based on real time situations.
CO5	Explain various functional aspects of SCADA/ECC along with various operating states of power system.
CO6	Understand the application of power System estimation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
System load – variation, load characteristics – load curves and load-duration curves, load factor, diversity factor, load forecasting, simple techniques of forecasting, basics of power system operation and control, reserve margin, load-frequency control, voltage control.
Unit II: Real Power – Frequency Control 8 Hours
Speed governing mechanism and modelling, speed-load characteristics, load sharing, control area concept, LFC control of a single-area system, static and dynamic analysis, integration of economic dispatch control with LFC, two-area system – modelling – static analysis of uncontrolled case, tie line with frequency bias control of two-area system.
Unit III: Economic Load Dispatch8 Hours
Economic dispatch problem – cost of generation, incremental cost curve, co-ordination equations, solution by direct method and λ- iteration method, unit Commitment problem – constraints, solution methods – Priority-list methods – forward dynamic programming approach (Numerical problems only in priority-list method using full-load average production cost).
Unit IV: Reactive Power – Voltage Control8 Hours
Reactive power control, excitation systems – modelling, static and dynamic analysis, stability compensation, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformers, tap setting of OLTC transformer and MVAR injection of switched capacitors.
Unit V: Computer control of power systems 8 Hours
Need of computer control of power systems, concept of energy control centre (or) load dispatch centre and the functions, system monitoring, data acquisition and control, system hardware configuration,
Unit VI Power System Estimation
SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states (Normal, alert, emergency, in-extremis and restorative).

Suggested Reading

1. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., 2003.
2. D.P. Kothari and I.J. Nagrath, „Modern Power System Analysis", Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
3. Chakrabarti&Halder, "Power System Analysis: Operation and Control", PHI, 2004 Edition.
4. L.L. Grigsby, „The Electric Power Engineering, Hand Book", CRC Press & IEEE Press, 2001.
5. Olle. I. Elgerd, "Electric Energy Systems theory: An introduction", Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

Name of The Course	Digital Control				
Course Code	BEEE5004				
Prerequisite	Control System				
Co-requisite	Advanced Control System				
Anti-requisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

1. The purpose of this course is to provide basic concepts of Digital control systems.
2. The main goal of the course is to teach the students how to select and design digital controller for different systems.
3. This course is also to learn microprocessors and microcontrollers based digital control systems.
4. This also provides knowledge of effect of quantization on signals in digital control systems.

Course Outcome

CO1	Analyze and design SISO systems through Z-transform.
CO2	Analyze and design of MIMO systems through state space analysis.
CO3	Understand the Controller design using transformation techniques.
CO4	Analyze system's stability.
CO5	Discuss Microprocessor and DSP based control.
CO6	Discuss the quantization effect on the digital control system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Overview of design approaches, continuous versus digital control, sampling process, effect of sampling rate. Calculus of difference equations. Z-transform. Signal flow graphs.
Unit II: Design of State space systems 8 Hours
Controllability, Observability, Discretization of continuous transfer functions; Digital filter properties.
Unit III: Controller design using transformation techniques
Z-plane specifications. Design in the w domain. PID controller. Deadbeat controller. Root Locus design.
Unit IV: State space methods 8 Hours
Pole placement design, stabilization and all stabilizing controllers. Observer design. Infinite time optimal regulator, Stability and tracking in SD systems.
Unit V: Quantization effects 8 Hours
Limit cycles and dither. Sample rate reduction. Multi-rate sampled data system and stability studies. Design of digital controller using fast output sampling.
Unit VI: Microprocessor and DSP control 8 Hours
Mechanization of control algorithms. Iterative computation via parallel, direct, canonical, cascade realization; Effects of computing time. Systems with time delay. Case studies

Suggested Reading

1. K. Ogata, “Discrete-time control sytems”, PHI, 2005.
2. B.C. Kuo, “Digital Control System”, Oxford University press, 1995
3. Norman S. Nise," Control systems Engineering", John Wiley and Sons, 4th Edition, 2004.
4. G. F. Franklin, J. David Powell and MichealWorkman,“Digital Control of Dynamic Systems“, Pearson Education, 3rd Edition,2003.
5. M.Gopal, “Digital Control Engineering”, New Age Publishers, 2008.

Name of The Course	Automation and Robotics			
Course Code	BEE03T5002			
Prerequisite	Control Systems			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To identify potential areas for automation and justify need for automation.

Course Outcomes

CO1	Select suitable major control components required to automate a process or an activity
CO2	Study the various parts of robots and fields of robotics.
CO3	Understand the fundamentals of automated assembly systems
CO4	Study the various kinematics and inverse kinematics of robots.
CO5	Study the control of robots for some specific applications.
CO6	Design real time robotics systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data.

Unit II: Automated Production lines 1 8 Hours
Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems,
Unit III: Automated Production lines 2
Fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies
Unit IV: Industrial Robotics 8 Hours
Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.
Unit V: Spatial descriptions and transformations8 Hours
Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space
Unit VI: Robot programming 8 Hours
Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications

Suggested Reading

1. Automation, Production systems, and computer integrated manufacturing-MikellP.Groover 3rd edition, Pearson 2009
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

Basket- (Power Engineering)

Name of The Course	Power System Equipments				
Course Code	BTEE3017				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

Power Engineering is concerned with the generation, transmission, distribution and utilization of electrical energy. Large power systems are interconnected physical networks of many different types of equipment and apparatus: synchronous generators for generating electricity, power transformers for changing the voltage levels, overhead transmission lines, underground cables, metering and control equipment, switchgear for connection/disconnection, high-voltage insulators, etc. Because of operating conditions (different voltage and power levels) each equipment type in turn comprises many different designs.

Course Outcomes

CO1	Identify various designs of transmission line and overhead line
CO2	Explain various Substation equipments Protection & Control theories
CO3	Explain various necessities of power system earthing
CO4	Identify various basic concepts about Surge Protection & Insulation Co-ordination
CO5	Identify various basic concepts about Insulation Co-ordination
CO6	Introduce reliability of transmission & distribution Systems

Text/ Reference Books:

1. Power System Analysis & Design by B.R. Gupta –S.Chand.
2. Sub Station Design and Equipment – Gupta & Satnam (Dhanpat Rai & Sons).
3. Transmission & Distribution – Westinghouse.

4. P. Gill, Electrical Power Equipment Maintenance and Testing, 2nd ed., CRC Press, 2008.
5. F. Kussy, and J. Warren, Design Fundamentals for Low Voltage Distribution and Control, Marcel Dekker, 1987.
6. Syllabus

Unit-I	Transmission Line Design & Overhead Line Design	8 Hours
Types of Insulator, String Efficiency, Improvement of voltage distribution, Improvement of String Efficiency, Line Supports, Types of Steel Towers, Cross Arms, Equivalent span, Conductor configurations, Spacing & Clearance, Sag & Tension calculations, Erection conditions, Factors affecting Sag, Sag Template, Catenary, Vibration of conductors & prevention, Selection of conductor size, Cross arm, No. Of circuits, Selection of ground wire.		
Unit-II	Electrical Substation &Earthing	8 Hours
Types of Substation, Layout and Bus Bar schemes, Voltage level, Substation equipments Protection & Control Substation Earthing, Tolerance limits of body currents, Soil resistivity, Earth resistance, Tolerable & Actual Step & Touch Voltages, Design of EarthingGrid, Tower Footing Resistance, Measurement of soil & earth resistivity		
Unit-III	Power System Earthing	6 Hours
Ground versus isolated neutral, Solidly and effectively grounded system Resistance and Impedance Grounding, Resonant Grounding, Reactance Grounding, Voltage Transformer Grounding, Zigzag Transformer Grounding, Grounding practice, Effect of grounding on system over voltages & protection over voltage and over voltage phenomenon in isolated and grounded neutral system.		
Unit-IV	Surge Protection	5 Hours
External and Internal over voltages mechanism of lighting discharge, wave shapes of stroke current line design based on direct stroke, over voltage protection, earth wire Rod gap T.F.R., Expulsion tube, surge diverter.		
Unit-V	Insulation Co-ordination	5Hours
General idea, Selection of B.I.L., International recommendation, Selection of arrester rating, Co-ordination of protector devices with apparatus insulation		
Unit-VI	Reliability of Transmission & Distribution Systems	7 Hours
Definition, Outage, Bath Tub Curve, Two State Model, Failure & Repair Rate, Probability Density Function, Probabilities of Survival & Failure, Mean Time to Failure, Mean Down Time, Reliability of Series & Parallel Systems, Two-State Fluctuating Enviornment, Approximate Method, Reliability Planning, Preparation of Reliability Models.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Quality			
Course Code	BTEE3023			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

1. To understand the various power quality issues
2. To understand the concept of power and power factor in single phase and three phase systems supplying non linearloads
3. To understand the active compensation techniques used for power factor correction.
4. To understand the active compensation techniques used for load voltage regulation.

Course Outcomes

CO 1	Toacquireanin-depthknowledgeonvariouspowerqualityissueslikevoltage sag, interruption and harmonics.
CO 2	To learn about various aspects of power quality measurements and power quality

CO 3	Ability to understand and analyze power system operation, stability, control and protection.
CO 4	Introduce the importance of grounding on power quality.
CO 5	Learn to apply appropriate solution techniques for power quality mitigation based on the type of problem.
CO 6	Illustrate the latest trends adapted in power quality improvements.

Text Book (s)

1.Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
2.R. Dugan, M. McGranahan, S. Santoso, W. Beaty, Electric Power Systems Quality, 2nd Edition (McGraw-Hill, New York, NY, 2002).

Reference Book (s)

1. Heydt, Electric Power Quality, Stars in a Circle Publications, 1991. (optional)
2. Handbook of power quality, editor: Angelo Baggini, John Wiley & Sons, 2008.

Unit I:
Power and Voltage Quality: General, classes of Power Quality Problems, Power quality terms, Power frequency variations, the power quality evaluation procedure. formula, sensitivity, Reduction of effect of parameter variation and disturbance by using negative feedback.
Unit II:
Voltage sags and Interruptions: Sources of sags and Interruptions, Estimating Voltage sag performance. Fundamental Principles of Protection, Solutions at the end-user level, Evaluating Ride-through Alternatives, Motor-Starting Sags.
Unit III:
Fundamentals of Harmonics: Harmonic distortion, Voltage versus Current distortion, Harmonic indexes, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic Distortion. Considerations.
Unit IV :
Distributed Generation and Power Quality: Resurgence of DG, DG Technologies, Interface to the Utility System, Power Quality Issues, Operating Conflicts, DG on distribution Networks, Sitting DG distributed Generation, Interconnection standards.
Unit V:
Wiring and Grounding: Recourses, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solution to wiring and grounding problems.
Unit VI: Recent Technologies
Recent trends and technologies using to improve the power quality

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	FACTS and HVDC			
Course Code	BTEE4010			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
3	0	0	3	

Course Objectives:

3. Apply concepts of transmission in HVDC Transmission
4. To prepare students to know the role of HVDC systems

Course Outcomes

CO1	Identify significance of DC over AC transmission system, types and application of HVDC links in practical power systems
CO2	To Analyze different converters viz.3,6 and 12 pulse converter
CO3	To Analyze AC/DC system interactions and know the operation and control of various MTDC systems.
CO4	Model AC/DC system and apply protection for HVDC system against transient overvoltage and over currents
CO5	To estimate Improvement of voltage stability
CO6	Illustrate the latest trends adapted in HVDC.

Text Book (s)

1. HVDC transmission by Adamson and Hingorani.
2. H.V.D.C.Transmission by J.Arillaga : Peter Peregrinus ltd., London UK 1983.

Reference Book (s)

3. Direct current Transmission, by . E.W. Kimbark , Wiely Inter Science – NewYork. EHV-AC & HVDC transmission Engg. Practice" by S.Rao, Khanna Publishers.
4. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Unit I: H.V.D.C. Transmission **6 lecture hours**
H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Static Power Converters: 3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.
Unit II:
Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters. Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control, DC power flow control.
Unit III:
Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.
Unit IV : FACTS Introduction
The concept of flexible AC transmission - reactive power control in electrical power transmission lines, uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC).
Unit V: 7 lecture hours
Voltage control by STATIC VAR COMPENSATOR (SVC), THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC) And Static Synchronous Compensator (STATCOM): advantages of slope in dynamic characteristics, influence of SVC on system voltage. Applications: enhancement of transient stability and steady state, power transfer.
Unit VI: Recent Technologies
Recent trends and technologies using in HVDC.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical and Hybrid vehicle			
Course Code	BEE02T5003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

3. To understand the electrical vehicle
4. To understand the hybrid vehicle

Course Outcomes

CO1 Understand basics of battery technology.
CO2 Understand scheme of HEV and full electric vehicle.
CO3 Analyse need of different motor drives for electric vehicle.
CO4 Apply new topologies to electric vehicle.
CO5 Evaluate performance parameters of electric vehicle.
CO6 Understand recent industrial power electronic applications for electric vehicle.

Text Books:

1. Sandeep Dharmeja, Electric Vehicle Battery Systems, 1st Edition, Newnes, 2001
2. K.T.Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, 1st Edition, John Wiley and Sons, 2011

Reference Books:

1. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001
2. Springer Books, Electrical Vehicle Integration into Modern Power Networks
3. A.T.P.So George C.Barney waterstones.com, International Journal of Elevator Engineering, United Kingdom
4. John Lowry, John Wiley and Sons, Electrical Vehicle Technology Explained-James Larminie, 1st Edition, 2003

Unit I: Introduction to Electric Vehicles

Electric vehicles (EV) development, past, present and future, comparison with IC engine driven vehicles.
Unit II: Storage Units
Batteries, fuel cells, ultracapacitors. Power converters in EV. Different types of motors used in EV and their torque-speed characteristics, motor control techniques,
Unit III: Vehicle Control
High performance and efficiency-optimized control, sensorless control. Electric vehicles modeling and their Characteristics.
Unit IV : Electric drive-trains
Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies - fuel efficiency analysis
Unit V: Hybrid Electric Vehicle
Fuel cell Vehicles, Hybrid Electric Vehicles (HEV), series, parallel and series-parallel (split) systems,
Unit VI: Recent Technologies
Recent industrial power electronic applications. Advanced topic on the subject

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Deregulation			
Course Code	BTEE4009			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

3. To understand the restructuring of electrical power systems
4. To understand the marketing in power sector

Course Outcomes

CO1	To provide in-depth understanding of operation of deregulated electricity market systems.
CO2	To Understand the Fundamentals of Economics
CO3	To examine topical issues in electricity markets and how these are handled world-wide in various markets.
CO4	To train the students to analyze various types of electricity market operational and control issues under congestion management.
CO5	To understand the operation of ancillary
CO6	To learn different pricing mechanism and power trading in restructured power system

Text Book (s)

1. L.Philipson and H. Lee Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekker 1998
2. Kankar Bhattacharya , Math Bollen and J.E. Daadler, "Operation of restructured Power Systems," Kluwer 2001
3. M. Shahidepour and M. Alomoush, "Restructured Electrical Power Systems", Marcel Dekker 2001
4. Steven Stoft, "Power System Economics: Designing Markets for Electricity", IEEE Press 2002
5. Ashikur Bhuiya, "Power System Deregulation: Loss Sharing in Bilateral Contracts and Generator Profit Maximization", VDM Publishing 2008
6. Daniel S. Kirschen, Goran Strbac, "Fundamentals of Power System Economics", WILEY 2004

Unit I: Restructuring Of Power Industry:
An Introduction: Introduction, reasons and objectives of restructuring/ deregulation of power industry, restructuring process, issues involved in restructuring/ deregulation.
Unit II: Fundamentals of Economics
Introduction, consumer behavior, supplier behavior, market equilibrium, short-run and long-run costs, various costs of production, perfectly competitive market
Unit III: Philosphy of market models:9 lecture hours
Introduction to philosophy of market models, market models based on contractual arrangements, comparison of various market models, electricity as a commodity market architecture
Unit IV: Transmission congestion management:10 lecture hours

Introduction, classification of congestion management methods, calculation of atc (available transfer capability), non-market methods, nodal pricing, inter-zonal/ intra-zonal congestion management, price area congestion management, capacity alleviation method
Unit V : Electricity market evolution:8 lecture hours
US and European electricity market evolution, PJM, NEMMCO, ERCOT, NORDIC Markets, comparison of power markets, towards standard market design (SMD)
Unit VI: Reforms in Indian power sector:7 lecture hours
Introduction, framework for Indian power sector, reform initiatives in India, The Electricity Act 2003, availability based tariff (ABT), open access issues, power exchange

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	High Voltage Engineering			
Course Code	BEE02T3005			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. The course imparts knowledge about voltage break down of solid, liquid and gaseous materials used in electrical engineering field.
2. Students will learn generation of high voltages and currents.
3. Students will learn the measurement and testing of high voltages and currents.

Course Outcomes

CO1	Understand the significance high voltage engineering and its implementation in power System
CO2	Overcome upon the challenges associated with generation and measurement of high voltages and currents
CO3	To analyze Generation of High Voltages and Currents drivers and its benefits.
CO4	To analyze measurement of High Voltages and Currents drivers and its benefits
CO5	Understand about Non-Destructive Testing Sources.
CO6	Understand about the High Voltage Testing.

Course Content:

Unit I: Break Down In Gases 08 Hours
Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, breakdown in vacuum.
Unit II: Break Down In Liquid Dielectrics 08 Hours
Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid. Break Down In Solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics.
Unit III: Generation of High Voltages and Currents 05 Hours
Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.
Unit IV: Measurement of High Voltages and Currents 05 Hours
Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements, factor, partial discharge measurements.
Unit V: Non-Destructive Testing 07 Hours
Measurement of direct current resistively, measurement of dielectric constant and loss.
Unit VI: High Voltage Testing08 Hours
Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

Suggested Reading

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill

2. Subir Ray,' An Introduction to High Voltage Engineering' Prentice Hall of India.
3. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
4. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers.
5. R. S. Jha, "High Voltage Engineering", DhanpatRai& sons.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Basket- (Energy Engineering)

SCHOOL OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING

Name of The Course	Energy Assessment and Audit			
Course Code	BTEE4011			
Pre-requisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To have an overview of energy audit.
2. To understand the need of energy assessment.

Course Outcomes

CO1	To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R &D institutions.
CO2	Toproducegraduatesstronginenergyresources, technologiesandmanagementfundamentals,andcapablein addressing the present and potential future energy problems
CO3	To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns ,and who can apply their specialized knowledge for the sustainable energy management.
CO4	Acquaintance with conservation of energy and its management.
CO5	Identify the source of conservation of energy and energy planning, and energy economics.
CO6	Know-How of energy efficient machinery systems, energy losses and their management

Text Book (s)

Albert Thumann,Handbook of energy engineering ,"AbeBooks ,1979
JamesWilsonBrownandShirleyHansen,,, InvestmentGradeEnergyAudit‟,Gordan &BreachScain Publishers,November2000
Endreni, J., „Reliability modelling in Electric Power System‟ John Wiley, 1980.

Reference Book (s)

Roy Billinton and Ronald Allan Pitam: Reliability Evaluation of Power Systems,1996
Wheel Wright and Makridakis: Forecasting methods and Applications, John Wiley, 1992.

Course Content:

Unit I: Energy Auditing
Introduction, Scope of Energy Audit, Types of Energy Audit, Detailed Energy Audit Methodology, Implementing Energy Efficiency Measures, Detailed Project Report (DPR), Measurement & Verification.
Unit II: Electrical System
Introduction, Main Components of Electrical System, Load Management, Power Factor, Electricity Tariff, Distribution Transformers, Voltage Drop Survey, Cable Losses, Inverter/UPS, Power Quality, Energy Auditing ApproachforElectricalDistributionSystemandTransformers,ENCONOpportunitiesinElectricalSystem.
Unit III: Electrical Motors
Introduction,TypesofMotors,SelectionofanElectricalMotor,MotorLoading,EnergyEfficiencyMotors,Power Factor Correction for Motors, Avoiding Idle Running of Motors, Efficient Belt Drives, Application of Variable Frequency Drive (VFD), Effect of Power Supply Quality on Motors
Unit IV :Pumping system-1
Introduction,PumpPerformanceCurves,SystemCurve,PumpPerformanceAssessment,Flow,Balance, Control Valve Operation (Throtiling), By-pass Valve Operation, Optimum Pipe Sizing, Impeller Trimming, Reducing Number of Stages, Variable Speed Operation,.
Unit V: Pumping System-2
Energy Auditing & Approach for Pumping System, ENCON OpportunitiesinPumpingSystem,DemoofEnergyEfficiencyPracticesinPumpLaboratory
Unit VI: Air Handling and Distribution System 7 lecture hours
Introduction, Ducting System Design, Fan Discharge and Inlet System, Filter Losses, Coil Losses, Fan Efficiency, ExcessAirFlow,ConstantAirVolume(CAV)versus VariableAirVolume(VAV),AirDistributionandBalancing, Fresh Air Control, Energy Auditing Approach in Air Handling & Distribution System,

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

20	30	50	100

Name of The Course	Utilization of Electrical Energy & Traction System				
Course Code	BTEE5102				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

3. To develop the lighting schemes.
4. To develop the analytical skills for electric heating.

Course Outcomes

CO1	Understand with the process and application of electrical energy utilization system
CO2	Identify effective electrical system with various applications prospective.
CO3	Analyse effective control scheme with different electrical appliances.
CO4	Solve problems in the subject of utilization of electrical energy and traction system.
CO5	Design an effective control structure and save energy in utilization of electrical energy and traction system.
CO6	Understand the advancement in in traction system

Text Book (s)

1. H. Pratab. "Art & Science of Electric Energy's" Dhanpat Rai & Sons.
2. G.K. Dubey, "Fundamentals of electric drives" Narosa Publishing house

Reference Book (s)

1. Pratab."Modern electric traction" Dhanpat Rai & Sons. □
2. C.L. Wadhwa,"Generation, Distribution and Utilization of Electrical Energy, "New Age International Publishers.

Course Content:

Unit I: ELECTRIC HEATING
Advantage & methods of electric heating, resistance heating, electric arc heating, induction heating, dielectric heating.
Unit II: ELECTRIC WELDING 9 lecture hours
Electric arc welding, electric resistance welding, electric welding control, electrolyte process: principle of electro deposition, laws of electrolysis, application of electrolysis.
Unit III: ILLUMINATION 10 lecture hours
Various definition, laws of Illumination, requirement of good lighting, design of indoor lighting & outdoor lighting system, refrigeration system, domestic refrigerator, water cooler, types of air conditioning, window air conditioner.
Unit IV : ELECTRIC TRACTION – I 8 lecture hours
Types of electric traction, system of track electrification, traction mechanics-types of services, speed time curve and its simplification, average and schedule speeds, tractive effort specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence.
Unit V: ELECTRIC TRACTION – II 7 lecture hours
Salient features of traction drives, series-parallel control of dc traction drives (bridge traction) and energy saving, power electronic control of dc & ac traction drives, diesel electric traction.
Unit VI: Recent Trends
Recent advancement in traction system

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power electronics application in renewable energy				
Course Code	BEE03T5010				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives:

To provide knowledge about various renewable energy technologies, their potential and applications

Course Outcomes

Text Books:

1. Title Power Electronics Hand book Author Rashid .M. H Publisher Academic press Edition 2001 and Reprints

2. Title Non-conventional energy sources Author Rai. G.D Publisher Khanna publishes Edition 1993 and Reprints
3. Title Solar energy utilization Author Rai. G.D Publisher Khanna publishes Edition 1993 and Reprints

Reference Books:
1. Title Wind energy system Author Gray, L. Johnson Publisher prentice hall linc Edition 1995 and Reprints 161
2. Title Non-conventional Energy sources Author B.H.Khan Publisher Tata McGraw-hill Publishing Company, New Delhi Edition 2nd Edition

Unit I: Introduction :
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.
Unit II: Electrical Machines for Renewable Energy Conversion :
Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.
Unit III : Power Converters :
Solar: Block diagram of solar photo voltaic system - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters-selection Of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.
Unit IV : Analysis of Wind Energy Systems :
Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system
Unit V: Analysis of PV Systems
solar system-Grid connection Issues -Grid integrated, Wind and PV solar hybrid system
Unit VI: Hybrid Renewable Energy Systems :
Need for Hybrid SystemsRange and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Special Electrical Machines			
Course Code	BTEE5202			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:
3. To understand the various machines
4. To understand the concept of special electrical machines and applications

Course Outcomes

CO1	Apply the knowledge of Commutator motors and circuits analysis of FHP Universal Commutator motors
CO2	Make use of application of the BLDC Motors with industries and day to day life
CO3	Analysis the demanding and appropriate drive performance for the Stepper motor.
CO4	Analysis the numerical problems associated with FHP Synchronous Motors
CO5	Test and estimate the parameter of the Special machine. Analysis the demanding and appropriate drive performance for the specific purpose.
CO6	Test and estimate the parameter of the LIM.

Text Book (s)

1. P.C. Sen, “Principles of Electric Machines and Power Electronics”, 2nd Edition, Wiley India Ltd. 2007
2. E. Openshaw Taylor, “The Performance and Design of AC Commutator Motors”, Wheeler Publishing, 1997
3. R. Krishnan, “Switched Reluctance Motor Drives”, 1st Edition, CRC Press. 2001

Unit I: FHP Universal Commutator motors:
Principle of operation and performance characteristics of universal commutator motor without and with compensating windings, phasor diagrams and expressions for power and torque, speed-torque characteristics with DC and AC excitations.
Unit II: Introduction to Brushless DC Motor Drives (BLDC)

Salient features of various permanent magnet materials- B-H- Loop and demagnetization characteristics, Comparison of BLDC Vs conventional, BLDC Vs Synchronous motor, BLDC Vs induction motor. Operating principle of BLDC- Principle of hall sensor - unipolar BLDC and Bi-polar BLDC.
Unit III: Stepper motors:
Introduction, Multi-stack variable-reluctance stepping motors, Principles of operation , Aspects of design, Single stack variable-reluctance stepping motors, Hybrid stepping motors, Comparison of motor types, design of drive circuits, torque/rotor position characteristics.
Unit IV : Servomotors:
DC and AC servomotors, transfer function analysis, Synchronous
Unit V: Switched Motor Reluctance Drives
Introduction, Poles, phase and windings, Static torque production, Partition of energy and effects of saturation, Dynamic torque production, Converter circuits, Current regulation, Commutation, torque – speed characteristics, Shaft position sensing.
Unit VI: Linear Induction motors
Basic principle of operation and types. Field analysis & Propulsion force; equivalent circuit

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Design, Estimation and Energy Audit			
Course Code	BEE02T4001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. The effective use of energy to maximize profits (minimize costs) and enhance competitive positions, it is necessary to conserve energy. Hence it is necessary to study energy auditing methods and energy saving opportunities in electrical system.

Course Objectives

On completion of the following units of syllabus contents, the students must be able to

- Draw conventional symbols for various electricalinstallations.
- To quote the relevant IE rules for a given electrical installation, earthing and clearance of service lines.
- Familiarize the types ofwiring.
- List the points to be considered for selectionwiring.
- Determine the size of wire for internalwiring.
- Explain the necessity and types ofearthing.
- Estimate the quantity of materials required forearthing.
- Differentiate between neutral and earthwire.
- Estimate the quantity of materials required for domestic and industrialwiring.
- Explain the concept and types of Energy of energyaudit.
- Explain the energy saving opportunities in Transformer, Induction motor, lighting and DGsystem.
- Explain the roll of power factor controller in energy savingsystem.
- Explain the roll of sensors in energy savingsystem.
- Explain the energy efficient technologies in electricalsystem.

Course Outcomes

CO1	Identification of different types of electrical symbols, need of earthing and various electrical wiring systems
CO2	Illustrate the estimation of components required for Industrial and Domestic application
CO3	Understand energy audit and energy management system
CO4	Identify the types of tariff that are benefit for consumers and methods of improving power factor
CO5	Understand different technologies used for Energy efficient Technologies in Electrical System

Text Books:

1. K.B.Raina& S.K.Battacharya, Electrical Design Estimating And Costing, New age International
2. General Aspect Of Energy Management And Energy Audit, Bureau of energy efficiency,

New Delhi
3. Energy Efficiency In Electrical Utilities, ,Bureau of energy efficiency, New Delhi

Reference books:
3. Surjit Singh, Electrical Design Estimating and Costing, Dhanpat Rai & Company
4. Surjit Singh, Electrical Engineering Design and Drawing, Dhanpat Rai & Company

Syllabus

Unit-I	System of Internal Wiring and Earthing	8 Hours
Need of electrical symbols – List of symbols – Brief study of important Indian Electricity Rules 1956 - Methods of representation for wiring diagrams – Looping back system and Joint box system and tree system of wiring - Types of internal wiring – Service connection (Overhead and Underground) - Protection of electrical installation against overload, short circuit and earth fault – protection against electric shock – Effects of electric shock – Recommended first aid for electric shock - Treatment for electric shock - Construction and working of ELCB – Overview of Busbar, Trunking and Cable tray. Necessity – General requirements of Earthing – Earthing and Soil Resistivity – Earth electrodes – Methods of earthing - Plate earthing - Pipe earthing - Rod earthing – Soil Resistivity – Methods of improving earth resistance - Size of earth continuity conductor - Difference between Neutral and Earth Wires. Safety signs showing type of PPE to be worn, Prohibition Signs, Warning Signs, Mandatory Signs, Advisory or Safe ConditionSigns.		
Unit-II	Domestic and Industrial Estimation	8 Hours
General requirements of electrical installations for Residential, Commercial and Industrial – Lighting and power sub- circuits – Diversity factor for sub circuits - Location of outlets, control switches, main board and distribution boards – Permissible voltage drops and size of wires - Steps to be followed in preparing electrical estimate. Estimate the quantity of material required in Electrical Installation for 7. Small residential building/Flat 8. Factory Lightingscheme 9. Computer centre having 10 computers, a/c unit, UPS, light and fan. 10. Street Light service having 12 lamp lightfitting 11. Workshop with one number of 3Φ, 15hp inductionmotor. 12. Small Workshop with 3 or 4Machines.		
Unit-III	Energy Audit	8 Hours
Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach- Understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments.		
Unit-IV	Energy Management of Electrical System	8 Hours
Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.		
Unit-V	Energy efficient Technologies in Electrical System	8 Hours
Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology.		

Basket-4 (IOT)

Name of The Course	Automation and Robotics			
Course Code	BEE03T5002			
Prerequisite	Control Systems			
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To identify potential areas for automation and justify need for automation.

Course Outcomes

CO1	Select suitable major control components required to automate a process or an activity
CO2	Study the various parts of robots and fields of robotics.

CO3	Understand the fundamentals of automated assembly systems
CO4	Study the various kinematics and inverse kinematics of robots.
CO5	Study the control of robots for some specific applications.
CO6	Design real time robotics systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Course Content:

Unit I: Introduction 8 Hours
Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data.
Unit II: Automated Production lines 1 8 Hours
Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems,
Unit III: Automated Production lines 2
Fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies
Unit IV: Industrial Robotics 8 Hours
Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.
Unit V: Spatial descriptions and transformations8 Hours
Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space
Unit VI: Robot programming 8 Hours
Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications

Suggested Reading

1. Automation, Production systems, and computer integrated manufacturing-MikellP.Groover 3rd edition, Pearson 2009
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

GALGOTIAS UNIVERSITY
(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Electrical, Electronics and Communication Engineering

Program: M. Tech VLSI Design

Scheme: 2019-2020

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MATH5001	Advanced Numerical & Statistical Methods	3	1	0	4	20	30	50
2	MVLS5020	Advanced Digital System Design	3	0	0	3	20	30	50
3	MVLS5021	Advanced VLSI Design	3	0	0	3	20	30	50
4	MVLS5004	Analog Filter Design	3	0	0	3	20	30	50
5	MVLS****	Program Elective 1	3	0	0	3	20	30	50
6	MVLS5019	Advanced Digital System Design Lab	0	0	2	1	50	-	50
7	MVLS5022	Advance VLSI Design Lab	0	0	2	1	50	-	50
		Total	15	1	4	18			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	CENG5001	Professional and Communication skills	0	0	4	2	20	30	50
2	MVLS5007	DSP for VLSI	3	0	0	3	20	30	50
3	MVLS5008	VLSI Testing and fault Tolerance	3	0	0	3	20	30	50
4	MVLS5009	ASIC Design and FPGAs	3	0	0	3	20	30	50
5	MVLS****	Program Elective 2	3	0	0	3	20	30	50
6	MVLS****	Program Elective 3	3	0	0	3	20	30	50
7	MVLS5012	ASIC Design Lab	0	0	2	1	50	-	50
8	MVLS5013	DSP for VLSI Lab	0	0	2	1	50	-	50
		Total	15	0	8	19			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MVLS6001	Embedded System Design	3	0	0	3	20	30	50
2	MVLS****	Program Elective 4	3	0	0	3	20	30	50
3	MVLS****	Program Elective 5	3	0	0	3	20	30	50
4	MVLS6004	Embedded System Lab	0	0	2	1	50	-	50
5	MVLS9997	Research Seminar	0	0	2	1	50	-	50
6	MVLS9998	Capstone Design- 1	0	0	10	5	50	-	50
		Total	9	0	14	16			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MVLS9999	Capstone Design- 2	0	0	30	15	50	-	50
		Total	0	0	30	15			

Programme Elective

Sl. No.	Course Code	Course Title	L	T	P	C
1	MVLS5003	Advanced VLSI Technology	3	0	0	3
2	MVLS5005	MOS Device Modelling	3	0	0	3
3	MVLS5010	Advanced Digital VLSI Design	3	0	0	3
3	MVLS5011	Low power VLSI Design	3	0	0	3
4	MVLS5014	Sensor Technology and MEMS	3	0	0	3
7	MVLS5015	Nano-Electronics	3	0	0	3
8	MVLS5016	Design of Semiconductor Memories	3	0	0	3
9	MVLS5017	Advanced Analog VLSI Design	3	0	0	3
10	MVLS5018	Reconfigurable Computing	3	0	0	3
11	MVLS6002	Physical Design Automation	3	0	0	3
12	MVLS6003	System-on-Chip Design	3	0	0	3
13	MVLS6005	Packaging and Interconnect Analysis	3	0	0	3
14	MVLS6006	EMI and EMC in System Design	3	0	0	3
15	MVLS6007	DSP Architecture	3	0	0	3
16	MVLS6008	Mixed Signal IC Design	3	0	0	3

Detailed Syllabus

Name of The Course	Advanced Numerical & Statistical Methods				
Course Code	MATH5001				
Prerequisite	Matrices and Calculus				
		L	T	P	C
		3	1	0	4

Course Objectives: To introduce the applications and trade off of various advanced methods used to solve a wide variety of engineering problems dealing with algebraic and differential equation that are often encountered in engineering and cannot be solved by analytical methods along with the introduction of design of experiment.

Course Outcomes

CO1	Do numerical integration for various problems
CO2	Do interpolation using various interpolation techniques.
CO3	Understand the Ordinary & Partial Differential equations and their solutions.
CO4	Do numerical integration
CO5	Use wavelets and their applications

Text Book (s)

1. **Numerical Method** : E. Balagurusamy , Tata McGraw Hill Publication.
2. **Applied Numerical Analysis :** Curtis F. Gerald and Patrick O. Wheatley – Pearson Education Ltd.

Reference Book (s)

1. **Numerical Methods for Scientific and Engineering computation:** M.K Jain, S.R.K Iyengar and R.K Jain, New age International Publishers.
2. **Statistical Methods :** S.P. Gupta, Sultan Chand and Sons
3. **Introduction to Mathematical Statistics:** A.M. Mood, F. Graybil and D.C.Boes, Mc Graw Hill Publication.

Course Content:

Unit-1	**System of Equations**	**8 hours**
Solution of system of linear equations- Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss-Seidel and Jacobi method, ill conditioned matrix Solution of system of non linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods.		
Unit-2	**Interpolation and Approximation**	**8 hours**
Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.		
Unit-3	**Numerical Integration**	**8 hours**
Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration.		
Unit-4	**Numerical Solution of Differential Equations**	**8 hours**

Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor-Corrector method, Solution of Laplace's and Poisson's equations by Liebmann's method, Solution of one dimensional time dependent heat flow.		
Unit-5	**Probability and statistics**	**8 hours**
Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced Digital System Design				
Course Code	MVLS5020				
Prerequisite	Digital Electronics				
		L	T	P	C
		3	0	0	3

Course Objectives:.

This course describes about the logic design techniques using simple combinational and sequential circuits to FPGAs, CPLDs.

Course Outcomes

CO1	**Understand the Basics of MOS transistor Theory**
CO2	**Understand the Device Modeling techniques using CAD and analyze the parameters which degrades the functionality of MOS Devices**
CO3	**Design Complex CMOS Circuits**
CO4	**Understand and design various combinational and Sequential Circuits using CMOS Transistors**
CO5	**Perform Data Path Operations using CMOS Circuits**

Text Book (s):

1. T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009.
2. Zainalabdien Navabi, Verliog Digital System Design,TMH, 2nd Edition.
3. Fundamentals ofDigital Logic with Verilog Design - Stephen Brown,Zvonkoc Vranesic, TMH, 2nd Edition.

Reference Book (s)

1. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.

2. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.

3. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI,2009.

Course Content:

Unit-1	**Overview of Verilog HDL**	**10 hours**
Introduction to VerilLog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools **Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.**		
Unit-2	**Modeling Concepts -I**	**8 hours**
Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delay, Strengths and Construction Resolution, Net Types, Design of Basic Circuit. **Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators.**		
Unit-3	**Modeling Concepts -II**	**8 hours**
Behavioural Modeling: Introduction, Operations and Assignments, Functional Bi furcation, 'Initial' Construct, Assignments with Delays, 'Wait Construct, Multiple Always Block, Designs at Behavioural Level, Blocking and Non-Blocking Assignments, The 'Case' Statement, Simulation Flow, 'If' an 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, Parallel Blocks, Force-Release, Construct, Event.		
Unit-4	**Modeling Concepts -III**	**8 hours**
Switch Level Modeling: Basic Transistor Switches, CMOS Switches, Bi Directional Gates, Time Delays with Switch Primitives, Instantiation with 'Strengths' and 'Delays' Strength Contention with Trireg Nets. **System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters. System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives**		
Unit-5	**Sequential Circuits and Test-benches**	**8 hours**
Sequential Circuit Description: Sequential Models - Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. **Components Test and Verification: Test Bench - Combinational Circuits Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.**		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced VLSI Design				
Course Code	MVLS5021				
Prerequisite	Basic knowledge of semiconductors and its devices				
		L	T	P	C
		3	0	0	3

Course Objectives:.

This course is designed to impart the knowledge of VLSI designing methodologies. The mathematical approach in dealing with the designing aspects enables the students to understand the subject in a better way.

Course Outcomes

CO1	Understand the Basics of MOS and Bipolar Transistor Amplifiers
CO2	Illustrate current mirrors and analyse the performance of various amplifiers with active loads
CO3	Desaign of Various MOS transistor powered operational Amplifiers
CO4	Understand and design various oscillators and Conveter circuits using CMOS Transistors
CO5	Understand the concepts of Switched Capacitor Filters

Text Book (s)

1. N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.
2. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998..
3. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits", Addison Wesley 1993.

Reference Book (s)

1. Randel & Geiger, " VLSI Analog and Digital Circuit Design Techniques" McGraw-Hill,1990.

2. William M. Penny, Lillian Lau, " MOS Integrated Circuits- Theory, Fabrication, Design and System Applications of MOS LSI", Van Nostrand Reihold Company..

3. Sung Ms Kang, Yusuf Lablebici, "CMOS Digital Integrated Circuits Analysis & Design", Tata Mc-Graw Hill.

Course Content:

Unit-1	**MOSFETs Fundamentals**	**9 hours**
Introduction To MOS Circuits: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory - Introduction MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices		
Unit-2	**Circuit Characterization And Performance Estimation**	**8 hours**

Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics CMOSGate Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margining, and Reliability.		
Unit-3	**CMOS Circuits**	**8 hours**
CMOS Circuit And Logic Design: CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design. Basic operation of CMOS inverter, detailed analysis of its noise margin propagation delay, power dissipation concept of layout & area, layout optimization & area estimation for a single as well as combinational logic circuits.		
Unit-4	**Systems Design And Design Method**	**8 hours**
Design Strategies CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, Design Economics, Data Sheets, CMOS Testing - Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques, Layout Design for Improved Testability.		
Unit-5	**CMOS Sub System Design**	**8 hours**
Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Analog Filter Design**			
Course Code	**MVLS5004**			
Prerequisite	**Analog Signal Processing**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:. Analog circuits are essential in interfacing and building amplifiers and low pass filters. This course introduces design methods for CMOS an alog filter circuit.

Course Outcomes

CO1	**Acquire a basic knowledge of filters and their characteristics.**
CO2	**Develop the ability to analyze and design analog filter circuits.**
CO3	**Learn noise modeling of CMOS analog circuits**
CO4	**Analysis of Butterworth and Chebyshev filters.**
CO5	**Design analog filter using recent active building block(CFOA, OTRA, CDTA, etc.)**

Text Book (s)

1. Sedra and K. C. Smith, “Microelectronic Circuits”, Oxford.
2. G. Daryanani, “Principles of Active Network Synthesis & Design”, John Wiley & Sons

Reference Book (s)

1. Design of Analog Filters, Van Valkenburg, Oxford.

Course Content:

Unit-1	**Basic Concepts**	**8 hours**
Filters: Types, Specifications and Transfer functions; Circuit elements and scaling; OP-AMP: integrator model & basic circuits; Bode plots.		
Unit-2	**Design and analysis of First & Second order Filters**	**8 hours**
First order: Bilinear transfer functions, Passive Realization, Active realization, Realization with Bode plots; Second order: Design parameters (ω and Q), Second order circuit.		
Unit-3	**Synthesis Techniques**	**8 hours**
Biquad Topology: Tow Thomas, KHN, Sallen-Key, Single Amplifier Biquad using Multiple feedback Topology; Inductance Simulation, General impedance converter (GIC) and FDNR.		
Unit-4	**Approximation Theory**	**8 hours**
Butterworth: Ideal low pass filter, Butterworth response & pole locations, low pass filter specifications; Chebyshev: Chebyshev polynomial, magnitude response, location of Chebyshev poles.		
Unit-5	**Study of Filter building blocks & recent trends**	**8 hours**
Current mode building blocks and tunable filters using OTA, Current conveyors (CCI, CCII), CFOA, OTRA etc. and recent trends.		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**PROFESSIONAL AND COMMUNICATION SKILL**			
Course Code	**CENG5001**			
Prerequisite	**--**			
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

Course Objectives:.

To develop the professional and communication skills of learners in a technical environment.
To enable the students to acquire functional and technical writing skills.
To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience.

Course Outcomes

CO1	**The learners will be able to exhibit their language proficiency and skill in *Describing Technology.***
CO2	**The learners will be able to exhibit their language proficiency and skill in *Investigating and designing using Technology.***
CO3	**Exhibit their language proficiency and skill in Technical Writing and Syntax.**
CO4	**Exhibit their language proficiency and skill in Technical Resume and Company Profile Presentation.**
CO5	**Exhibit their language proficiency and skill in Pie chart, Bar chart, Line graphs: analysis and interpretation**

Text Books and Softwares:

1. English Vocabulary in Use Advanced, McCarthy & Felicity, CUP, 2003
2. Sky Pronunciation CD-ROM
3. Cambridge Advanced Learner's Dictionary CD-ROM

4. English Master : Grammar

Reference Book (s)

1. Writing, Researching, Communicating, Keith et al, Tata McGraw-Hill, 1989
2. Advanced English Grammar, Martin, CUP, 2006

Course Content:

Unit-1	**Basics of Communication**	**8 hours**
Functional Language	Basic structures- Tense agreement, Prepositional phrases Techno-words : Basic Concepts 62, 63 Pronunciation : sounds of syllables: Past tense & plural endings	
Technical Expression	Organizational techniques in technical writing Guided writing: Paragraph Writing, Note Making	
Presentation Skills	Techniques of presentation (general topic: speech without visual aids) Listening to speeches and comprehending	
Graphical Skills	Flow chart: Process and Functional description	
Unit-2		**8 hours**
Functional Language	Basic structures- Voice, Conditionals Techno-words : Basic Concepts 64,65,67 Pronunciation : Word Stress: two syllable words	
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Letter and email	
Presentation Skills	Interpersonal Communication Skills Writing techniques for Power point presentation, Group Discussion	
Graphical Skills	Technical Illustrations and Instructions	
Unit-3		**8 hours**
Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 68,69,70,71 Pronunciation : Word Stress: compound words	
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Technical Description	
Presentation Skills	Career advancement: Technical Resume and Company Profile Presentation and Group Discussion	
Graphical Skills	Pie chart, Bar chart, Line graphs: analysis and interpretation	
Unit-4		**8 hours**
Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 72,73,74, Functional vocabulary 87 Pronunciation : Sentence Stress	
Technical Expression	Guided and Free writing: Abstract and Technical articles	
Presentation Skills	Nuances of Presentation to a Technical audience	
Graphical Skills	Oral Presentation of graphical representation	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	DSP for VLSI				
Course Code	MVLS5007				
Prerequisite	DSP				
		L	T	P	C
		3	0	0	3

Course Objectives:

To design and analysis of DSP systems at chip level design

Design the different digital filters with efficient ways using VLSI.

Course Outcomes

CO1	To understand theory of different filters and algorithms
CO2	understand theory of multirate DSP, solve numerical problems and write algorithms
CO3	understand theory of prediction and solution of normal equations
CO4	know applications of DSP at block level.
CO5	understand theory of adaptive filters and algorithms

Text Book (s)

1. Parhi, K.K., VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley (2007).

2. Oppenheim, A.V. and Schafer, R.W., Discrete-Time Signal Processing, Prentice Hall (2009) 2nd ed

Reference Book (s)

1. Mitra, S.K., Digital Signal Processing. A Computer Based Approach, McGraw Hill (2007)3rd ed.

2. Wanhammar, L., DSP Integrated Circuits, Academic Press (1999).*2005, ISBN: 978-0131543188.*

Course Content:

Unit-1	**Introduction to DSP Systems**	**8 hours**
Introduction to DSP Systems, Iteration bound, Data Flow graphs (DFGs) representation, Loop Bound, Iteration rate, Critical loop, Critical path, Area-Speed-Power trade-offs, Algorithms for computing iteration bound, Pipelining of FIR Digital Filters, Parallel Processing, Pipelining and Parallel Processing for low power		
Unit-2	**Algorithmic Transformations**	**8 hours**
Retiming Definitions and properties, Retiming Techniques, Clock period minimization, Unfolding, An algorithm for unfolding, Critical path, Applications of unfolding, Sample period reduction, Folding, Folding order, Folding Factor, register minimization techniques, register minimization in folded architecture, Forward Backward Register Allocation technique, folding of multi-rate systems, Folding Bi-quad filters, Retiming for folding.		
Unit-3	**Systolic Architecture Design and Fast Convolution**	**8 hours**
Introduction, system array design methodology, FIR systolic arrays, , Systolic Design for space representations containing delays Systolic architecture design methodology, Design examples of systolic architectures, selection of scheduling vector, matrix-matrix multiplication and 2-D systolic array design, Hardware Utilization efficiency, Cook-Toom Algorithm, Wniograd Algorithm, Iterated Convolution, Cyclic Convolution, Design of fast convolution algorithm by inspection.		
Unit-4	**Algorithm Strength Reduction in filter**	**8 hours**
Introduction, Parallel FIR filters, Polyphase decomposition, Discrete Cosine Transform and Inverse Discrete Cosine Transform, parallel architectures for Rank Order filters.		
Unit-5	**Pipelined and Parallel Recursive and Adaptive Filters**	**8 hours**

Introduction, pipelining in 1st order IIR digital filters, pipelining in higher order IIR digital filters, parallel processing for IIR filters, combined pipelining and parallel processing for IIR filters, low power IIR Filter Design using pipelining and parallel processing, pipelined adaptive digital filters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	VLSI Testing and Fault Tolerance			
Course Code	MVLS5008			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:. This course deals with basics of testing and fault diagnosis in IC design. The combinational and sequential circuits are tested with various test patterns. Self checking circuits and algorithms are also discussed.

Course Outcomes

CO1	Understand various testing techniques.
CO2	Various physical faults and their modelling
CO3	Various self test circuits and test algorithms
CO4	Know fault diagnosis methods for combinational and sequential circuits
CO5	Verify increasingly complex designs more efficiently and effectively.

Course Content:

Unit-1	Physical Fault Modeling And Basics Of Testing	8 hours
Physical Faults and their modelling, Stuck at Faults, Bridging Faults, Fault collapsing, Fault Simulation, Deductive, Parallel, and Concurrent Fault Simulation, Introduction to Testing		
Unit-2	Test Generation For Combinational And Sequential Circuits	8 hours
Deterministic and Weighted Random Test Pattern Generation, Test generation for combinational logic circuits, Testable combinational logic circuit design, Test generation for sequential circuits, design of testable sequential circuits.		
Unit-3	Design For Testability	8 hours
Design for Testability, Ad-hoc design, Generic scan based design, Classical scan based design ,System level DFT approaches, Time Frame Expansion, Controllability and Observability Scan Design, Boundary Scan for Board Level Testing		
Unit-4	Self Test And Test Algorithms	8 hours
Built-In Self Test and Totally Self checking circuits, Test pattern generation for BIST , Circular BIST, BIST Architectures, Testable Memory Design -Permanent, Intermittent and Pattern Sensitive Faults, Marching Tests, Test algorithms , Test generation for Embedded RAMs.		
Unit-5	Fault Diagnosis	8 hours
Logic Level Diagnosis, Diagnosis by UUT reduction, Fault Diagnosis for Combinational Circuits , Self-checking design, System Level Diagnosis, Concept of Redundancy, Spatial Redundancy, Time Redundancy, Error Correction Codes, Reconfiguration Techniques, Yield Modelling, Reliability and effective area utilization.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	ASIC Design and FPGA				
Course Code	MVLS5009				
Prerequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:. This course deals with the concepts of ASIC design, ASIC Construction and design using Xilinx

Course Outcomes

CO1	Define the basic concepts of ASIC design and Verilog HDL
CO2	Express the details of programmable ASICs and FPGAs technologies from ACTEL, ALTERA and XILINX
CO3	Practice writing the Dataflow and Behavioral models of digital circuits for simulation and synthesis using ASICs and FPGAs
CO4	Testing and Verification of Register Transfer Level (RTL) models of Digital Circuits using ASICs and FPGAs.
CO5	Simulate and Synthesize using Xilinx family FPGA

Text Book (s):

1. M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison -Wesley Longman Inc., 1997
2. R. B. Reese, M A Thornton, “Introduction to Logic Syntehsis Using Verilog HDL,” Morgan & Claypool Publishers, 2006

Reference Book (s)

1. Skahill, Kevin,” VHDL for Programmable Logic”, Addison-Wesley, 1996
2. John F. Wakherly, “ Digital Design: Principles and Practices”, 2nd Edn 1994, Prentice Hall International Edn
3. Charles W. Mckay, “Digital Circuits a proportion for microprocessors”, Prentice Hall International Edition.

Course Content:

Unit-1	Introduction To ASIC and HDL	8 hours
Introduction To ASICS, CMOS Logic And ASIC Library Design,Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort - Library cell design - Library architecture. **Review of VHDL/Verilog: Entities and architectures**		

Unit-2	**Programmable ASICS**	**8 hours**
Programmable Asics, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks		
Unit-3	**Programmable ASIC Interconnect & Software**	**8 hours**
Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX - Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation		
Unit-4	**ASIC Construction & FPGA partitioning**	**8 hours**
ASIC Construction, Floor Planning, Placement And Routing,System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing -circuit extraction - DRC.		
Unit-5	**Design using Xilinx**	**8 hours**
Design using Xilinx family FPGA		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Embedded Systems Design**			
Course Code	**MVLS6001**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

This course deals introduction to Embedded Computing, embedded Processors, RTOS Design and Simulation.

Course Outcomes

CO1	**understand the basic of Embedded System Design.**
CO2	**visualize the role of CISC & amp; RISC in processor operation.**
CO3	**differentiate between embedded processor and other general-purpose processors and how to use them in specific application**
CO4	**understand RTOS – basics and relevance in embedded system.**
CO5	**list Issues involved in embedded system design**

Text Book (s)

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers.
2. Jane.W.S. Liu, “Real-Time systems”, Pearson Education Asia.
3. Heath, S., Embedded Systems Design, Elsevier Science (2003).

Reference Book (s)

1. C. M. Krishna and K. G. Shin, “Real-Time Systems” , McGraw-Hill, 1997

2. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction" , John Wiley & Sons.
3. Fisher, J.A., Faraboschi, P. and Young, C., Embedded Computing - A VLIW
4. Approach to Architecture, Compilers and Tools, Morgan Kaufman (2005).

Course Content:

Unit-1	**Embedded Processing**	**8 hours**
Introduction to Embedded Computing, Difference between Embedded and General-Purpose Computing, Characterizing Embedded Computing, Design Philosophies, RISC, CISC, VLIW versus superscalar, VLIW versus DSP Processors, Role of the Compiler, Architectural structures, The data path, Registers and Clusters, Memory Architecture, Branch architecture, Speculation and prediction, Prediction in the embedded domain, Register File Design, Pipeline Design, the control unit, control registers		
Unit-2	**Embedded Processors**	**8 hours**
Embedded Computers, Characteristics of Embedded Computing Applications, and Challenges in Embedded Computing system design. ARM architecture, Embedded Cores, Soft and Hard Cores, Architecture of Configurable Microblaze soft core, Instruction set, Stacks and Subroutines, Microblaze Assembly Programming, Input-Output interfacing, GPIO, LCD interfacing, Peripherals, DDR Memory, SDRAM, Microblaze interrupts, Timers, Exceptions, Bus Interfacing, DMA, On-chip Peripheral bus (OPB), OPB Arbitration, OPB DMA		
Unit-3	**Networks**	**8 hours**
Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link supports, Ethernet, Myrinet, Internet, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.		
Unit-4	**RTOS and Application Design**	**8 hours**
Programming embedded systems in assembly and C – Meeting real time constraints –Multi-state systems and function sequences. Embedded software development tools –Emulators and debuggers. Embedded Matlab, Embedded JAVA, Embedded C extensions, Real time operating systems, Embedded RTOS, Real time process scheduling, structure of real time operating system, Memory management in Embedded operating system. File systems in Embedded devices, Different types of locks, Semaphores, Application studies with Vxworks, Montavista Linux etc.		
Unit-5	**System Design Techniques and Simulation**	**8 hours**
Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance. System-on-a-Chip (SoC), IP Blocks and Design Reuse, Processor Cores and SoC, Non-programmable accelerators, reconfigurable logic, multiprocessing on a chip, symmetric multiprocessing, heterogeneous multiprocessing, use of simulators, Compilers, Loaders, Linkers, locators, assemblers, Libraries, post run optimizer, debuggers, profiling techniques, binary utilities, linker script, system simulation.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Advanced VLSI Technology			
Course Code	MVLS5003			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:.

A course in VLSI semiconductor devices, to give knowledge about modern CMOS technology, crystal growth, fabrication, and basic properties of silicon wafers. It will focus on lithography, thermal oxidation, (Si/Si)2, interface, dopant diffusion, ion implantation, thin film deposition, etching, and back-end technology

Course Outcomes

CO1	Understand various IC fabrication techniques.
CO2	Have knowledge of fabrication of various semiconductor components.
CO3	Understand fundamentals of different deposition techniques for thin film deposition.
CO4	Learn basics of lithography and application of different lithographic technologies in IC fabrication processes.
CO5	Understand etching and metallization process and its significance in IC fabrication process.

Text Book (s)

1. W. Wolf, "Modern VLSI design", 4th Edition, PHI Learning, 2009, ISBN 9788120338241.
2. S.M.Sze, "VLSI technology", 2nd Edition, Tata Mc Graw Hill Education, 2003, ISBN 9780070582910

Reference Book (s)

1. Douglas Pucknell, "Basic VLSI design", 3rd Edition, PHI Learning, 2011, ISBN 9788120309869

Course Content:

Unit-1	IC Fabrication Technologies	8 hours
Process steps in IC fabrication Crystal growth and wafer preparation- Czochralski process-apparatus- silicon shaping, slicing and polishing- Diffusion of impurities- physical mechanism- Fick's I and II law of diffusion- Diffusion profiles- complementary (erfc) error function- Gaussian profile- Ion implantation- Annealing process- Oxidation process- Lithography- Photolithography, Fine line lithography, electron beam and x-ray lithography- Chemical vapour deposition- epitaxial growth- reactors- metallisation- patterning- wire bonding and packaging – Comparison.		
Unit-2	Fabrication of Semiconductor Devices	8 hours
Monolithic components Isolation of components- junction isolation and dielectric isolation- Transistor fabrication- buried layer- impurity profile- parasitic effects- monolithic diodes- schottky diodes and transistors- FET structures- JFET- MOSFET- PMOS and NMOS, control of threshold voltage (Vth)- silicon gate technology- Monolithic resistors- sheet resistance and resistor design- resistors in diffused regions- MOS resistors- monolithic capacitors- junction and MOS structures- IC crossovers and vias		
Unit-3	CMOS Technology	8 hours
CMOS technology Metal gate and silicon gate- oxide isolation- Twin well process- Latch up- BiCMOS technology- fabrication steps- circuit design process- stick diagrams- design rules- Capacitance of layers- Delay- Driving large capacitance loads- Wiring capacitance- Basic circuit concepts- scaling of MOS structures- scaling factors- effects of miniaturization.		
Unit-4	CMOS Logic Systems	8 hours

Subsystem design and layout- Simple logic circuits- inverter, NAND gates, BiCMOS circuit, NOR gates, CMOS logic systems – bus lines- arrangements- power dissipation- power supply rail distribution- subsystem design process- design of a 4 bit and 8 bit shifter.		
Unit-5	**GaAs Fabrication**	**8 hours**
Gallium Arsenide Technology Sub-micro CMOS technology- Crystal structure- Doping process- Channeling effect- MESFET- GaAs fabrication- Device modeling.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**MOS Device Modelling**			
Course Code	**MVLS5005**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

This course deals with fundamentals of semiconductor devices, which are undergraduate level, will be reviewed and distributed-constant circuit models will be also provided. Then, in-depth modeling of MOS transistors will be introduced using the textbook. This helps you design VLSIs using the deep sub-micron CMOS in the near future

Course Outcomes

CO1	**Explain basic concept of semiconductor devices**
CO2	**Design CMOS VLSI chips**
CO3	**model, analyze and design different types of MOS devices**
CO4	**Learn Parameter Measurement**
CO5	**Forecast the future direction of VLSI technologies**

Text Book (s)

1. Tsividis, Y., “Operation and Modeling of the MOS Transistor”, 2nd ed.,Oxford University Press, 2008.
2. Sze, S.M., “Physics of Semiconductor Devices”, John Wiley, 2008.

Reference Book (s)

1. Muller, R.S., Kamins, “T.I., and Chan, M., Device Electronics for Integrated Circuits”, 3rd ed., John Wiley, 2007.
2. Taur, Y. and Ning, T.H., “Fundamentals of Modern VLSI Devices”, Cambridge University Press, 2009.

Course Content:

Unit-1	**Semiconductor and Quantum Mechanics Fundamentals**	**8 hours**
Poisson and Continuity Equations, Recombination, Equilibrium carrier concentrations electron statistics, density of states, effective mass, bandgap narrowing), Review of PN and MS diodes. Basic Quantum Mechanics, Crystal symmetry and band structure, 2D/1D density of states, Tunneling		
Unit-2	**Modeling and Simulation of Carrier Transport and MOS Capacitors**	**8 hours**
Carrier Scattering (impurity, phonon, carriercarrier, remote/interface), Boltzmann Transport Equation, Drift-diffusion. Modes of operation (accumulation, depletion,		

strong/weak inversion), Capacitance versus voltage, Gated diode, Non-ideal effects (poly depletion, surface charges), High field effects (tunneling, breakdown).		
Unit-3	**MOSFET Modeling**	**8 hours**
Introduction Interior Layer, MOS Transistor Current, Threshold Voltage, Temperature Short Channel and Narrow Width Effect, Models for Enhancement, Depletion Type MOSFET, CMOS Models in SPICE, Long Channel MOSFET Devices, Short Channel MOSFET Devices.		
Unit-4	**Parameter Measurement**	**8 hours**
General Methods, Specific Bipolar Measurement, Depletion Capacitance, Series Resistances, Early Effect, Gummel Plots, MOSFET: Long and Short Channel Parameters, Statistical Modeling of Bipolar and MOS Transistors.		
Unit-5	**Advanced Device Technology**	**8 hours**
SOI, SiGe, strained Si, Alternative oxide/gate materials, Alternative geometries (raised source/drain, dual gate, vertical, FinFET), Memory Devices (DRAM, Flash). Sub-micron and Deep sub-micron Device Modeling.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Advanced Digital VLSI Design**			
Course Code	**MVLS5010**			
Prerequisite				
	L	**T**	**P**	**C**

Course Objectives:.

This course deals with the concepts of MOS transistor, Modelling of MOS transistor, CMOS, Latches and Registers.

Course Outcomes

CO1	**understand the concepts of MOS devices**
CO2	**model MOS transistor**
CO3	**Design latches and registers**
CO4	**Design data paths**
CO5	**Understand memory control elements**

Text Book (s):

1. Jan.M.Rabaey., Anitha Chandrakasan Borivoje Nikolic, "Digital Integrated Circuits", Second Edition
2. Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Addition Wesley, 1998

Reference Book (s):

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital IC- Analysis and Design", 3rd Edition, Tata McGraw Hill publication

Course Content:

Unit-1	**MOS Transistor**	**8 hours**
MOS Transistor-Introduction to MOS device, MOS Transistor under static conditions-threshold voltage-Resistive operation-saturation region -channel length modulation-velocity saturation-Hot carrier effect-drain current Vs voltage charts - sub threshold conduction - equivalent resistance-MOS structure capacitance-Design A logic sates using NMOS and PMOS and CMOS devices-Stick Diagram.		
Unit-2	**Modelling of MOS Transistor**	**8 hours**
Modeling of MOS Transistor using PSPICE-Introduction - Basic Concepts-LEVEL1-LEVEL2-LEVEL3 modeling technique-various model comparison. Static CMOS inverter-Evaluating the Robustness of CMOS Inverter. Performance of CMOS inverter: Dynamic Behavior-computing the capacitance-propagation delay sizing inverter for performance-sizing a chain of invertors - Dynamic power consumption-static consumption		
Unit-3	**CMOS**	**8 hours**
Static CMOS design-complementary CMOS - static properties- complementary CMOS design-Power consumption in CMOS logic gates-dynamic or glitching transitions - Design techniques to reduce switching activity - Radioed logic-DC VSL - pass transistor logic - Differential pass transistor logic -Sizing of level restorer-Sizing in pass transistor-Dynamic CMOS design-Basic principles - Domino logic-optimization of Domino logic-NPCMOS-logic style selection -Designing logic for reduced supply voltages		
Unit-4	**Latches & Registers**	**8 hours**
Timing metrics for sequential circuit -latches Vs registers -static latches and registers - Bistability principle - multiplexer based latches-master slave edge triggered registers- non-ideal clock signals-low voltage static latches-static SR flip flop - Dynamic latches and registers-C2MOS register - Dual edge registers-True single phase clocked registers-pipelining to optimize sequential circuit latch Vs register based pipelines-non-Bistable sequential circuit-Schmitt trigger-mono stable -Astable -sequential circuit - choosing a clocking strategy.		
Unit-5	**Data Path Operations**	**8 hours**
Data Path Operations Addition/Subtraction - Comparators- Zero/One Detectors- Binary Counters- ALUs- Multiplication- Shifters- Memory elements- control : Finite-State Machines.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Low power VLSI Design**			
Course Code	**MVLS5011**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:. This course deals with issues and models to design low-power VLSI circuits, fundamentals of power dissipation in microelectronic devices, will be able to estimate power dissipation due to switching, short circuit.

Course Outcomes

CO1	**analyze and design low-power VLSI circuits using different circuit technologies and design levels.**
CO2	**design chips used for battery-powered systems**

CO3	**design high-performance circuits not exceeding power limits**
CO4	**Design and test of low-voltage CMOS circuits.**
CO5	**Learn architecture level estimation and synthesis**

Text Book (s)

1. Roy, K. and Prasad, Sharat C., "Low Power CMOS VLSI: Circuit Design" , John Wiley, 2009.

2. Chandrakasan, A.P. and Broderson, R.W., "Low Power Digital CMOS Design", Kluwer, 1995.

Reference Book (s)

1. Rabaey, J.M. and Pedram, M., " Low Power Design Methodologies", Springer 1996.

2. Yeo, K.S. and Roy K., Low Voltage, "Low Power VLSI Subsystems", McGraw Hill, 2004.

3. Sanchez-Sinencio, E. and Andreou, A.G., " Low-Voltage/Low-Power Integrated

Course Content:

Unit-1	**Low Power Microelectronics**	**8 hours**
Retrospect and Prospect, Fundamentals of power dissipation in microelectronic devices, Estimation of power dissipation due to switching, short circuit, subthreshold leakage, and diode leakage currents.		
Unit-2	**Device & Technology Impact on Low Power**	**8 hours**
Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.		
Unit-3	**Simulation Power and Probabilistic power analysis**	**8 hours**
SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems. Monte Carlo simulation. Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.		
Unit-4	**Low Voltage Technologies and Circuits**	**8 hours**
Threshold Voltage Scaling and Control, Multiple Threshold CMOS (MTCMOS), Substrate Bias Controlled Variable Threshold CMOS, Testing Issues: Design and test of low-voltage CMOS circuits.		
Unit-5	**Algorithm and architectural level methodologies**	**8 hours**
Introduction, design flow, algorithmic level analysis and optimization, Architectural level estimation and synthesis.		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**Sensor Technology and MEMS**			
Course Code	**MVLS5014**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Description:

This course deals with study of different Sensors and MEMS technology

Course Outcomes

CO1	**Understand working of sensors**
CO2	**know microsystems and MEMES**
CO3	**Know materials used for MEMS**
CO4	**Understand fabrication process**
CO5	**Know design process of microsystem**

Text Book (s):

1. Integrated Sensors, Microp-actuators and micro-systems (MEMS): K.D. (Guest Editor) , Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998

2. RF MEMS: Theory, Design, and Technology: Gabriel M. Rebeiz, Wiley, 2003.

Reference Book (s)

1. Fundamentals of Microfabrication : Marc Madou, CRC Press, 1997.

Course Content:

Unit-1	**Overview of Sensors**	**8 hours**
Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples : Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors, Case study on strain sensors, Temperature sensors, Pressure sensors, Humidity sensors, Accelerometers, Gyroscopes , RF MEMS Switch, phase shifter, and smart sensors.		
Unit-2	**Microsystems**	**8 hours**
MEMS and Microsystems, Microsystems and microelectronics, Microsystems and miniaturization, Working principle of micro system, Micro sensors, Micro actuators, MEMS with Micro actuators		
Unit-3	**Materials For MEMS**	**8 hours**
Substrate and wafer, silicon as a substrate material, silicon compound, silicon Piezo-resistors, Gallium Arsenide, quartz, Piezoelectric crystals, polymers and packaging Materials.		
Unit-4	**Fabrication Process**	**8 hours**
Photolithography, Ion implantation, Oxidation, Chemical vapor deposition (CVD), Physical vapor deposition, Deposition by Epitaxy, Etching.Manufacturing Process - Bulk Micromachining, Surface Micromachining, LIGA Process		
Unit-5	**Micro system Design**	**8 hours**
Design consideration, process design, Mechanical design, Mechanical design using MEMS. Mechanical packaging of Microsystems, Microsystems packaging, interfacing in Microsystems packaging, packaging technology, selection of packaging materials, signal mapping and transduction. MEMS for RF Applications: Need for RF MEMS components in communications, space and defense applications		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**Nano-Electronics**
Course Code	**MVLS5015**
Prerequisite	

L	**T**	**P**	**C**
3	**0**	**0**	**3**

Course Objectives:.

1.Understand the fundamental forces controlling the dynamic and static response of materials at the Nano-scale.
2. To have comprehensive understanding of state-of-the-art Nano-fabrication methods.
3. To have knowledge of processing conditions to functional nanomaterials.
4. To scalable system for the continuous production of nanomaterials.
5. To understand the state-of-the-art characterization methods for nanomaterials.

Course Outcomes

CO1	**Understand the fundamental forces controlling the dynamic and static response of materials at the Nano-scale..**
CO2	**To demonstrate a comprehensive understanding of state-of-the-art Nano-fabrication method**
CO3	**To determine and evaluate processing conditions to functional nanomaterials.**
CO4	**Design and analyse scalable system for the continuous production of nanomaterials.**
CO5	**Understand the state-of-the-art characterization methods for nanomaterials.**

Text Book (s):

1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, Jan Dienstuhl.

Reference Book (s)

1. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003
2. Microfabrication by Marc Madaon, CRC Press

Course Content:

Unit-1	**Introduction to nanoelectronics**	
Recent past, the present and its challenges, Future, Overview of basic Nanoelectronics, Physics of solid state, Structure - Energy band - Quantum mechanics.		
Unit-2	**Fundamentals of Nanoelectronics**	**8 hours**
Fundamentals of logic devices:- Requirements, dynamic properties, threshold gates, physical limits to computations, concepts of logic devices:- classifications , two terminal devices, field effect devices, coulomb blockade devices, spintronics , quantum cellular automata – quantum computing ; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons, performance estimation for the human brain. Ultimate computation:- power dissipation limit – dissipation in reversible computation – the ultimate computer.		
Unit-3	**Molecular Electronics Components**	**8 hours**
Characterization of switches and complex molecular devices, polyphenylene based Molecular rectifying diode switches. Technologies, Single Electron Devices, Quantum Mechanical Tunnel Devices, Quantum Dots & Quantum wires.		
Unit-4	**Nanocomputers**	**8 hours**
Nanoelectronic & Nanocomputer architectures and nanotechnology: Introduction to nanoelectronic and nanocomputers, Quantum DOT cellular Automata (QCA), Single electron circuits, molecular circuits Nanocomputer Architecture.		
Unit-5	**Silicon MOSFETs & Quantum Transport Devices**	**8 hours**
Silicon MOSFETS - Novel materials and alternate concepts:- fundamentals of MOSFET Devices, scaling rules, silicon-dioxide based gate dielectrics, metal gates, junctions & contacts, advanced MOSFET concepts, Quantum transport devices based on resonant tunneling:-		

Electron tunneling, resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applications:- Single electron devices – applications of single electron devices to logic circuits.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Design of Semiconductor Memories			
Course Code	MVLS5016			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:.

1. Comprehend the concept of memory structures, reliability and radiation effects.
2. Have a knowledge on Memory fault modelling, Testing and design for fault tolerance.

Course Outcomes

CO1	Select architecture and design semiconductor memory circuits and subsystems.
CO2	Know non-volatile memory architecture
CO3	Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
CO4	Understand reliability issues and RAM failures
CO5	Know about packaging technologies of memory

Text Book (s)

1. Ashok K. Sharma, “Semiconductor Memories Technology, Testing and Reliability”, Prentice-Hall of india Private Limited, New Delhi, 1997.
2. Tegze P. Haraszti,” CMOS Memory Circuits”, Kluwer Academic Publishers, 2001

Reference Book (s)

1. Betty Prince, “Emerging Memories: Technologies and Trends”, Kluwer academic publishers, 2002
2. Kiyoo Itoh, “VLSI memory chip design”, Springer International Edition

Course Content:

Unit-1	RAM Technologies	8 Hours
Static Random Access Memories: SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar SRAM Technologies- SOI Technology-Advanced SRAM Architectures and Technologies-Application Specific SRAM- Dynamic Random Access Memories: DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures -BiCMOS, DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application, Specific DRAMs.		
Unit-2	Nonvolatile Memories	8 hours

Masked Read-Only Memories (ROMs)-High Density ROMs-PROMs-Bipolar PROMs-CMOS, PROMs-Erasable (UV) - EPROM-Floating-GateEPROM Cell-One-Time Programmable (OTP) EPROMs-EEPROM-EEPROM Technology And Arcitecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture		
Unit-3	**Memory Fault Modelling, Testing and design for Fault Tolerance**	**8 hours**
RAM Fault Modeling, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing- Application Specific Memory Testing		
Unit-4	**Reliability and Radiation Effects**	**8 hours**
General Reliability Issues-RAM Failure Modes and Mechanism-Nonvolatile Memory Reliability-Reliability Modeling and Failure Rate Prediction-Design for Reliability-Reliability Test Structures-Reliability Screening and Qualification. RAM Fault Modeling, Electrical Testing, Psuedo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing-Application Specific Memory Testing.		
Unit-5	**Packaging Technologies**	**8 hours**
Radiation Effects-Single Event Phenomenon (SEP)-Radiation Hardening Techniques-Radiation Hardening Process and Design Issues-Radiation Hardened Memory Characteristics-Radiation Hardness Assurance and Testing - Radiation Dosimetry-Water Level Radiation Testing and Test Structures. Ferroelectric Random Access Memories (FRAMs)-Gallium Arsenide (GaAs) FRAMs-Analog Memories-Magnetoresistive. Random Access Memories (MRAMs) -Experimental Memory Devices. Memory Hybrids and MCMs (2D)-Memory Stacks and MCMs (3D)-Memory MCM Testing and Reliability Issues-Memory Cards-High Density Memory Packaging Future Directions.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Advanced Analog VLSI Design**			
Course Code	**MVLS5017**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

1. Recognize transistor amplifiers.
2. Design multistage MOS amplifiers.

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Course Outcomes

CO1	**demonstrate the use of analog circuit analysis techniques to analyze the operation and behavior of various analog integrated circuits.**
CO2	**demonstrate their knowledge by designing analog circuits.**
CO3	**compute the gain, power, and bandwidth of analog circuits.**
CO4	**Understand the concept of different parameters like gain, power, and bandwidth.**
CO5	**understand the Switched capacitor circuits and data converters.**

Text Book (s)

1. Paul B Gray and Robert G Meyer, "Analysis and Design of Analog Integrated Circuits".

2. D. A. Johns and Martin, Analog Integrated Circuit Design, John Wiley, 1997.

Reference Book (s)

1. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.

2.R L Geiger, P E Allen and N R Strader, VLSI Design Techniques for Analog & Digital Circuits, McGraw Hill, 1990.

Course Content:

Unit-1	**MOS & BJT Transistor Amplifiers**	**8 hours**
Single transistor Amplifiers stages: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers Multiple Transistor Amplifier stages: CC-CE, CC-CC, & Darlington configuration, Cascode configuration, Active Cascode. Differential Amplifiers: Differential pair & DC transfer characteristics.		
Unit-2	**Current Mirrors, Active Loads & References**	**8 hours**
Current Mirrors: Simple current mirror, Cascode current mirrors Widlar current mirror, Wilson Current mirror, etc. Active loads, Voltage & current references. Analysis of Differential Amplifier with active load, supply and temperature independent biasing techniques, Frequency Response,		
Unit-3	**Operational Amplifier**	**8 hours**
Applications of operational Amplifier, theory and Design; Definition of Performance Characteristics; Design of two stage MOS Operational Amplifier, two stage MOS operational Amplifier with cascodes, MOS telescopic-cascode operational amplifiers,MOS Folded-cascode operational amplifiers, Bipolar operational amplifiers. Frequency response & compensation..		
Unit-4	**Nonlinear Analog Circuits**	**8 hours**
Analysis of four quadrant and variable Tran conductance multiplier, Voltage controlled oscillator, Comparators, Analog Buffers, Source Follower and Other Structures. Phase Locked Techniques; Phase Locked Loops (PLL), closed loop analysis of PLL. Digital-to-Analog (D/A) and Analog-to-Digital (A/D) Converters		
Unit-5	**OTA & Switched Capacitor filters**	**8 hours**
OTA Amplifiers. Switched Capacitor Circuits and Switched Capacitor Filters.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Physical Design Automation**			
Course Code	**MVLS6002**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

1. Learn automation process used in VLSI system design

2. Understand various physical design CAD tools and designing algorithm.

Course Outcomes

CO1	**know automation process for VLSI System design.**
CO2	**Understanding of fundamentals for various physical design CAD tools.**
CO3	**Know floor-planning and PIN assignment**
CO4	**Learn to implement different routing algorithms**
CO5	**Develop and enhance the existing algorithms and computational techniques for physical automation**

Text Book (s)

1. Sung Kyu Lim, Practical Problems for VLSI Physical Design Automation, Springer Publications
2. Majid Sarrafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, McGraw Hill, 1996

Reference Book (s)

1.Computer Aided Logical Design with Emphasis on VLSI – Hill & Peterson, Wiley,1993.

2. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Springer Publications.
3. Modern VLSI Design: Systems on silicon – Wayne Wolf, Pearson Education Asia, 2nd

Unit-1	**Data Structures and Basic Algorithms**	**8 hours**
Basic Terminology, Complexity Issues and NP-hardness, Basic Algorithms, Basic Data Structures, Graph Algorithms for Physical design.		
Unit-2	**Partitioning**	**8 hours**
Problem Formulation, Classification of Partitioning Algorithms, Group Migration Algorithms, Simulated Annealing and Evolution, Other Partitioning Algorithms. Performance Driven Partitioning		
Unit-3	**Floorplanning and Pin Assignment**	**8 hours**
Floorplanning, Chip planning, Pin Assignment. Global Routing: Problem Formulation, Classification of Global Routing, Maze Routing Algorithms, Line-Probe Algorithms, Shortest Path Based Algorithms, Steiner Tree based Algorithms Integer Programming Based Approach, Performance Driven Routing.		
Unit-4	**Detailed Routing**	**8 hours**
Problem Formulation, Classification of Routing Algorithms, Single-Layer Routing Algorithms, Two-Layer Channel Routing Algorithms, Three-Layer Channel Routing Algorithms, Multi-Layer Channel Routing Algorithms, Switchbox Routing Algorithms		
Unit-5	**Over-the-Cell Routing and Via Minimization**	**8 hours**
Over-the-cell Routing, Via Minimization. Clock and Power Routing: Clock Routing, Power and Ground Routing. Compaction: Problem Formulation, Classification of Compaction Algorithms, One-Dimensional Compaction, Two-Dimensional Compaction		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	System-on-Chip Design			
Course Code	MVLS6003			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:.

1. Apply concepts of semiconductor devices to design and analyze circuits.
2. To prepare students to know the characteristics of different semiconductor devices.
3. Apply fundamentals of semiconductor devices in electronics projects in circuit design, evaluation and analysis.
4. Explain the fundamental principles necessary for the analysis and design of analog integrated circuits at transistor level.

Course Outcomes

CO1	**Define the hardware and software structures used to implement and model inter-component communication in System on Chip.**
CO2	**Describe the details of subsystem components like Adders, Multipliers and ALUs etc.**
CO3	**Practice writing the Behavioral models of digital circuits for simulation and synthesis using SystemC, including transactional modelling.**
CO4	**Learn Testing and Verification of system level designs using SystemC.**
CO5	**Simulate and Synthesize using SystemC.**

Text Book (s)

1. Wolf, W., “Modern VLSI Design: System-on-chip Design”, 3rd ed., Prentice Hall 2002.
2. Lin, S. Y.L., “Essential Issues in SOC Design: Designing Complex Systems-On-Chip”, Springer ,2006.
3. D. Black, J. Donovan, B. Bunton, A. Keist, “SystemC: From the Ground Up”, Second Edition, Springer, 2010.

Reference Book (s)

1. Asheden, P.J. and Mermet J., “System-on-Chip Methodologies and Design Languages”, Kluwer Academic, 2002.
2. Erbas, C., “System-Level Modelling and Design Space Exploration for Multiprocessor Embedded System-on-Chip Architectures”, Amsterdam University Press, 2007.

Course Content:

Unit-1	**Introduction to SOC Design/Overview**	**8 hours**
Introduction, Integrated Circuit Manufacturing, CMOS Technology, Integrated Circuit Design Techniques, Fabrication Processes, Transistors, Wires and Vias, Design Rules Layout Design and Tools		
Unit-2	**SoC Architecture Design**	**8 hours**
Introduction, Front-end chip design, Back-end chip design, Integration platforms and SoC Design, Function Architecture Co-design, Designing Communication Networks, System Level Power Estimation and Modeling, Transaction Level Modeling, Design Space Exploration, Software design in SoCs.		
Unit-3	**Basic SoC Subsystem Design**	**8 hours**

Introduction. Subsystem Design Principles. Combinational Shifters. Adders. ALUs. Multipliers. High-Density Memory. Field-Programmable Gate Arrays. Programmable Logic Arrays.		
Unit-4	**High level HDL for SoC Design- SystemC**	**8 hours**
Introduction of SystemC, Transaction-Level Modeling (TLM) and Electronic System-Level (ESL) languages, SystemC Class Concepts for Hardware, Overview of SystemC Components.		
Unit-5	**SoC Design and Test Optimization**	**8 hours**
Design methodologies for SoC, Noise and signal integrity analysis, System Integration issues for SoC, SoC Test Scheduling and Test Integration, SoC Test Resource partition.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Reconfigurable Computing**			
Course Code	**MVLS5018**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

Understand concept of Reconfigurable Computing and their applications

Course Outcomes

CO1	**Understand parallelism and pipelining concepts, the design aspects and challenges.**
CO2	**Evaluate the issues in vector and array processors.**
CO3	**Study and analyze the high performance scalable multithreaded and multiprocessor**
CO4	**Know Reconfigurable Design**
CO5	**know Reconfigurable Devices application**

Text Book (s)

1 C. Maxfield, The Design Warrior's Guide to FPGAs, Newnes, 2004, ISBN: 978-0750676045

2 M. Gokhale and P. Graham, Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays, Springer, 2005, ISBN: 978-0-387-26105-8.

3 C. Bobda, Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications, Springer, 2007, ISBN: 978-1402060885.

Reference Book (s)

1. P. Lysaght and W. Rosenstiel (eds.), New Algorithms, Architectures and Applications for Reconfigurable Computing, Springer, 2005, ISBN: 978-1402031274.

2. D. Pellerin and S. Thibault, Practical FPGA Programming in C, Prentice-Hall, 2005, ISBN: 978-0131543188.

3. W. Wolf, FPGA-based System Design, Prentice-Hall, 2004, ISBN: 0-13-142461-0.

4. R. Cofer and B. Harding, Rapid System Prototyping with FPGAs: Accelerating the Design Process, Newnes, 2005, ISBN: 978-0750678667.

Course Content:

Unit-1	**Introduction of RC**	**8 hours**
Reconfigurable Computing Basics, Reconfigurable Computing Hardware Components, Custom Computing, Machine Overview, Comparison of Computing Machines, Interconnects, Delays in VLSI Structures, control path and data path, logic minimization.		
Unit-2	**FPGA Architectures**	**8 hours**
Introduction, Technology-independent optimization, FPGA Mapping, FPGA Partitioning and Placement, Routing, Computing Elements, LUT's, LUT Mapping, ALU and CLB's, Retiming, Multi-FPGA Partitioning, Logic Emulation, Power Reduction Techniques for FPGAs.		
Unit-3	**RC Architectures**	**8 hours**
Device characteristics, The Systolic Model, Fine-grained architecture, Coarse-grained architecture, Comparison of different architectures, Function-Unit Architectures, Logic Emulation Architectures, Programming Reconfigurable Computers, Logic Cell and Data path Mapping, Hardware/Software Co-design, Systolic Loop Transformations, Software Pipelining, MATRIX and RaPiD, Module Generators.		
Unit-4	**Reconfigurable Design**	**8 hours**
Temporal portioning algorithms, Online temporal placement, Device space management, Binding Time and Programming Styles, Overheads, Data Density, Data BW, Function density, Function diversity, Interconnect methods, Contexts, Context switching; Area calculations for PE; Efficiency, ISP, Hot Reconfiguration, Partial reconfigurable design and Dynamic Reconfiguration design.		
Unit-5	**RC Applications**	**8 hours**
Reconfigurable Coprocessors, Reconfigurable Memory Security, Reconfigurable Weather Radar Data Processing, Dynamically Reconfigurable Adaptive Viterbi Decoder, High Speed Data Acquisition System for Space Applications.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Packaging and Interconnect Analysis**			
Course Code	**MVLS6005**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:. Analysis and design for high-performance interconnects at both IC and packaging levels, including interconnect modeling, delay modeling for devices and interconnects, timing-driven placement, interconnect topology construction, buffer insertion, device and wire sizing, clock network design, thermal modeling, analysis, and thermal-based placement

Course Outcomes

CO1	**understand problems in modeling and design of high-performance VLSI**
CO2	**Learn delay calculations**
CO3	**Optimize interconnection and topology**
CO4	**Know clock design for interconnection**

CO5	**Demonstrate thermal modelling and analysis**

Text Book (s)

1. M. Celik, L. Pileggi, A. Odabasioglu, IC Interconnect Analysis, Kluwer Academic Publishers, 2002.

2. C. K. Cheng, J. Lillis, S. Lin, N. Chang, Interconnect Analysis and Synthesis, John Wiley & Sons, Inc. 2000.

Reference Book (s)

1.J. M. Rabaey, A. Chandrakasan, B. Nikoli´c, Digital Integrated Circuits A Design Perspective, Pearson Education, Inc. 2003

2. N. Menezes, L. Pileggi, Analyzing On-chip Interconnect Effects, Chapter 16 in Design of High-Performance Microprocessor Circuits, IEEE Press, 2001.

3. H. B. Bakoglu, Circuits, Interconnects, and Packaging for VLSI, Addison-Wesley Publishing Company, 1990

Course Content:

Unit-1	**Introduction**	**8 hours**
Introduction, Functions of an electronic packages, Brief history of electronic packaging, Packaging Hierarchy, Challenges of Interconnect Design, Modeling of VLSI Interconnects, Laplace transform, Elmore delay model, Moment Computation, Asymptotic waveform evaluation, Pade via Lanczos and transmission line modeling.		
Unit-2	**Delay Calculation**	**8 hours**
Delay calculating: Devices modeling, R(L)C Delay Calculation. Overview of Layout Design, and Optimization Techniques. Delay Budgeting, Net-based Timing-driven Placement, and Path-base Timing-driven Placement.		
Unit-3	**Device , Topology and Interconnect Optimization**	**8 hours**
Transistor Ordering, Device Sizing, and Buffer Insertion. Topology Optimization: Wirelength Minimization, Pathlength Minimization, and Delay Minimization. Interconnect Sizing: Local Refinement-based, Dynamic Programming-based, Sensitivity-based, and Mathematical Programming. Simultaneous Device and Interconnect Sizing, Simultaneous Topology Construction, Buffer Insertion, Buffer Sizing, and Interconnect Sizing.		
Unit-4	**Clock Design and Noise Modeling**	**8 hours**
Clock Network Design: Zero-Skew, Bounded-Skew, Buffer and Wire Optimization, Non-Tree Routing, and Clock Schedule. Noise Modeling, Avoiding and Control: Simultaneous Switching Noise, Reflection Noise, Coupling Noise, Power/Ground Design, Topology Selection, Optimal Termination, Track Permutation, Layer Assignment, Buffer Insertion, and Interconnect Sizing and Spacing		
Unit-5	**Thermal Modeling and Analysis**	**8 hours**
Thermal Modeling, Analysis, and Thermal-aware Design: Compact Thermal Modeling, Electro-thermal Simulation, Thermal Characterization of Stacked Dies, and Thermal Based Placement		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	EMI and EMC in System Design			
Course Code	MVLS6006			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:.

Understand basics of electro-magnetic Interference and describes the concepts of its effects in system designing. The EMI measurements, EMI Control methods and Standards

Course Outcomes

CO1	Understand basic concept of electro-magnetic Interference.
CO2	Know methods for EMI measurements
CO3	Learn EMC standards and regulations
CO4	Understands control methods and fixes
CO5	Design EMC and interconnection

Course Content:

Unit-1	Basic Concepts	8 hours
History and concept of EMI, Definition of EMI and EMC with examples, Classification of EMI/EMC, Units of Parameters, Sources of EMI, EMI coupling modes, ESD Phenomena and effects, Transient phenomena and suppression, Electro magnetic environment, Practical experiences and concerns, frequency spectrum conservations, mechanisms of EMI generation, EMI testing, Methods of elimination of EMI		
Unit-2	EMI Measurements	8 hours
Basic principles of RE, CE, RS and CS measurements, EMI measuring instruments- Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique open area site, shielded anechoic chamber, TEM cell, Natural and manmade sources of EMI/EMC: Sources of Electromagnetic noise, typical noise paths, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electro magnetic pulse (EMP).		
Unit-3	EMC Standard and Regulations	8 hours
National and International standardizing organizations- FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards, CISPR, CE and RE Standards, IEC/EN, CS standards, Frequency assignment - spectrum conversation, Components for EMC and EMC Standards: Choice of capacitors, inductors, transformers and resistors.		
Unit-4	EMI Control Methods and Fixes	8 hours
Grounding, Bonding, Filtering, EMI gasket, Isolation transformer, opto isolator, Shielding and Bonding: effectiveness of shielding, near and far fields / impedances, methods of analysis, total loss due to absorption and reflection effects, composite absorption and reflection losses for electric fields / magnetic fields, magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets, Electrical Bonding, Shape and Material for Bond straps.		
Unit-5	EMC Design and Interconnection Techniques	8 hours
Cable routing and connection, Component selection and mounting, PCB design- Trace routing, Impedance control, decoupling, Zoning and grounding, Grounding and Cabling: Safety and signal grounds, low and high frequency grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding, types of cables, mechanism of EMI emission / coupling in cables		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	DSP Architecture
Course Code	
Prerequisite	

	L	T	P	C
	3	0	0	3

Course Objectives:.

Identify and formalize architectural level characterization of P-DSP hardware

Ability to design, programming (assembly and C), and testing code using Code Composer

Studio environment

Deployment of DSP hardware for Control, Audio and Video Signal processing

applications

Understanding of major areas and challenges in DSP based embedded systems

Course Outcomes

CO1	**Understand the hardware and software structures used to implement digital signal processing.**
CO2	**Describe the details of Architectures For Programmable DSP Devices.**
CO3	**Describe Programmable Digital Signal Processors TMS320C54XX addressing modes, control unit and its operation.**
CO4	**Implement basic DSP algorithms like FIR and IIR digtal filters.**
CO5	**Describe interfacing of memory and input output peripherals to programmable DSP devices**

Text Book (s)

1. B Venkataramani and M Bhaskar “Digital Signal Processors”, TMH, 2002.
2. Peter Pirsch “Architectures for Digital Signal Processing”, John Weily, 2007.
3. Avatar Singh and S. Srinivasan, “Digital Signal Processing”, Thomson Learning, 2004

Reference Book (s)

1. Lars Wanhammer, “DSP Integrated Circuits”, 1999 Academic press, New York

2.A.V.Oppenheim et.al, “Discrete-time Signal Processing”, Pearson Education, 2000.

3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital signal processing – A practical approach”, Second Edition, Pearson Education, Asia.

4.Keshab K.Parhi, “VLSI Digital Signal Processing Systems design and Implementation”, John Wiley & Sons, 1999.

Course Content:

Unit-1	**Introduction to Digital Signal Processing**	**8 hours**

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Typical DSP Algorithms (Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Least Mean Square(LMS)). Representation of Signal Processing Algorithms, Signal-Flow, Data-Flow graphs, Digital Filters, Decimation and Interpolation, Analysis and Design Tool for DSP Systems.		
Unit-2	**Architectures For Programmable DSP Devices**	**8 hours**
Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.		
Unit-3	**Programmable Digital Signal Processors**	**8 hours**
Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs,Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.		
Unit-4	**Implementation Of Basic DSP Algorithms**	**8 hours**
The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, PID Controller, Adaptive Filters. Implementation of FFT algorithms.		
Unit-5	**Interfacing Memory And I/O Peripherals To Programmable Dsp Devices**	**8 hours**
Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**MIXED SIGNAL IC DESIGN**			
Course Code	**MVLS6008**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

Understand basics of Data Converters and describes the concepts of modulator, filters to improve SN and SPICE modeling

Course Outcomes

CO1	**Understand basic concept of ADC, DAC**
CO2	**Learn SNR improvement methods**
CO3	**Know noise shaping data converters**
CO4	**Design data converters**
CO5	**Design various filters**

Text Book (s)

1. R. J. Baker, CMOS Mixed Signal Cicuit Design, Wiley/IEEE, 2002.

2. Handkiewicz, Mixed-Signal Systems : A Guide to CMOS Circuit Design, Wiley-IEEE, 2002.

3. Razavi, Principles of Data Conversion System Design, IEEE Press, 1995

Reference Book (s)

1. E. Sanchez-Sinencio and A. G. Andreou, Low-Voltage/Low-Power Integrated Circuits and Systems: Low-Voltage Mixed-Signal Circuits, IEEE, 1999.

2. Y. Tsividis, Mixed Analog-Digital VLSI Devices and Technology, MH, 1996.

3. S. Rabii and B. A. Wooley, Design of Low-Voltage Low-Power Sigma-Delta Modulators, Kluwer, 1998.

4. P. G. A. Jespers, Integrated Converters : D-A and A-D Architectures, Analysis and

5. Simulation, OUP, 2001.
6. R. Van de Plassche, Integrated Analog-to-Digital and Digital-to-Analog Converters Kluwer, 1994.

Course Content:

Unit-1	**Data Converters**	**8 hours**
Data Converters: Introduction, Characteristic Parameters, Basic DAC and ADC Architectures. Sampling and Aliasing, SPICE models for DACs and ADCs, Quantization Noise.		
Unit-2	**Data Converters SNR**	**8 hours**
Clock Jitter, Improving SNR using Averaging, decimating filters for ADC's, Interpolating filters for DAC's, Band pass and high pass Sinc filters, using feedback to improve SNR.		
Unit-3	**Noise Shaping Data Converters**	**8 hours**
Noise Shaping data converters: SPICE model, First order noise shaping, First order Noise Shaping, - Digital first order NS Modulators, Modulation Noise, Decimating and filtering the output of a NS Modulator, Analog Sync filter using SPICE, Analog Implementation of First order NS Modulator, Feedback DAC, Forward modulator, op-amp. Second order Noise Shaping.		
Unit-4	**Implementing Data Converters**	**8 hours**
Implementing data converters: R-2R topologies for DAC's – Current mode, voltage mode, wide swing current mode DAC, topologies without an op-amp, effects of op-amp parameters. Implementing ADC's- Implementing S/H,Cyclic ADC, Pipeline ADC using1.5 bits per stage, capacitor error averaging, comparator placement, clock generation, offsets and alternative topologies, Layout of Pipelined ADC's.		
Unit-5	**Filters**	**8 hours**
Low Pass filters, active RC integrators, Effect of parameters of Integrator, MOSFET-C integrators, transconductance-C integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transfer function		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**RESEARCH SEMINAR**				
Course Code	**MVLS9997**				
Prerequisite					
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

Course Objectives:.

1. To make literature survey for various recently emerging technologies.

2. To select any topic of interest and to review the related literature in detail.

3. To compare and analysis the various topologies for the selected topic of interest.

4. To conclude the advantage, drawbacks and future scope of the technique.

Course Outcomes

CO1	**Get familiar with the recently advanced techniques.**
CO2	**Get detailed information about the topic of interest.**
CO3	**Know how to do literature survey.**
CO4	**Develop the interest in research in area of VLSI Design**

Text Book (s)

Depending upon the area of interest student may choose any text book of relevant field

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)(Presentaion)**	**Total Marks**
50	**50**	**100**

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Electrical, Electronics and Communication Engineering

Program: M. Tech. Communication Engineering

Scheme: 2019-2020

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MATH5001	Advanced Numerical & Statistical Methods	3	1	0	4	20	30	50
2	MCEN5002	Information Theory and Coding (PC)	3	0	0	3	20	30	50
3	****	Program Elective 1	3	0	0	3	20	30	50
4	****	Program Elective 2	3	0	0	3	20	30	50
5	MCEN5018	Advanced Digital Signal Processing (PC)	3	0	0	3	20	30	50
6	MCEN5005	Advanced Digital Signal Processing Lab (PC)	0	0	2	1	50	-	50
7	MCEN5006	Information Theory and Coding Lab (PC)	0	0	2	1	50	-	50
		Total	15	1	4	18			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	CENG5001	Professional and Communication skills (UC)	0	0	4	2	20	30	50
2	MCEN5020	Optical Communication (PC)	3	0	0	3	20	30	50
3	****	Program Elective 3	3	0	0	3	20	30	50
4	****	Program Elective 4	3	0	0	3	20	30	50
5	MCEN5021	Mobile and Wireless Communication (PC)	3	0	0	3	20	30	50
6	MCEN5011	Digital Communication System Design (PC)	3	0	0	3	20	30	50
7	MCEN5012	Digital Communication System Design Lab (PC)	0	0	2	1	50	-	50
8	MCEN5013	Optical Communication Lab (PC)	0	0	2	1	50	-	50
		Total	15	0	8	19			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCEN6009	Data Communication Networks (PC)	3	0	0	3	20	30	50
2	****	Program Elective 5	3	0	0	3	20	30	50
3	****	Program Elective 6	3	0	0	3	20	30	50
4	MCEN9997	Research Seminar (PC)	0	0	2	2	50	-	50

5	**MCEN9998**	**Capstone Design-1 (PC)**	**0**	**0**	**10**	**5**	**50**	**-**	**50**
		Total	**9**	**0**	**12**	**16**			

Semester IV

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	**MCEN9999**	**Capstone Design-2 (PC)**	**0**	**0**	**30**	**15**	**50**	**-**	**50**
		Total	**0**	**0**	**30**	**15**			

Programme Elective

Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	MCEN5003	Advanced Radiation Systems	3	0	0	3
2	MCEN5008	Advanced Satellite Communication	3	0	0	3
3	MCEN5009	Mobile Ad Hoc Networks	3	0	0	3
4	MCEN6001	Advanced Digital Image Processing	3	0	0	3
5	MCEN5014	Network Security	3	0	0	3
6	MCEN5015	RF System Design	3	0	0	3
7	MCEN5016	Fiber Optic Communication Networks	3	0	0	3
8	MCEN5017	RF MEMS	3	0	0	3
9	MCEN6005	Communication ICs and Design	3	0	0	3
10	MCEN6006	Embedded System Design	3	0	0	3
11	MCEN6007	Spread Spectrum Techniques	3	0	0	3
12	MCEN5019	Wireless Sensor Networks	3	0	0	3
13	MCEN6011	Introduction to IoT and Architecture	3	0	0	3
14	MCEN6012	Error Control Coding	3	0	0	3

Detailed Syllabus

Name of The Course	**Advanced Numerical & Statistical Methods**				
Course Code	**MATH5001**				
Prerequisite	**Matrices and Calculus**				
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objectives: To introduce the applications and trade off of various advanced methods used to solve a wide variety of engineering problems dealing with algebraic and differential equation that are often encountered in engineering and cannot be solved by analytical methods along with the introduction of design of experiment.

Course Outcomes

CO1	**Do numerical integration for various problems**
CO2	**Do interpolation using various interpolation techniques.**
CO3	**Understand the Ordinary & Partial Differential equations and their solutions.**
CO4	**Do numerical integration**
CO5	**Use wavelets and their applications**

Text Book (s)

3. Numerical Method : E. Balagurusamy , Tata McGraw Hill Publication.
4. Applied Numerical Analysis : Curtis F. Gerald and Patrick O. Wheatley – Pearson Education Ltd.

Reference Book (s)

4. Numerical Methods for Scientific and Engineering computation: M.K Jain, S.R.K Iyengar and R.K Jain, New age International Publishers.
5. Statistical Methods : S.P. Gupta, Sultan Chand and Sons
6. Introduction to Mathematical Statistics: A.M. Mood, F. Graybil and D.C.Boes, Mc Graw Hill Publication.

Course content:

Unit-1	**System of Equations**	**8 hours**
Solution of system of linear equations- Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss-Seidel and Jacobi method, ill conditioned matrix Solution of system of non linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods.		
Unit-2	**Interpolation and Approximation**	**8 hours**
Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.		
Unit-3	**Numerical Integration**	**8 hours**
Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration.		
Unit-4	**Numerical Solution of Differential Equations**	**8 hours**
Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor-Corrector method, Solution of Laplace's and Poisson's equations by Liebmann's method, Solution of one dimensional time dependent heat flow.		
Unit-5	**Probability and statistics**	**8 hours**

Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Information Theory and Coding				
Course Code	MCEN5002				
Prerequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the fundamental concept of entropy and information as they are used in communications.
2. To enhance knowledge of probabilities, entropy, measures of information.
5. To identify the implications and consequences of fundamental theories and laws of information theory and coding with reference to the application in modern communication and computer systems.
6. To design different encoders using the different coding schemes like Huffman Coding, Shannaon Fano Coding, Cyclic codes, etc.,

Course Outcomes

CO1	**Calculate the information content of a random variable from its probability distribution.**
CO2	**Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities.**
CO3	**Define channel capacities and properties using Shannon's Theorems.**
CO4	**Construct efficient codes for data on imperfect communication channels.**
CO5	**Generalize the discrete concepts to continuous signals on continuous channels.**

Text Book (s):

1.Andrew J,Viterbi " *Principles of Digital Communication and Coding*", McGraw-Hill,1996.
2. Ranjan Bose, "Information Theory, Coding and Cryptography", TMH Publication, 2003.

Reference Book (s)

1. Andrea Goldsmith, " Wireless Communications", Cambridge University Press,2005.

2. Saro Glisic ,Advanced Wireless Communications 4G technologies, Wiley & Sons.

3. Stephen G.Wilson, " Digital Modulation & Coding", Prientice-Hall Inc.1996.

4. Daniel J.Costello ,"Error-Control Coding", Pearson Education Inc.2004.

5. John G.Proakis, "Digital Communication", 4th edition, McGraw Hill.

Course content:

Unit-1	**Introduction to Information Theory**	**10 hours**
Information theory and statistics. Method of types. Stein's lemma. AEP. Information capacity of networks. Slepian-Wolf theorem. Optimal investment and information theory. Universal portfolios and universal data compression. Maximum entropy and Burg's theorem		
Unit-2	**Introduction to Coding Theory**	**8 hours**
An overview – A frame work for Digital Communications-Concepts of Information theory for Discrete Alphabets-Information source and Entropy: Entropy for Discrete Random Variable, Shannon's noiseless coding theorem, Mutual information and Channel capacity, information measures for continuous random variables		
Unit-3	**Linear Block Codes and Convolution Codes**	**8 hours**
Binary Linear Block Codes, The generator matrix and the parity check matrix. Examples of linear block codes. Cyclic codes. Hard Decision Decoding-Probability of error for Hard Decision Decoding for AWGN, Soft Decision Decoding- Probability of error for Soft Decision Decoding for AWGN. Non-Linear Block codes-Reed Solomon code. Convolution, Encoder Basic structures-Code characterization: Trellis Diagrams-Maximum Likelihood Decoding-Viterbi algorithm-Distance properties of Convolutional codes for Binary-Input channels-Intersymbol Interference channels-Coding for Intersymbol Interference channels.		
Unit-4	**Space Time Codes**	**8 hours**
System model-Independent fade coefficients, Design criteria for Rayleigh Space-Time Codes-Code Construction-Reconfiguration efficiency of Space-Time coding. Space-Time codes for frequency selective channels-Coding gain properties-Diversity gain properties-Space-time trellis code design.		
Unit-5	**Cryptography**	**8 hours**
Security issues, private key encryption algorithms-stream ciphers, Shannon‟s theory, Introduction to number theory-modular arithmetic, public key encryption algorithms-Diffie-Hellman-public key distribution scheme, RSA public key distribution crypto system; Message authentication, hashing functions, Digital signatures.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Advanced Digital Signal Processing**				
Course Code	**MCEN5018**				
Prerequisite					
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

This course examines the fundamentals of detection and estimation for signal processing. It will help the students to implement new algorithms for signal processing applications in frequency, time and mixed domains.

Course Outcomes

CO1	**Learn Multirate signal processing.**
CO2	**Design digital filters.**
CO3	**Know signal processing application in frequency and time**
CO4	**Understand FFT and power estimation**
CO5	**Learn DSP Processors and its application**

Text Book (s)

1. Steven W. Smith, " Digital Signal Processing: A Practical Guide for Engineers and Scientists", Elsevier, 2003.
2. John G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications" ,

4th edition , PHI 2007.

Reference Book (s)

1. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital Signal Processing", PHI 2001.
2. Roberto Cristi "Modern Digital Signal Processing", Thomson Brooks/Cole, 2004

Course content:

Unit-1	**Introduction to Modern Digital Signal Processing**	**8 hours**
Introduction to Modern Digital Signal Processing: Signals, systems and signal processing (continuous & discrete an overview), time domain and frequency domain analysis of signals. Sampling and reconstruction of signals, Concepts of Two dimensional, Multi-rate and adaptive signal processing.		
Unit-2	**Design of Filters**	**8 hours**
Design of digital filters, moving average filters, adaptive filters and Filter banks.		
Unit-3	**Fast Fourier Transform**	**8 hours**
Discrete and fast Fourier transform algorithms, Power spectrum estimation		
Unit-4	**Introduction to Digital signal Processors**	**8 hours**
Introduction to Digital signal Processors: Fixed and Floating Point Processors, Complex numbers – fixed and floating point representation. Applications: Applications of Digital Signal Processing to Speech & Audio coding and processing		
Unit-5	**Design and implementation example**	**8 hours**
An IIR and FIR audio filters - Modelling in MATLAB - Analog measurement on DSP Systems, Fixed and floating Point Realization impacts.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**PROFESSIONAL AND COMMUNICATION SKILL**				
COURSE CODE	**CENG5001**				
Prerequisite	**--**				
	L	**T**	**P**	**C**	
	0	**0**	**4**	**2**	

Course Objectives:.

To develop the professional and communication skills of learners in a technical environment.
To enable the students to acquire functional and technical writing skills.

To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience.

Course Outcomes

CO1	**The learners will be able to exhibit their language proficiency and skill in *Describing Technology*.**
CO2	**The learners will be able to exhibit their language proficiency and skill in *Investigating and designing using Technology*.**
CO3	**Exhibit their language proficiency and skill in Technical Writing and Syntax.**
CO4	**Exhibit their language proficiency and skill in Technical Resume and Company Profile Presentation.**
CO5	**Exhibit their language proficiency and skill in Pie chart, Bar chart, Line graphs: analysis and interpretation**

Text Books and Softwares:

1. English Vocabulary in Use Advanced, McCarthy & Felicity, CUP, 2003
2. Sky Pronunciation CD-ROM
3. Cambridge Advanced Learner's Dictionary CD-ROM
4. English Master : Grammar

Reference Book (s)

1. Writing, Researching, Communicating, Keith et al, Tata McGraw-Hill, 1989
2. Advanced English Grammar, Martin, CUP, 2006

Unit-1	**Basics of Communication**	**8 hours**
Functional Language	Basic structures- Tense agreement, Prepositional phrases Techno-words : Basic Concepts 62, 63 Pronunciation : sounds of syllables: Past tense & plural endings	
Technical Expression	Organizational techniques in technical writing Guided writing: Paragraph Writing, Note Making	
Presentation Skills	Techniques of presentation (general topic: speech without visual aids) Listening to speeches and comprehending	
Graphical Skills	Flow chart: Process and Functional description	
Unit-2		**8 hours**
Functional Language	Basic structures- Voice, Conditionals Techno-words : Basic Concepts 64,65,67 Pronunciation : Word Stress: two syllable words	
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Letter and email	
Presentation Skills	Interpersonal Communication Skills Writing techniques for Power point presentation, Group Discussion	
Graphical Skills	Technical Illustrations and Instructions	
Unit-3		**8 hours**
Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 68,69,70,71 Pronunciation : Word Stress: compound words	
Technical Expression	Mechanics of Technical Writing and Syntax Guided writing: Technical Description	
Presentation Skills	Career advancement: Technical Resume and Company Profile Presentation and Group Discussion	
Graphical Skills	Pie chart, Bar chart, Line graphs: analysis and interpretation	

Unit-4		**8 hours**
Functional Language	Basic structures- Modal Verbs and Phrasal verbs Techno-words : Basic Concepts 72,73,74, Functional vocabulary 87 Pronunciation : Sentence Stress	
Technical Expression	Guided and Free writing: Abstract and Technical articles	
Presentation Skills	Nuances of Presentation to a Technical audience	
Graphical Skills	Oral Presentation of graphical representation	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Optical Communication**			
Course Code	**MCEN5020**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

To prepare the students understand the various process and subsystems involved in the optical communication.

To enable the students appreciate the different multiplexing technologies in the fiber optic communication.

To design optical communication systems to serve a defined purpose

Course Outcomes

CO1	**understand the various process and subsystems involved in the optical communication.**
CO2	**Understand multiplexing techniques**
CO3	**To understand the different kind of losses, signal distortion, SM fibers.**
CO4	**Know the various optical sources, materials and fiber splicing**
CO5	**Know the fiber optical receivers and noise performance in photo detector.**

Text Book (s)

1. R. Ramaswami & K.N. Sivarajan, Morgan Kaufmann," Optical Networks A practical Perspective", 2nd Edition, Pearson Education, 2000.

2. Govind P. Agrawal, "Fiber-Optic Communication Systems" , 3rd Ed., John Wiley & Sons 2003.

Reference Book (s)

1. Gerd Keiser, "Optical Fiber Communications" McGraw-Hill, 3rd Edition, 2000.
2. Thomas E. Stern and Krishna Bala, "Multiwavelength Optical Networks A Layered Approach", Addison Wesley, 1996

Course content:

Unit-1	**Introduction**	**8 hours**

Optical and Photonic Device Technology: Attenuation and dispersion, Chirp, Dispersion Management, Couplers, Isolators, Circulators, Multiplexers and Filters, EDFA, Raman Amplifier, SOA, SRA, Active and Passive Optical Switches, Optical Cross Connects, Wavelength Selective Cross Connects, Wavelength Converters, Optical Time Domain Reflectometry (OTDR),Optical Spectrum Analysers (OSA),WDM and Filters: dielectric, AWG and Fiber Bragg Grating (FBG) devices, Nonlinear optical fibers.		
Unit-2	**Optical Modulators**	**8 hours**
Phenomenological theory of nonlinearities. Optics of anisotropic media. Harmonic generation, mixing and parametric effects. Two-photon absorption, saturated absorption and nonlinear refraction. Rayleigh, Brillouin and Raman scattering. Self-focusing and self-phase-modulation. Self-induced transparency Solitons. Optical switching, Electro-Optic Effect and Acousto-Optic effects. EO and AO modulators		
Unit-3	**Detection and receiver design**	**8 hours**
Receiver Sensitivity – Bit-Error Rate, Eye Pattern, Minimum received power, Quantum limit of photo detection; Receiver Design – Front End, Linear channel, Decision circuit, Integrated Receivers; Noise in detection Circuit – Shot Noise, Thermal noise; Concept of Carrier to Noise Analysis		
Unit-4	**Network Architectures and Topologies**	**8 hours**
The End To End Transmission Path, Loss And Dispersion Budgets in Network Designing, Optical Signal Flow And Constraints, Design of STAR, BUS, MESH and RING Topologies, Static Multipoint Networks: The Broadcast Star, Multiplexing and Multiple Access Schemes: TWDM/MA, Sub carriers, CDMA, Capacity Allocation for Dedicated Connections, Demand Assigned Connections.		
Unit-5	**Optical Networks Architecture**	**8 hours**
Optical Networks Architecture, SONET/SDH Optical Network, WDM Optical Networks, Wavelength Routed Optical Network, Routing Algorithms, Network Monitoring and Management, Fault and Security Management, Routing Protocols, Intelligent Optical Network (ION), FDDI, FTTH, Business Drivers for Next Generation-Optical Networks, Coherent Optical Communication Systems and Design Requirements		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Mobile and Wireless Communication**				
Course Code	**MCEN5021**				
Prerequisite	**Signals and Systems, Modulation Theory, Digital Communication**				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:.

1. To understand the basic cellular system concepts.
2. To have an insight into the various propagation models and the speech coders used in mobile communication.
3. To understand the multiple access techniques and interference education techniques in mobile communication.

Course Outcomes

CO1	**Understand 2G and 3G Wireless networks**

CO2	**Have a knowledge in Channel coding and Diversity**
CO3	**Understand various Modulation techniques for Mobile Radio.**
CO4	**Classify multiple access techniques in mobile communication.**
CO5	**Outline cellular mobile communication standards.**

Text Book (s)

1. K.Feher, Wireless digital communications, PHI, New Delhi, 1999.
2. T.S.Rappaport, Wireless digital communications; Principles and practice, Prentice H NJ, 1996.

Reference Book (s)

1. W.C.Y.Lee, Mobile communications Engineering: Theory And Applications, Second Edition, McGraw Hill, New York.1998.
2. Schiller, Mobile Communications; Pearson Education Asia Ltd., 2000.

Course content:

Unit-1	**Introduction to Wireless Mobile Communications**	**8 hours**
History and evolution of mobile radio systems. Types of mobile wireless services/systems- Cellular, WLL, Paging, Satellite systems, Standards, Future trends in personal wireless systems.		
Unit-2	**Cellular Concept and System Design Fundamentals**	**8 hours**
Cellular concept and frequency reuse, Multiple Access Schemes, channel assignment and handoff, Interference and system capacity, Trunking and Erlang capacity calculations.		
Unit-3	**Mobile radio Propagation**	**8 hours**
Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and Base band impulse respond models, parameters of mobile multipath channels, Antenna systems in mobile radio.		
Unit-4	**Modulation and Signal Processing**	**8 hours**
Overview analog and digital modulation techniques, Performance of various modulation techniques-Spectral efficiency, Error-rate, Power Amplification, Equalizing Rake receiver concepts, Diversity and space-time processing, Speech coding and channel coding.		
Unit-5	**System Examples and Design Issues**	**8 hours**
Multiple Access Techniques-FDMA, TDMA and CDMA systems, operational systems, Wireless networking, design issues in personal wireless systems		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**Digital Communication System Design**				
Course Code	**MCEN5011**				
Prerequisite					
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

To understand the building blocks of digital communication system. To prepare mathematical background for communication signal analysis. To understand and analyse the signal flow in a digital communication system. To

analyse error performance of a digital communication system in presence of noise and other interferences

Course Outcomes

CO1	**Understand basics of digital communication systems.**
CO2	**Design various digital communication modulators demodulators.**
CO3	**interpret optimum receivers and matched filter receivers**
CO4	**summarize phase and carrier estimation methods.**
CO5	**Analyze Performance of spread spectrum communication system.**

Text Book (s)

1. Simon Haykin, "Digital Communications", John Wiley & Sons, 2004.
2. John proakis, "Digital Communications",4th Edition, McGraw Hill,.

Reference Book (s)

1. Bernard Sklar, "Modern Digital Communication Techniques – Fundamental and applications", , Pearson Education, 2009.
2. Marvin K. Simon, Jim K. Omura, Robert A. Scholtz, Barry K. Levitt ,"Spread spectrum communications Handbook",McGraw-Hill,2002
3. Ha.H.Nguyen, Ed Shwedyk, "A First Course in Digital Communications", Cambridge University Press, 2009.
4. Dennis Silage, "Digital Communication Systems using MATLAB and Simulink", Bookstand Publishing, 2009.
5. Marvin K. Simon, Hinedi Sami, Lindsay William C. , "Digital Communication Techniques: Signal Design and Detection", PHI

Course content:

Unit-1	**Introduction to Digital Communication Systems**	**8 hours**
Building blocks of Digital Communication System- Source Coders, Channel Coders, Encryption concepts, Noise Sources and detection of known signals in noise, Probability of error, Channel decoders, Sources decoders, Correlation receiver, Concept of Matched filter, Overall system performance analysis.		
Unit-2	**Sampling, Quantization and Coding**	**8 hours**
Sampling in 1-D, 2-D and 3-D, Ideal sampling, Natural Sampling, Flat Sampling system design techniques. Various Sample and Hold designs, Quantizers- Quantization with error, Computation of quantization error for linear and non-linear quantizers like A-law and μ-law companders, Effect on Noise Spectrum, Error free quantizers like MAX quantizer.		
Unit-3	**Delta Modulation**	**8 hours**
Delta Modulator (DM), Adaptive Delta Modulators (ADM) Codecs, DPCM - Theoretical and Practical design of DPCM Codecs, effect of predictors, Computation of quantization error, Delta Modulator-Demodulators - Design concepts, Adaptive Delta Modulation and its design aspects.		
Unit-4	**Shift Keying Techniques**	**8 hours**
Concepts of ASK, PSK, FSK, Q-PSK, PSK, QAM, QAM Modems, M-ASK, M-PSK, M-FSK Modems, Techniques of coherent modulation and demodulation, Design of matched filters,		

System design aspects, Intersymbol Interference, Eye Pattern.		
Unit-5	**Spread Spectrum Concepts**	**8 hours**
Spread Spectrum Systems - Concepts of DS and FH systems, Spectral Pictures, Process Gain and Jamming Margin, Concepts of coders and decoders in each case, suppressed carrier modulation and coherent detection techniques.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Data Communication Networking**			
Course Code	**MCEN6009**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

To impart the students a thorough exposure to the layered architecture of communication network and to analyse the protocols adopted for traffic management, routing and QOS provisioning.

Course Outcomes

CO1	**Understand basic computer network technology, OSI and TCP/IP model**
CO2	**Analyze wireless transmission, multiplexing, switching, error detection and corrections**
CO3	**Differentiate among data link protocol, MAC protocols and their applications**
CO4	**Understands the design issues associated with Network layer, Routing algorithms and Congestion control algorithms**
CO5	**Analyze the design issues transport layer, connection management and network securities**

Text Book (s)

1. J Frauzon “Computer Communication and Networks”.
2. W. Stallings, “Data and computer communication”, PHI.

Reference Book (s)

1. A.S. Tanenbaum, “Computer Networks”, PHI.

Course content:

Unit-1	**Introduction**	**8 hours**
Introduction – Network Hardware – Software – Reference Models – OSI and TCP/IP models – Example networks: Internet, ATM, Ethernet and Wireless LANs - Physical layer – Theoretical basis for data communication - guided transmission media		
Unit-2	**Wireless Transmission**	**8 hours**
Wireless transmission - Communication Satellites – Telephones structure –local loop, trunks and multiplexing, switching. Data link layer: Design issues – error detection and correction.		
Unit-3	**Data Link**	**8 hours**

Elementary data link protocols - sliding window protocols – Data Link Layer in the Internet - Medium Access Layer – Channel Allocation Problem – Multiple Access Protocols.		
Unit-4	**Network Layer**	**8 hours**
Network layer - design issues - Routing algorithms - Congestion control algorithms – IP protocol – IP Address – Internet Control Protocol.		
Unit-5	**Transport Layer**	**8 hours**
Transport layer - design issues - Connection management - Addressing, Establishing & Releasing a connection – Simple Transport Protocol – Internet Transport Protocol (TCP) - Network Security: Cryptography.		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**Advanced Radiation Systems**				
Course Code	**MCEN5003**				
Prerequisite	**Microwave Engineering**				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:.

To understand antenna radiation and its parameters. Design different types of antennas.

Course Outcomes

CO1	**understand Antenna parameters and theory associated**
CO2	**Ability to design antenna for various applications**
CO3	**Knowledge of modern antenna design**
CO4	**Able to design microstrip antenna**
CO5	**Able to compare various microstrip antennas parameters**

Text Book (s)

1. Balanis.A, "Antenna Theory Analysis and Design", 3rd edition, John Wiley and Sons, New York, 2010.
2. Kraus.J.D.,"Antennas for all applications" 3rd edition, TMH, 2010.

Reference Book (s)

1. Collin.R.E. and Zucker.F.,"Antenna Theory", Mc Graw Hill,New York,1996.
2. R.S.Elliot, “Antenna Theory and Design”, IEEE Press, John Wiley, 2005

Course content:

Unit-1	**Basic Concepts of Radiation**	**8 hours**
Radiation Mechanism – single wire, Double wire, dipole, Current distribution of thin wire antenna, Basic antenna parameters, Vector magnetic potential, Impedance concept-Balanced to Unbalanced transformer, Power radiated from Half wave dipole antenna.		
Unit-2	**Antenna Parameters**	**8 hours**
Types of linear arrays- Uniform spacing and amplitude, Uniform spacing and non-uniform amplitude, current distribution and directivity, Phased arrays, Continuous aperture sources, Antenna synthesis techniques.		
Unit-3	**Radiation from Apertures**	**8 hours**

Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Babinet's principle, Geometrical theory of diffraction, Horn antenna - E-plane,H- plane and Pyramidal types, Parabolic Reflector antenna.		
Unit-4	**Micro Strip Antennas**	**8 hours**
Radiation mechanisms, Feeding methods, Rectangular patch, Circular patch, Input impedance of patch antenna, Circular polarization, Microstrip dipole, Microstrip arrays.		
Unit-5	**Antennas and Measurements**	**8 hours**
Modern Antennas: EBG antennas, UWB antennas, Smart Antennas, Terrahertz antennas. Antenna measurements: Antenna range, Radiation patterns, Gain, Directivity, Impedance and polarization measurements.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Advanced Satellite Communication**			
Course Code	**MCEN5008**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:.

This course describes multiplexing and multiple access techniques used in Satellite communication. The satellite link design is also discussed. GPS and applications of satellite communication are covered in this course.

Course Outcomes

CO1	**Discuss various multiplexing and multiple access techniques.**
CO2	**Design satellite uplink and downlink in various conditions.**
CO3	**Understand GPS concepts.**
CO4	**Compare competitive satellite services**
CO5	**Understand satellite access techniques**

Text Book (s)

1. Wilbur L. Pritchard, H.G. Suyderhoud ,Robert A.Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006.

2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003.

Reference Book (s)

1. D.Roddy, Satellite Communication, McGrawHill, 2006.

2. Tri T Ha, Digital Satellite Communication, McGrawHill,1990.

3. B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993.

Course content:

Unit-1	**Introduction to Satellite Communication**	**8 hours**
Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.		

Unit-2	**Multiplexing and Multiple Access Techniques**	**8 hours**
Different modulation and Multiplexing Schemes, Multiple Access Techniques – FDMA, TDMA, CDMA, and DAMA, Coding Schemes		
Unit-3	**Satellite Link Design**	**8 hours**
Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.		
Unit-4	**Global Positioning System**	**8 hours**
Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS.		
Unit-5	**Applications**	**8 hours**
Satellite Packet Communications , Intelsat series – INSAT series –VSAT, mobile satellite services, IMMERSAT, Satellite and Cable Television, DBS (DTH), VSAT, Satellite Phones.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Mobile Ad Hoc Networks**			
Course Code	**MCEN5009**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: This course introduces literature on wireless and ad-hoc networks. It exposes fundamental issues in designing and analyzing Wireless and ad-hoc network.

Course Outcomes

CO1	**Explain the characteristics features, wireless channels and mobility models of mobile Adhoc networks.**
CO2	**Summarize the protocols used at the MAC layer and scheduling mechanisms.**
CO3	**Compare and analyze types of routing protocols used for unicast and multicast routing.**
CO4	**Examine the network security solution and routing mechanism.**
CO5	**evaluate the energy management schemes and Quality of service solution in ad hoc networks**

Text Book (s)

1.C.Siva ram murthy,B.S. Manoj, “Ad hoc wireless networks-Architectures and protocols” Pearson Education, 2005
2. Stefano Basagni, Marco Conti, “Mobile ad hoc networking”, Wiely interscience 2004

Reference Book (s)

3. Charles E.Perkins ,”Ad hoc networking”, Addison Wesley,2001

Course content:

Unit-1	**Ad Hoc Wireless Networks**	**8 hours**
Introduction to cellular and ad hoc wireless networks, applications of ad hoc networks,		

issues in ad hoc wireless networks – medium access scheme, routing, multicasting, transport layer protocols, pricing scheme, quality of service provisioning, self organization, security, addr and security discovery, energy management, scalability, deployment considerations, ad hoc wireless Internet.		
Unit-2	**MAC Protocol**	**8 hours**
Issues in Designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms, Other MAC protocols.		
Unit-3	**Routing Protocol**	**8 hours**
Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols.		
Unit-4	**Multicasting Protocol**	**8 hours**
Design issues and operation, Architecture Reference Model, classification, Tree-based and Mes Based Protocols, Energy-Efficient Multicasting, Multicasting with Quality of Service Guarante Application Dependent Multicast Routing. Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks, Network security issues.		
Unit-5	**Energy Management**	**8 hours**
Need, classification of battery management schemes, Transmission power management schemes, System power management schemes. Wireless Sensor Networks: Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensor network.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Advanced Digital Image Processing**			
Course Code	**MCEN6001**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

Course Outcomes

CO1	**Students will be able to describe and Interpret basic elements of Digital Image Processing, Analyze the need and suitability of transforms in image processing applications**
CO2	**Design and implement filters for image enhancement in spatial domain and frequency domain for real time applications and apply image restoration algorithms**
CO3	**Segment and Extract features from images for analysis and recognition**
CO4	**Perform Wavelet analysis on images**
CO5	**Interpret Still and Video compression algorithms**

Text Book (s)

1.Digital Image Processing/ Gonzalez and Woods/ Pearson Education 2008/Third Edition

2. Fundamentals of Digital Image Processing/ A.K. Jain/ PHI Indian Edition

3. Digital Image Processing using MATLAB/ Gonzalez, Woods, and Eddins/ Mc Graw Hill Second/ 2013

Reference Book (s)

1.Digital Image Processing/ K.R. Castleman/ Pearson 2014
2. Digital Image Processing Algorithms and Applications/I. Pitas/John Wiley 2002
3. Image Processing, Analysis, and Machine Vision/Milan Sonka, Vaclav Hlavac, Roger Boyale/ Cengage Learning 4th Edition

Course content:

Unit-1 Introduction	**8 hours**
Need for DIP- Fundamental steps in DIP – Elements of visual perception -Image sensing and Acquisition – Image Sampling and Quantization – Imaging geometry, discrete image mathematical characterization, Two dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT Discrete cosine transform and KL transform.-Discrete Short time Fourier Transform	
Unit-2	**8 hours**
Image enhancement in spatial domain: Gray-level transformations, histogram equalization, spatial filters- averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks; Image filtering in frequency domain: Smoothing and sharpening filtering in frequency domain, ideal and Butterworth filters, homomorphic filtering; **Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering**	
Unit-3	**8 hours**
Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors.	
Unit-4	**8 hours**
Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.	
Unit-5	**8 hours**
Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000. **Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.**	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	Network Security				
Course Code	MCEN5014				
Prerequisite					
		L	T	P	C
		3	0	0	3

Course Objectives: This course introduces various techniques used to provide security of networks. The data encryption and decryption methods are also discussed.

Course Outcomes

CO1	identify some of the factors driving the need for network security
CO2	identify and classify particular examples of attacks
CO3	define the terms vulnerability, threat and attack
CO4	identify physical points of vulnerability in simple networks
CO5	compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

Text Book (s)

1. William Stallings, Cryptography and Network Security: Principles and Standards, PrenticeHall India, 3rd Edition, 2003

Reference Book (s)

1. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security: Private Communication in a public world, Prentice Hall India, 2nd Edition, 2002
2. Man Young Rhee, "Internet Security", JohnWiley & Sons, 2003.
3. Pfleeger & Pfleeger, "Security in Computing", Pearson Education, 3rd Edition, 2003.

Course Content:

Unit-1	Introduction	8 hours
Attacks, Services– Mechanisms – Conventional Encryption – Classical and Modern Techniques – Encryption Algorithms – Confidentiality.		
Unit-2	Public Key Encryption	8 hours
RSA – Elliptic Curve cryptography – Number Theory Concepts.		
Unit-3	Message Authentication	8 hours
Hash Functions, Hash and Mac algorithms– Digest Functions – Digital Signatures – Authentication Protocols.		
Unit-4	Network Security Practice	8 hours
IP Security overview, architecture, authentication header, security payload and key management–Web Security: secure socket layer, transport layer security, secure electronic transaction, dual signature.		
Unit-5	System Security	8 hours
Intruders, viruses, worms, Fire Walls, Trusted systems: antivirus techniques and digital immune systems		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	RF System Design				
Course Code	MCEN5015				
Prerequisite					
		L	T	P	C
		3	0	0	3

Course Objectives: This Course introduces physics of CMOS. The impedance matching and design of amplifiers, oscillators are also discussed.

Course Outcomes

CO1	Understand basics of CMOS physics.
CO2	Perform impedance matching in RF circuits.
CO3	Design RF amplifiers, Oscillators and Mixers.
CO4	Describe analog and digital modulation techniques and modulation schemes
CO5	Understand and describe mathematically the relationship between baseband signals and bandpass signals

Text Book (s)

1. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004

2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997

Reference Book (s)

1. D.M.Pozar, “Microwave Engineering”, John Wiley, 2005.

2. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001.

Course Content:

Unit-1	CMOS Physics	8 hours
CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise Transceiver Specifications: Two port Noise theory, Noise Figure, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link. Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct upconversion, Two step upconversion		
Unit-2	Impedance Matching and Amplifiers	8 hours
S-parameters with Smith chart – Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers – OC Time constants in bandwidth estimation and enhancement – High frequency amplifier design. Low Noise Amplifiers: Power match and Noise match – Single ended and Differential LNAs – Terminated with Resistors and Source Degeneration LNAs.		
Unit-3	Feedback Systems and Power Amplifiers	8 hours
Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques – Time and Frequency domain considerations – Compensation - Power Amplifiers: General model – Types – Linearisation Techniques – Efficiency boosting techniques		
Unit-4	PLL and Frequency Synthesizers	8 hours

PLL: Linearised Model – Noise properties – Phase detectors – Loop filters and Charge Pumps. Frequency Synthesizers: Integer-N frequency synthesizers – Direct Digital Frequency Synthesizers		
Unit-5	**Mixers and Oscillators**	**8 hours**
Mixer: characteristics – Non-linear based mixers: Quadratic mixers – Multiplier based mixers: Single balanced and double balanced mixers – subsampling mixers Oscillators: Describing Functions, Colpitts oscillators – Resonators – Tuned Oscillators – Negative resistance oscillators – Phase noise.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Fiber Optic Communication Networks**			
Course Code	**MCEN5016**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: This course provides insight on light wave networks. It emphasizes on methodology for optical network design and analysis.

Course Outcomes

CO1	**Distinguish Step Index, Graded index fibers and compute mode volume.**
CO2	**Explain the Transmission Characteristics of fiber and Manufacturing techniques of fiber/cable.**
CO3	**Classify the construction and characteristics of optical sources and detectors.**
CO4	**Discuss splicing techniques, passive optical components and explain noise in optical system.**
CO5	**Design short haul and long haul Analog/ Digital optical communication system and explain advanced optical transmission systems**

Text Book (s)

1. R. Ramaswami & K.N. Sivarajan, Morgan Kaufmann," Optical Networks A practical Perspective", 2nd Edition, Pearson Education, 2000.

2. Govind P. Agrawal, "Fiber-Optic Communication Systems" , 3rd Ed., John Wiley & Sons 2003.

Reference Book (s)

1. Gerd Keiser, "Optical Fiber Communications" McGraw-Hill, 3rd Edition, 2000.

2. Thomas E. Stern and Krishna Bala, "Multiwavelength Optical Networks A Layered Approach", Addison Wesley, 1996.

Course Content:

Unit-1	**Network Elements**	**8 hours**

Optical and Photonic Device Technology: Attenuation and dispersion, Chirp, Dispersion Management, Couplers, Isolators, Circulators, Multiplexers and Filters, EDFA, Raman Amplifier, SOA, SRA, Active and Passive Optical Switches, Optical Cross Connects, Wavelength Selective Cross Connects, Wavelength Converters, Optical Time Domain Reflectometry (OTDR),Optical Spectrum Analysers (OSA),WDM and Filters: dielectric, AWG and Fiber Bragg Grating (FBG) devices, Nonlinear optical fibers.		
Unit-2	**Optical Modulators**	**8 hours**
Phenomenological theory of nonlinearities. Optics of anisotropic media. Harmonic generation, mixing and parametric effects. Two-photon absorption, saturated absorption and nonlinear refraction. Rayleigh, Brillouin and Raman scattering. Self-focusing and self-phase-modulation. Self-induced transparency Solitons. Optical switching, Electro-Optic Effect and Acousto-Optic effects. EO and AO modulators.		
Unit-3	**Detection and receiver design**	**8 hours**
Receiver Sensitivity – Bit-Error Rate, Eye Pattern, Minimum received power, Quantum limit of photo detection; Receiver Design – Front End, Linear channel, Decision circuit, Integrated Receivers; Noise in detection Circuit – Shot Noise, Thermal noise; Concept of Carrier to Noise Analysis.		
Unit-4	**Network Architectures and Topologies**	**8 hours**
The End To End Transmission Path, Loss And Dispersion Budgets in Network Designing, Optical Signal Flow And Constraints, Design of STAR, BUS, MESH and RING Topologies, Static Multipoint Networks: The Broadcast Star, Multiplexing and Multiple Access Schemes: TWDM/MA, Sub carriers, CDMA, Capacity Allocation for Dedicated Connections, Demand Assigned Connections.		
Unit-5	**Optical Networks Architecture**	**8 hours**
Optical Networks Architecture, SONET/SDH Optical Network, WDM Optical Networks, Wavelength Routed Optical Network, Routing Algorithms, Network Monitoring and Management, Fault and Security Management, Routing Protocols, Intelligent Optical Network (ION), FDDI, FTTH, Business Drivers for Next Generation-Optical Networks, Coherent Optical Communication Systems and Design Requirements		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**RF MEMS**			
Course Code	**MCEN5017**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

This course introduces various sensors, actuators and RF MEMS and it's applications.

Course Outcomes

CO1	**Know various sensors, actuators and RF MEMS.**
CO2	**Design MEMS based circuit.**
CO3	**able to analyze different MEMS technologies**
CO4	**familiar with the micro machnied designs for the design of reconfigurable antennas.**
CO5	**Design circuit using RF MEMS**

Text Book (s)

1. Hector J. De Los Santos, "RF MEMS Circuit Design for Wireless Communications", Artech House, 2002.
2. Vijay K. Varadan, K.J. Vinoy, K.A. Jose, "RF MEMS and their Applications", John Wiley and Sons, Ltd., 2002.

Reference Book (s)

1. Gabriel M. Rebeiz, "RF MEMS Theory, Design & Technology", Wiley, 2002.

Course Content:

Unit-1	**7. Introduction to Sensors, Actuators and Mathematical Models**	**8 hours**
Micro machines, micro systems, benefits, Scaling laws, nano machines. Classification of transducers: electrostatic, piezoelectric, thermal sensing principles, SAW devices.		
Unit-2	**8. Surface Bulk Micro Machining**	**8 hours**
9. Overview of silicon processes techniques, micro machining techniques and special process for MEMS, polymer MEMS, Recent advances in MEMS fabrication.		
Unit-3	**RF MEMS**	**8 hours**
10. Enabled circuit elements and models – RF/Microwave substrate properties, Micro machined – enhanced elements – capacitors, inductors, varactors, MEM switch – shunt MEM switch, low voltage hinged MEM switch approaches, push-pull series switch, folded – beam–springs suspension series switch, Resonators – transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustics wave resonators, MEMS modeling – mechanical modeling, electromagnetic modeling.		
Unit-4	**Novel RF MEMS**	**8 hours**
11. Enabled circuits – reconfigurable circuits – the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS microswitch arrays, Reconfigurable circuits – double – stud tuner, Nth-stub tuner, filters, resonator tuning system, massively parallel switchable RF front ends, true delay digital phase shifters, reconfigurable antennas – tunable dipole antennas, tunable microstrip patch-array antenna.		
Unit-5	**RF MEMS Based Circuit Design**	**8 hours**
Phase shifters – fundamentals, X-Band RF MEMS phase shifter for phased array applications, Ka-Band RF MEMS phase shifter for radar systems applications, Film bulk acoustic wave filters – FBAR filter fundamentals, FBAR filter for PCS applications, RF MEMS filters – A Ka-Band millimeter-wave Micro machined tunable filter, A High-Q 8 MHz MEM Resonators filter, RF MEMS Oscillators – fundamentals, A 14GHz MEM Oscillator, A Ka-Band Micro machined cavity oscillator, A 2.4 GHz MEMS based voltage controlled oscillator.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Communication ICs and Design**			
Course Code	**MCEN6005**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

This course discusses on integrated circuit design techniques, transceiver architectures and telecommunication ICs.

Course Outcomes

CO1	**Design low noise RF amplifiers and Oscillators.**
CO2	**Understand the concept of Nonlinear elements**
CO3	**Know communication ICs and their applications.**
CO4	**Design transceiver**
CO5	**Know various telecommunication IC**

Text Book (s)

1. D.M. Pozar. Microwave Engineering. 3rd Ed., N.Y., John Wiley & Sons, Inc., 2005.
2. Leon W. Couch. Digital and Analog Communication Systems . 6th Ed, Prentice Hall PTR, New Jersey, 2001.

Reference Book (s)

1 B. Sklar. Digital Communications. Fundamentals and Applications. 2nd Ed., Prentice Hall PTR, New Jersey, 2001

Course Content:

Unit-1	**Introduction to RF IC design**	**8 hours**
Gain, decibels, impedance, levels. Nonlinearities and harmonic distortions. Intermodulation, dynamic range. Review of thermal noise. Noise models and circuit noise calculations. Introduction to low-noise amplifiers, Low-noise RF amplifiers structure. Relationship between power consumption, gain, linearity and noise figure.		
Unit-2	**Nonlinear Elements**	**8 hours**
Nonlinear elements, their characteristics and approximation methods. Harmonics analysis of the current in the nonlinear elements. Nonlinear resonant amplifiers and frequency multipliers. RF mixers: Up and down conversion mixers, single and double balanced mixers.		
Unit-3	**Oscillators**	**8 hours**
Types of oscillators. Feedback oscillator topologies. Resonant oscillators. Crystal oscillators. Small signal analysis of an oscillator. Short introduction to Voltage Controlled Oscillators (VCOs).		
Unit-4	**Transceivers**	**8 hours**
Transceivers architectures. Transceivers functions and characteristics. Direct conversion and super heterodyne receivers. Phase-locked loops: Phase-locked loops and frequency synthesis. Basic building blocks of the PLL. PLL synthesizers for radio applications.		
Unit-5	**Telecommunication ICs**	**8 hours**
PCM, CVSD codec, filters MODEMS, LAN chip sets, ISDN Codecs, Telephone subscriber circuits, line interface, switched capacitor, DSP chips. High speed decision circuits. MIC and MMIC. High speed DSP Chips. Fibre optic chips.		

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	**30**	**50**	**100**

Name of The Course	**Embedded System Design**			
Course Code	**MCEN6006**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: This course introduces basic concepts of embedded systems, their programming, multiprocessors & synchronization.

Course Outcomes

CO1	**Critically explain the components of Embedded Processing**
CO2	**Evaluate the architecture and functioning of embedded processors**
CO3	**Understand the various communication links in embedded system**
CO4	**Demonstrate Knowledge of RTOS and Its applications**
CO5	**Design and simulate the embedded system**

Text Book (s)

1. Raj Kamal , Embedded Systems Architecture, Programming and Design, Tata McGraw-Hill, New Delhi, 2003.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001.

Reference Book (s)

1. Frank Vahid and Tony Givargi Embedded System Design: A Unified Hardware/Software Introduction, s, John Wiley & Sons, 2000.
3. John B Peatman, Design with PIC Microcontrollers, Prentice Hall of India, 2007

Course Content:

Unit I	**Introduction to Embedded System**	**8 hours**
An embedded system, processor, hardware unit, soft ware embedded into a system, Example of an embedded system, OS services, Embedded Design life cycle; Modeling embedded systems Processor and Memory Organization: Structural unit in as processor, processor selection for an embedded systems. Memory devices, memory selection for an embedded system, allocation of memory to program statements and blocks and memory map of a system. Direct memory accesses. .		
Unit II	**Devices and Buses for Device Networks**	**8 hours**
I/O devices, serial communication using FC, CAN devices, device drivers, parallel port device driver in a system, serial port device driver in a system, device driver for internal programmable timing devices, interrupt servicing mechanism, V context and periods for switching networked I/O devices using ISA, PCI deadline and interrupt latency and advanced buses.		
Unit III	**Programming Concepts and embedded programming in C**	**8 hours**
Languages, Firmware development environment, Start up code or Boot loader, Abstraction Layers, Application Layer, build download debug process of firmware.		
Unit IV	**Single and Multiprocessor Systems**	**8 hours**
Program Modeling Concepts in Single and Multiprocessor Systems: software development process, modeling process for software analysis before software implementation, programming model for the event controlled or response time constrained real time programs, modeling of multiprocessor system.		
Unit V	**Multiprocessing & Synchronization**	**8 hours**
Inter-Process Communication and Synchronization of Processors Tasks: and threads; multiple process in an application, problems of sharing data by multiple tasks and routines, inter process communications. RTOS task scheduling models interrupt literacy and response times, performance metric in scheduling models, standardization of RTOS, list of basic functions, synchronization		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Spread Spectrum Techniques			
Course Code	MCEN6007			
Prerequisite				
	L	T	P	C
	3	0	0	3

Course Objectives: This course introduces the architecture and elements of spread-spectrum systems. It also explains characteristics of spread-spectrum signal waveforms, methods for spread-spectrum and CDMA system performance analysis.

Course Outcomes

CO1	Know concept of spread spectrum system.
CO2	Learn jamming performance of coded & encoded spread spectrum system
CO3	Understand theory & concept of W-CDMA
CO4	Apply their knowledge of communications technology to CDMA and wireless systems
CO5	Understand the methods for spread-spectrum and CDMA system performance analysis

Text Book (s)

1. Jack K Holmes, "Spread Spectrum Systems for GNSS and wireless communication" Artech house, London.
2. Roger L Peterson, Rodger E. Ziemer, David E. Borth, "Introduction to Spread Spectrum Communications", prentice Hall.

Reference Book (s)

1. Kiji Tachikawa,"W-CDMA mobile communication systems", John Wiley & Sons.
2.. J.Prokais, "Digital Communications", McGraw Hill.

Course Content:

Unit I	Introduction to spread spectrum systems	8 hours
Introduction to Spread Spectrum Technique – Direct Sequence Spread Spectrum Systems, Frequency hopping Spread Spectrum Systems and Hybrid Spread Spectrum Systems-Time hopping Spread Spectrum Signals- Common Problems faced in Spread Spectrum Systems- Introduction to OFDM - Introduction to UWB communication		
Unit II	**Jamming performance of Uncoded Spread Spectrum Systems**	8 hours
Introduction-Jammer types-BER performance in Broadband noise jamming, Partial brand noise jamming and Pulsed jamming (DS/PSK, SFH/DPSK, SFH/PSK, JFH/MFSK, FFH/BFSK, Hybrid DS-SFS SS). BER performance in single tone and multi tone jamming.		
Unit III	**Jamming performance of Coded Spread Spectrum Systems**	8 hours

Interleaver structures for coded systems- Jamming Performance analysis using Linear Block codes, Convolutional codes, Iteratively decode codes.		
Unit IV	**Introduction to W-CDMA**	8 hours
Introduction to W-CDMA – Basic W-CDMA transmission technologies, Link capacity Expansion Technologies – WCDMA Characteristics and Specifications- W-CDMA system architecture- Radio Access Interface Standard – Design of W-CDMA Radio system – Quality of Service in W-CDMA systems.		
Unit V	**Rake Receiver, Capacity Analysis & Power Control**	8 hours
Multipath Effects (Delay Spread and Distortion) and Rake Receiver Approach; Capacity Analysis of Cellular CDMA Communication Systems; Power Control in CDMA Communication Systems, Interference Rejection for DS/SS		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Wireless Sensor Networks**				
Course Code	**MCEN5019**				
Prerequisite					
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools Course Outcomes

Course Outcomes

CO1	**Analyze the knowledge of wireless sensor networks in various application areas.**
CO2	**Comprehend and analyze localization and tracking issues associated with WSN network.**
CO3	**Evaluate the performance of energy saving approaches used in MAC Protocols.**
CO4	**Understand and analyze various routing metrics and routing algorithms in WSN network**
CO5	**Apply the techniques used for sensor data gathering, data storage and data retrievals in WSN.**

Text Book (s)

1.Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press

2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati,

Reference Book (s)

1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

2. Wireless Sensor Networks: Technology, Protocols, and Applications: KazemSohraby, Daniel Minoli, TaiebZnati, Wiley Inter Science.

Course Content:

Unit I	**Introduction**	8 Hours
Overview of sensor network protocols, architecture, and applications, simulation and experimental platforms, main features of WSNs, research issues and trends.		
Unit II	**Existing Technologies**	8 Hours
Fundamentals of 802.11 – Types, Concepts of 802.16, Basics of 802.15.4, Bluetooth, and UWB, Physical and MAC layers – Applications.		
Unit III	**Sensor Node Hardware and Software**	8 Hours
Hardware: mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (OS): tinyOS, MANTIS, Contiki, and RetOS, Programming tools: C, nesC, Mate.		
Unit IV	**Network Connectivity and Routing**	8 Hours
Sensor deployment mechanisms, coverage issues, node discovery protocols, Data dissemination and processing, multi-hop and cluster based protocols, routing.		
Unit V	**Energy Management**	8 Hours

Data dissemination; data storage, query processing, sensorWeb, sensorGrid, Energy preservation and efficiency, security challenges, fault-tolerance.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Introduction to IoT and Architecture				
Course Code	MCEN6011				
Prerequisite	IoT				
Corequisite	IoT				
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

To understand the basic concept of IoT and study the applications of IoT.

Course Outcomes

CO1	Understand the concepts of Internet of Things
CO2	Analyze basic protocols in wireless sensor network
CO3	Design IoT applications in different domain and be able to analyze their performance
CO4	Implement basic IoT applications on embedded platform
CO5	Analyze and design of academic project

Text Book (s)

1.Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms " Copyright © 2016 Elsevier Inc.

2.Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. 2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen

Reference Book (s)

1.API Features and Arduino Projects for Linux Programmers", Apress, 2014.

2.Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

Unit-1 Introduction 8 hours
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related, Standardization, Recommendations on Research Topics.
Unit-2 8 hours
Background/Related Work - OpenIoT Architecture for IoT/Cloud Convergence - Scheduling Process and IoT Services Lifecycle - Scheduling and Resource Management - Validating Applications and Use Cases - Future Research Directions
Unit-3 8 hours

Introduction - Background and Related Work - Device/Cloud Collaboration Framework - Powerful Smart Mobile Devices - Runtime Adaptation Engine - Privacy-Protection Solution - Applications of Device/Cloud Collaboration - Context - Aware Proactive Suggestion - Semantic QA Cache - Image and Speech Recognition.- Future Work
Unit-4 8 hours
Principles, Architectures, and Applications: Introduction - Motivating Scenario - Definitions and Characteristics. - Reference Architecture - Applications - Research Directions and Enablers.- Commercial Products - Case Study
Unit-5 8 hours
Introduction - Scenario -- Architecture Overview- Sensors - The Gateway - Summary - Data Transmission

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Error Control Coding**			
Course Code	**MCEN6012**			
Prerequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

Discuss the theory of Linear Block Codes their Encoding and Decoding Techniques as well their application in real World Scenarios.

Course Outcomes:

CO1	**Be familiar with importance of error correction methods in data communication and storage.**
CO2	**Have gained experience of use of mathematical tools from groups and finite fields, in the design of codes and sequences.**
CO3	**Develop an ability to compare and contrast the strengths and weaknesses of various errors correcting code for a given application.**
CO4	**Develop and model different error correcting codes for appraise of reaching data rate to Shannon limit.**
CO5	**Demonstrate competence in analyzing and evaluating the practice of different error correcting coded in digital communication system**

Text Book (s):

1. Gravano Salvatore,"Introduction to Error Control Codes", Oxford University Press, 1st Ed., 2007.

2. Bose Ranjan,"Information Theory, Coding and Cryptography", Tata McGraw-Hill, 1st Ed., 2007.

Reference Book (s)

1. Moon Tood K.,"Error Correction Coding - Mathematical Methods and Algorithms", Wiley- Interscience, 1st Ed., 2006.

2. Sklar Bernard,"Digital Communications - Fundamentals and Applications", Pearson Education-LPE, 2nd Ed., 2009.

3. Glover Lan and Grant Peter,&qout;Digital Communications", Pearson Education-LPE, 1st Ed., 2008.

Course Content:

Unit-1	**Channel Capacity And Coding**	**8 hours**
Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit, Random Selection Of Codes, Hamming Distance, Few Points Of Information Theory.		
Unit-2	**Block Codes**	**8 hours**
The Digital Communication Channel, Introduction To Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, Hamming Codes, Minimum Distance Of Block Codes, Soft - Decision Decoding, Automatic Repeat Request Schemes		
Unit-3	**Linear Codes**	**8 hours**
Definition of Linear Codes, Generator Matrices, The Standard Array, Parity - Check Matrices, Error Syndromes, Error Detection And Correction, Shortened And Extended Linear Codes.		
Unit-4	**Cyclic Codes**	**8 hours**
Definition Of Cyclic Codes, Polynomials, Generator Polynomials, Encoding Cyclic Codes, Decoding Cyclic Codes, Factors Of XN +1, Parity-Check Polynomials, Dual Cyclic Codes, Generator And Parity-Check Matrices Of Cyclic Codes.		
Unit-5	**Convolution Codes**	**8 hours**
Convolution, Encoding Convolutional Codes, Generator Matrices For Convolutional Codes, Generator Polynomials For Convolutional Codes, Graphical Representation Of Convolutional Codes, The Viterbi Decoder.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**