UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Program structure & Syllabi

Academic Session 2020 – 2021

Bachelor of Technology (B.Tech.)

in

ELECTRICAL AND ELECTRONICS ENGINEERING

Uttarakhand Technical University, Dehradun

Semester III

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted						Contact Hours			Credits
				Theory			Practical						
				End Sem.	Mid Sem.	Quiz/ Assignment	End Sem.	Term work Lab Work & Sessional		L	T	P	
1.	BCET 301	ES	Energy & Environmental Engineering	100	30	20	-	-	150	3	-	-	3
2.	BEST 301	BSC	Mathematics-III	100	30	20			150	3	1	-	4
3.	BEET 301 BEEP 301	DC	Electrical Measurements & Instrumentation	100	30	20	30	20	200	3	1	2	5
4.	BECT 304 BECP 304	DC	Electronic Devices	100	30	20	30	20	200	3	0	2	4
5	BEET 305 BEEP 305	DC	Networks Analysis and Synthesis	100	30	20	30	20	200	3	1	2	5
6.	BEEP 306	DC	Programming Practices	-	-	-	30	20	50	-	-	2	1
7	BASP 307		Evaluation of Internship-I Completed at I year level/Seminar Presentation for Lateral Entry					50	50			2	1
8.	BASP 307	DLC	90 hrs. Internship	To be completed anytime during fourth semester. Its evaluation/credit to be added in fifth semester.									
Total				500	150	100	90	160	1000	15	3	8	23
9.	BC	MC	Cyber Security	Non-credit course									
			NSS/NCC										

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III

Semester IV

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted						Contact Hours			Credits
				Theory			Practical						
				End Sem.	Mid Sem	Quiz/ Assignment	End Sem.	Term work Lab Work & Sessional		L	T	P	
1.	BECT 402	DC	Signals and Systems	100	30	20	-	-	150	3	1	-	4
2.	BEET 402 BEEP 402	DC	Electrical Machine-I	100	30	20	30	20	200	3	1	2	5
3.	BECT 401 BECP 401	DC	Digital Electronics	50	30	20	30	20	200	3	0	2	4
4.	BEET 404 BEEP 404	DC	Power System-I	100	30	20	30	20	200	3	1	2	5
5.	BEET 405 BEEP 405	DC	Control System	100	30	20	-	-	150	3	1	0	4
6.	BHUT 401	DLC	Universal Human	50	30	20			100	2	0	0	2
7.	BENP 407	DLC	90 hrs. Internship based on using various software's – Internship –II	To be completed anytime during fourth semester. Itsevaluation/credit to be added in fifth semester.									
			Total	500	180	120	90	110	1000	17	4	6	24
8.	BCSP 408	MC	Cyber Security	Non-credit course									
			NSS/NCC										

V Semester

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per Week			
				Theory			Practical						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
1.	BEET- 501 BEEP-501	DC	Electrical Machine-II	100	30	20	30	20	200	3	1	2	5
2.	BEET -502 &BEEP 501	DC	Power System-II	100	30	20	30	20	200	3	1	2	5
3.	BEET-503 (A or B or C)	DE	Departmental Elective-I	100	30	20	-	-	150	3	0	0	3
4.	BOET-504 (A / B / C / D)	OE	Open Elective-I	100	30	20	-	-	150	3	0	0	3
5.	BEET-505	DC	Electromagnetic Field theory	100	30	20	-	-	150	3	1	0	4
6	BENP-506	IN	Evaluation of Internship-II completed at II-year level	-	-	-	-	100	100	0	0	4	2
7	BENP-507		Open-Source Lab					50	50				
8	BASP-507/607	IN	Internship -III	To be completed any time during Fifth/ Sixth semester. Its evaluation/credit to be added in Seventh semester.									
Total				500	150	100	60	190	1000	11	5	19	22
NSS/NCC													

Departmental Electives			Open Electives	
BEET 503(A)	CAD of Power Apparatus		BOET-504(A)	Digital Control System
BEET 503(B)	Applied Instrumentation		BOET-504(B)	Communication Engineering
BEET 503(C)	Electrical Engineering Material		BOET-504(C)	Industrial electronics
			BOET- 504(D)	Innovation and Entrepreneurship

VI Semester

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per Week			
				Theory			Practical						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Team Work /Lab Work & Sessional		L	T	P	
1.	BEET-601 & BEEP-601	DC	Power Electronics	100	30	20	30	20	200	3	1	2	5
2.	BECT-602 & BECP-602	DC	Microprocessor & Embedded systems	100	30	20	30	20	200	3	1	2	5
	BECT-603	DC	Digital Signal Processing	100	30	20	30	20	200	3	1	2	5
3.	BEET-604(A or B or C)	DE	Departmental Elective	100	30	20	-	-	150	3	0	0	3
4.	BOET-605(A or B or C)	OE	Open Elective	100	30	20	-	-	150	3	0	0	3
5.	BEEP-606	O/E Lab	Simulation lab/Virtual Lab	-	-	-	30	20	50	0	0	4	2
6.	BEEP-607	P	Minor Project -I				-	50	50	0	0	4	2
7	BASP-507/607	IN	Internship - III	To be completed anytime during Fifth/Sixth semester. Its evaluation/credit to be added in Seventh Semester.									
Total				500	150	100	90	160	1000	14	4	14	25

Departmental Electives			Open Electives	
BEET 604(A)	FACTS		BOET-605(A)	Introduction to Smart Grids
BEET 604(B)	Energy Management and SCADA		BOET-605(B)	Power Plant Engineering
BEET 604(C)	NCER		BOET-605(C)	Special Electromechanical Systems

S No	Course No	Subject	Periods			Evaluation				Total Marks
			L	T	P	Sessional			External Exam	
						CT	TA	Total		
Semester: VII										
Theory										
1	TEE701	Switch Gear and Protection	3	1	0	30	20	50	100	150
2	TEE702	ANN & Fuzzy Logic	3	1	0	30	20	50	100	150
3	TEC701	Optical Fiber Communication System	3	1	0	30	20	50	100	150
4		Elective-1	3	1	0	30	20	50	100	150
5		Open Elective	3	1	0	30	20	50	100	150
Practical/Design										
1	PEE751	Power System Lab	0	0	2	0	0	25	25	50
2	PEC751	OFC Lab	0	0	2	0	0	25	25	50
3	PEE753	Industrial Training Seminar	0	0	2	0	0	25	25	50
4	PEE754	Project	0	0	2	0	0	50	50	100
Semester: VIII										
Theory										
1	TEE801	Electric Drives	3	1	0	30	20	50	100	150
2	TEE802	SCADA & Energy Management	3	1	0	30	20	50	100	150
3		Elective-2	3	1	0	30	20	50	100	150
4		Elective-3	3	1	0	30	20	50	100	150
Practical/Design										
1	PEE851	Electric Drive Lab	0	0	2	0	0	25	25	50
2	PEE852	Project	0	0	2	0	0	100	200	300
3	DIS850	Discipline	0	0	0	0	0	0	50	50

BCET 301	Energy and Environmental Engineering	3L:1T:0P	4 Credits

Course Objectives:

The objective of this course is to apply knowledge of mathematics, science, technology and engineering appropriate to energy science and engineering degree discipline and to enhance the understanding of conventional and non-conventional energy sources and its relationship with the ecology and environment. More precisely the objectives are:

1. Use mathematical or experimental tools and techniques relevant to the energy and energy-related environmental disciplines along with an understanding of their processes and limitations.
2. Equip the students with knowledge and understanding of various possible mechanisms about renewable energy projects
3. To produce graduates strong in understanding on energy resources, technologies and systems, energy management fundamentals, and capable in innovative technological intervention towards the present and potential future energy.
4. To identify, formulate and solve energy and energy-related environmental problems by pursuing development of innovative technologies that can generate clean and sustainable energy to address energy scarcity and combat pollution and climate change.

Course Outcomes

1. Apply advanced level knowledge, techniques, skills and modern tools in the field of Energy and Environmental Engineering.
2. Distinguish the different energy generation systems and their environmental impacts.
3. Respond to global policy initiatives and meet the emerging challenges with sustainable technological solutions in the field of energy and environment.

Detailed Content

Module I:

Introduction to Energy Science - Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment, Global Energy Scenario: Role of energy in economic development. Indian Energy Scenario: Introduction to Energy resources & Consumption in India. Common terminologies

Module II

Energy Sources - Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sun as Source of Energy, Availability of Solar Energy, Nature ofSolar Energy, Solar Energy & Environment. Various Methods of using solar energy. Commercial and noncommercial forms of energy, Fossil fuels, Renewable sources including: Nuclear Energy, Hydel Energy, Storage of Hydrogen, Hydrogen Production,Hydrogen Energy Geothermal, Tide and Wave Energy, Bio-fuels in India.

Module III

Energy Efficiency and Conservation - Introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How

future energy use can be influenced by economic, environmental, trade,and Research policy.

Module IV

Energy & Environment - Environment**:** Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness. Ecosystem: Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession. Environmental Pollution: Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, solid waste Management.

Module V

Environmental Protection and Ethics - Environmental Protection- Role of Government Initiatives by Non-governmental Organizations (NGO) Environmental Education. Ethicsand moral values Objectives of ethics, Professional and Non- professional ethics Sustainable Development of the ecology and environment Codes of ethics and their limitations.

Suggested Reading Material:

1. Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (eds.) 2004. Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press, 619 pages (ISBN: 0-19-926179-2)
3. Energy Management Principles: C.B.Smith (Pergamon Press)
4. Renewable Sources of Energy and Conversion Systems: N.K.Bansal and M.K.Kleeman.
5. EnergyManagement: W.R.Murphy, G.Mckay (Butterworths)
6. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley
7. Ravindranath, N. H., & Hall, D. O. (1995). Biomass, energy and environment: a developing country perspective from India. Oxford University Press.
8. Popp, D., Newell, R. G., & Jaffe, A. B. (2010). Energy, the environment, and technological change. In Handbook of the Economics of Innovation (Vol. 2, pp. 873-937). North-Holland.

BAST 301	Mathematics – III	3L-1T-0P	4 Credits

Students Should have the knowledge of Mathematics I and Mathematics II

Course Objective:

The objective of this course is to familiarize the students with Laplace Transform, Fourier Transform, techniques in numerical methods & some statistical techniques. It aims to present the students with standard concepts and tools at B. Tech first year to superior level that will provide them well towards undertaking a variety of problems in the concern discipline.

The students will learn:

- The idea of Laplace transforms of functions and their applications.
- The idea of Fourier transforms of functions and their applications.
- To evaluate roots of algebraic and transcendental equations.
- Interpolation, differentiation, integration and the solution of differential equations.
- The basic ideas of statistics including measures of central tendency, correlation, regression and their properties.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

1. Remember the concept of Laplace transform and apply in solving real life problems.
2. Understand the concept of Fourier transform to evaluate engineering problems
3. Understand to evaluate roots of algebraic and transcendental equations.
4. Understand interpolation, differentiation, integration and the solution ofdifferential equations.
5. Understand the concept of correlation, regression, moments, skewness and kurtosis and curve fitting.

Module 1: Fourier Transforms: (8 hours)

Fourier integral, Fourier Transform, Complex Fourier transform, Inverse Transforms, Convolution Theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one-dimensional heat transfer equations.

Module 2: Laplace Transform: (8 hours)

Definition of Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve linear differential equations.

Module 3: Solution of Algebraic and Transcendental equations & Interpolation (8hours)

Number and their accuracy, Solution of algebraic and transcendental equations: Bisection method, Iteration method, Newton-Raphson method and Regula-Falsi method. Rate of convergence of these methods (without proof).

Interpolation: Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formula. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula.

Module 4: Numerical differentiation, Integration & Solution of ODE (8 hours)

Numerical Differentiation, Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8 rule Runge- Kutta method of fourth order for solving first order linear differential equations. Milne's predicator-corrector method.

Module 5: Statistical Techniques (8 hours)

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting : Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves. Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non-linear regression.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics; John Wiley & Sons
2. B.V. Ramana: Higher Engineering Mathematics; Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. Peter V.O' Neil. Advanced Engineering Mathematics, Thomas (Cengage) Learning
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
6. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
7. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
8. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
9. N.P. Bali and Manish Goyal, Computer Based Numerical and Statistical Techniques , Laxmi Publications, Reprint, 2010.
10. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
11. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab MahalDistributers, New Delhi.

BEET-301 BEEP 301	Electrical Measurements & Instrumentation	3L:1T:2P	5 Credits

Course Objectives:

At the end of this course students will demonstrate the ability to:

- Able to learn the errors in measurement and use different types of instruments for the measurement
- Acquire the knowledge of electrical quantities and their measurement
- Acquire the knowledge of working of instrument transformers
- Acquire the knowledge of working of electronic instruments
- Acquire the knowledge of transducers, their classifications and applications for the measurement of physical quantities

Course outcomes:

At the end of this course students will demonstrate the ability to:

- Able to understand the importance of calibration of measuring instruments
- Able to understand and learn the construction and working of different measuring instruments
- Able to understand and learn the construction and working of different AC and DC bridges, along with their applications
- Able to measure electrical engineering parameters like voltage, current, power & phase difference in industry as well as in power generation, transmission and distribution sectors
- Able to understand and acquire the capability to analyze and solving the variety of problems in the field of electrical measurements.

Unit	Topics
I	**Electrical Measurements:** Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement & Measurement standards, Review of indicating and integrating instruments: Voltmeter, Ammeter andWattmeter, Power, Power Factor.
II	**Measurement of Resistance, Inductance and Capacitance:** Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement.
III	**Instrument Transformers:** Current and Potential transformer, ratio and phase angle errors, design considerations and testing.
IV	**Electronic Measurements:** Electronic instruments: Voltmeter, Multimeter, Wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum & Wave analyzer, Digital counter, frequency meter, and Digital Voltmeter.
V	**Instrumentation:** Transducers & sensors, classification & selection of sensors, Measurement of force using strain gauges, Measurement of pressure using piezoelectric sensor, Measurement of temperature using Thermistors and Thermocouples, Measurement of displacement using LVDT.

LIST OF EXPERIMENTS:

1. Calibration of AC voltmeter and AC ammeter.
2. Measurement of inductance using Maxwell's Bridge.
3. Measurement of capacitance using Schering Bridge.
4. Measurement of low resistance using Kelvin's Double Bridge.
5. Measurement of Power using CT and PT.
6. Measuring displacement using LVDT.
7. PC based data logging of temperature sensor using Lab VIEW/ MATLAB.
8. Signal conditioning of analog signal using Lab VIEW/ MATLAB.

Text/Reference Books:

1. A K Sawhney, "Electrical & Electronic Measurement & Instrument", DhanpatRai&Sons,
2. India
3. BC Nakra& K. Chaudhary, "Instrumentation, Measurement and Analysis," Tata McGraw
4. Hill 2ndEdition
5. Purkait, "Electrical & Electronics Measurement & Instrumentation", TMH
6. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India
7. M. Stout , "Basic Electrical Measurement", Prentice Hall of India
8. WD Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International
9. EW Golding & F.C. Widdis, "Electrical Measurement &Measuring Instrument", AW Wheeler & Co. Pvt. Ltd. India

BECT 304 & BECP 304	ELECTRONIC DEVICES	3L-1T-2P	5 Credits

COURSE OBJECTIVES:

1. To understand operation of semiconductor devices.
2. To understand DC analysis and AC models of semiconductor devices.
3. To study diodes and its application
4. To study basic concepts for the design of BJT and FET

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the principles of semiconductor Physics.
2. Understand and utilize the mathematical models of semiconductor junctions.
3. Understand carrier transport in semiconductors.
4. Utilize the mathematical models of MOS transistors for circuits and systems.
5. Analyze and find application of special purpose diodes.

Course Contents:

Module 1: Introduction to Semiconductor: Crystal Properties and charge Carriers in Semiconductors, Elemental and compound semiconductor materials, crystal lattice Structure, Energy bands in intrinsic and extrinsic silicon, carrier transport, diffusion current, driftcurrent, mobility and resistivity, Hall effect.

Module 2: Generation and recombination of carriers: Poisson and continuity equation P-N junction characteristics, I-V characteristics, carrier recombination, and small signal switching models.

Module 3: Diodes and its Applications: PN Junction diode: Half & Full wave rectifier, Clipper, Clamper. Voltage multiplier. Avalanche breakdown, Zener diode, Schottky diode, LED, Solar cell, tunnel diode.

Module 4: Bipolar Junction Transistor: Basic construction, transistor action, CB, CE and CC configurations, input/output Characteristics, concept of Biasing of transistors-fixed bias, emitter bias, potential divider bias, BJT Models.

Module 5: Field Effect Transistor: JFET: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristics equation CG, CS and CD configurations, Introduction to self and fixed biasing. MOSFFT: depletion and enhancement type MOSFET-construction, operation and characteristics.

LIST OF EXPERIMENTS

1. **Study of Lab Equipment and Components:** CRO, multimeter, and function generator, power supply- active, passive components and bread board.
2. **P-N Junction diode:** Characteristics of PN junction diode - static and dynamic resistance measurement from graph.
3. **Applications of PN Junction diode:** Half & Full wave rectifier- Measurement of V_{rms}, V_{dc}, and ripple factor.

4. **Characteristics of Zener diode:** V-I characteristics of Zener diode, graphical measurement of forward and reverse resistance.
5. **Characteristics of Photo diode:** V-I characteristics of photo diode, graphical measurement of forward and reverse resistance.
6. **Characteristics of Solar cell:** V-I characteristics of solar cell, graphical measurement of forward and reverse resistance.
7. **Application of Zener diode:** Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
8. **Characteristic of BJT:** BJT in CE configuration- graphical measurement of h- parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
9. **Field Effect Transistors:** Single stage common source FET amplifier –plotof gain in dB Vs frequency, measurement of bandwidth and input impedance.
10. **Metal Oxide Semiconductor Field Effect Transistors:** Single stage MOSFET amplifier–plot of gain in dB Vs frequency, measurement of bandwidth and input impedance.

Textbooks/References:

1. Boylestad and Nashelsky, 'Electronic Devices and circuits' PHI, 6e, 2001.
2. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
3. D. Neamen , D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
4. C.T. Sah, "Fundamentals of Solid-State Electronics," World Scientific publishing Co.Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford univ. press, 2011.
6. Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

BEET 304 BEEP 304	Networks Analysis and Synthesis	3L:1T:2P	5 Credits

Course Objectives:

At the end of this course students will demonstrate the ability to:

- Ability to solve electrical circuits with Graphs
- To learn techniques of solving circuits involving different active and passiveelements
- To analyze the behaviors of the circuit's response in time domain
- To analyze behavior of the circuit's response in frequency domain
- To understand the significance of network function

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- To understand basic electrical circuits with nodal and mesh analysis
- To apply Laplace transform for steady state and transient analysis
- Determine different network functions
- To understand electrical network theorems

Unit	Topics
I	**Graph Theory:** Basic circuital law, Mesh & Nodal analysis. Importance of Graph Theory in Network Analysis, Graph of a network, Definitions, planar &Non-Planar Graphs, Isomorphism, 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.
II	**AC Network Theorems**: Concepts of DC Network Theorems, Electrical Sources, Basic circuital law. Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Compensation theorem, Tellegen's Theorem.
III	Laplace transforms and properties, Application of Laplace transforms in Electrical System, Application of Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.
IV	**Two Port Networks-** Characterization of LTI two port networks; Z, Y, ABCD & h parameters, Reciprocity and symmetry, Inter-relationships between the parameters, Interconnections of two port networks, Ladder and Lattice networks.
V	**Network Synthesis:** Concept of poles and zeros, Properties of driving point and transfer functions. 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.

LIST OF EXPERIMENTS:

1. Verification of principle of superposition with dc and ac sources.
2. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits
3. Verification of Tellegin's theorem for two networks of the same topology.
4. Determination of transient response of current in RL and RC circuits with step voltage input.
5. Determination of transient response of current in RLC circuit with step voltage input for under damp, critically damp and over damp cases
6. Determination of frequency response of current in RLC circuit with sinusoidal ac input
7. Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.
8. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.

Text/Reference Books:

1. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.
2. CL Wadhwa, "Network Analysis and Synthesis", New Age InternationalPublishers.
3. A. Chakrabarti, "Circuit Theory", Dhanpat Rai& Co.
4. Reference Books:
5. Hayt, Kimmerly, Durbin, "Engineering Circuit Analysis", McGraw Hill.
6. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach",McGraw Hill.
7. ME Van Valkenburg, "An Introduction to Modern Network Synthesis", Wiley Eastern Ltd.
8. T.S.K.V. Iyer, "Circuit Theory", Tata McGraw Hill.
9. Samarjit Ghosh, " Network Theory: Analysis & Synthesis" Prentice Hall India.

BEEP 306	Programming Practices	0L:0T:4P	2 Credits

Course Objectives:

1. The course is intended to assist undergraduates in learning the basics of programming in general and programming MATLAB in particular.
2. Basics of programming in MATLAB will be covered, with the goal of having students become comfortable enough to continue learning MATLAB and other programming languages on their own.

Course Outcomes:

At the end of the course, students will be able to

1. Use MATLAB for programming purposes
2. Learn and explore MATLAB further on their own
3. Use this learning experience to learn other programming languages.

MODULE 1: INTRODUCTION

Data types and variables: Introduction to MATLAB, Data Types, Inter-conversion of Data types, MATLAB Variables, Keywords and Constant, Session Command. *MATLAB Operators and Operations:* Operators (Arithmetic, Relational, Logical, Bitwise), Set Operations, Operator Precedence, Mathematical Functions.

MODULE 2: PROGRAMMING IN MATLAB

Script and Function: Decision Making, Loops, branches, Functions, Working on Script File (Creating, Saving and Executing), MATLAB I/O, Formatted I/O Method.

MODULE 3: ARRAYS AND GRAPHICS

Matrices and Arrays: Introduction to Matrices, Operations on Arrays/Matrices, Manipulations of Arrays/Matrices, Expansion of Matrix Size, Reduction of Matrices/Arrays order.

Graphics: Introduction to plot, Basic 2-D Plots (Style options, Labels, Axis control, etc.), specialized 2-D Plots, drawing multiple plots. Using MATLAB for fractals and chaos and Conway game of life

MODULE 4: FILE HANDLING AND DEBUGGING

File Handling: Introduction to file handling, working on files, accessing of Text File, Saving/ Loading MATLAB Variables, reading data without opening file, reading and writing Excel.

Debugging: Introduction to debugging, Break points, debugger, stepping, watching variable values, debugging commands.

REFERENCES:

1. Delores M. Etter, David C. Kuncicky, Holly Moore, "*Introduction to MATLAB 7.0*", Pearson, 2013.
2. Rudra Pratap, "*Getting Started with MATLAB*", OXFORD University Press, 2010.
3. Agam Kumar Tyagi, "*MATLAB and Simulink for Engineers*", University Press, 2012.

WEB REFERENCES

https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming- fall-2011/syllabus/

BCST 308	Cyber Security	Non- Credit Course

1. Understand the basic concept of Cyber Security.
2. Understand the basic concept of Viruses.
3. Understand the basic concept of Digital Attacks.
4. Understand the basic concept of Phishing.
5. Understand the basic concept of Cyber Law.

Course Outcomes:

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

1. Know about various attacks and viruses in cyber systems
2. Know about how to prevent digital attacks
3. Know about how to prevent Phishing Attacks
4. Know about how to do secure transactions

MODULE-1

Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

MODULE-2

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control.

Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce- Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, public Key Cryptography.

MODULE-3

Developing Secure Information Systems, Application Development Security, Information Security, Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

MODULE-4

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate Policies-Sample Security Policies, Publishing and Notification Requirement of the Policies.

Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

References:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analysing Computer Security", Pearson Education India.
2. V.K. Pachghare, "Cryptography and information Security", PHI Learning Private Limited, Delhi India.
3. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla," Introduction to Information Security and Cyber Law" Willey Dreamtech Press.
4. Schou, Shoemaker, " Information Assurance for the Enterprise", Tata McGraw Hill.
5. Chander, Harish," Cyber Laws and It Protection", PHI Learning Private Limited, Delhi ,India

BECT 402	Signals & Systems	3L-1T-0P	4 Credits

Course Objective:

The objectives of this course are

1. To develop good understanding about signals, systems and their classification to provide with necessary tools and techniques.
2. To analyze electrical networks and systems to develop expertise in time-domain and frequency domain approaches to the analysis of continuous and discrete systems.
3. To introduce to the basics of probability, random variables and the variousdistribution and density functions;
4. To develop students' ability to apply modern simulation software to system.

COURSE OUTCOME:

Upon the completion of the course, students will be able to:

1. Analyze the properties of signals & systems
2. Apply Laplace transform, Fourier transform, Z transform and DTFT in signal analysis
3. Analyze continuous time LTI systems using Fourier and Laplace Transforms
4. Analyze discrete time LTI systems using Z transform and DTFT

Module 1: Signals and Systems: Continuous-time and discrete-time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, Continuous-Time and Discrete-Time LTI Systems and their properties.

Module 2: Time domain representation of LTI System: Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral and convolution sum using graphical method for unit step to unit step, unit step to exponential only. Properties of Convolution. Introduction to basic signals simulation using MATLAB.

Module 3: Fourier series and Fourier Transform: The response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-time Periodic Signals and their Properties, Continuous time and discrete time Fourier Transforms and their properties, System Characterized by Linear Constant Coefficient Differential equations and Difference equation.

Module 4: Sampling and Laplace Transform: Signal representation by samples, sampling theorem, Impulse train sampling, sampling of discrete time signals, discrete time processing of continuous time signals. Laplace Transform, Region of convergence, inverse Laplace Transform, Analysis and characterization of LTI System, Block diagram representation, Unilateral Laplace transform.

Module 5: Z-Transform: Z-Transform, Region of convergence, Inverse Z-transform, analysis and characterization of LTI system, Block diagram representation, Unilateral Z- transform.

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems," Pearson, 2015.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems -Continuous and Discrete," 4th edition, Prentice Hall, 1998.
3. B.P. Lathi, "Signal Processing and Linear Systems," Oxford University Press, 1998.
4. Douglas K. Lindner, "Introduction to Signals and Systems," McGraw HillInternational Edition: 1999.
5. Simon Haykin, Barry van Veen, "Signals and Systems," John Wiley and Sons(Asia) Private Limited, 1998.
6. V. Krishnaveni, A. Rajeswari, ""Signals and Systems," Wiley India PrivateLimited, 2012.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems," JohnWiley and Sons, 1995.

8. M. J. Roberts, "Signals and Systems - Analysis using Transform methodsand MATLAB," TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems," TMHNew Delhi, 2001.
10. A. Anand Kumar, “Signals and Systems,” PHI 3rd edition, 2018.
11. D. Ganesh Rao, K.N. Hari Bhat, K. Anitha Sheela, “Signal, Systems, andStochastic Processes,” Cengage publication, 2018.

BEET 402 & BEEP 402	Electrical Machines-I	3L:1T:2P	5 Credits

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

- Able to learn and analyze the various principles & concepts involved in Electromechanical Energy conversion
- Acquire the knowledge and Demonstrating the constructional details of DC machines as well as transformers
- Acquire the knowledge of working of transformers
- Acquire the knowledge of working of DC machines
- Acquire the knowledge of performance of transformers, individually and in parallel operation

Unit	Topic
I	**Principles of Electro-mechanical Energy Conversion:** Introduction, Review of magnetic system, Energy in Magnetic system, Force and torque in magnetic field system, Energy balance equation, Energy conversion via electrical field, Energy in a singly excited system, Determination of the Force and Torque from energy and co-energy, Generation of EMF in Machines, Torque in machine with cylindrical air gap.
II	**DC Machines-I:** Principle & Construction, Classification and circuit model, EMF equation of generator and torque equation of motor. Armature winding (Concentrated and Distributed), Armature reaction, Commutation, Interpoles and compensating windings, Performance characteristics of DC generators, Applications.
III	**DC Machines-II:** Performance characteristics of DC motors, Starting of DC motors; 3 point and 4 point starters, Speed control of DC motors; Field control, Armature control and Voltage control (Ward Leonard method); Efficiency and Testing of DC machines (Hopkinson's and Swinburne's Test), Applications, Introduction to Brushless DC Motor, stepper motor and DC Servo motor and their applications.
IV	**Single Phase Transformer:** Construction & Principle, Ideal and practical transformer, equivalent circuit & phasor diagram, losses in transformers. Efficiency and voltage regulation, all day efficiency, Testing of Transformers- O.C. and S.C. tests, Polarity test, Sumpner's test. Auto Transformer- Single phase and three phase autotransformers, Volt-amp relation, Copper saving in autotransformer, Efficiency, Merits & demerits and applications.
V	**Three Phase Transformers:** Construction, Three phase transformer, phasor groups and their connections, open delta connection, three phase to 2 phase and their applications, Three winding transformers. Parallel operation of single phase and three phase transformers and load sharing.

Experiments

1. To obtain magnetization characteristics of a DC shunt generator
2. To obtain load characteristics of a DC shunt generator and compound generator (a)

Cumulatively compounded (b) Differentially compounded

3. To perform Hopkinson's test and determine losses and efficiency of DC machine
4. To obtain speed-torque characteristics of a dc shunt motor
5. To obtain speed control of DC shunt motor using (a) armature resistance control (b) field control
6. To study polarity and ratio test of single phase and 3-phase transformers
7. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using O.C. and S.C. tests.
8. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.

Text/Reference Books:

1. IJ Nagrath & D.P. Kothari, "Electrical Machines", Tata McGraw Hill
2. Rajendra Prasad, "Electrical Machines", PHI
3. PS Bimbhra, "Electrical Machinery", Khanna Publisher
4. AE Fitggerald, C. Kingsley Jr and Umans, "Electric Machinery", McGraw Hill, International Student Edition.
5. H. Cotton, "Electrical Technology", CBS Publication.
6. MG Say, "The Performance and Design of AC machines", Pit man& Sons.
7. PS Bimbhra, " Generalized Theory".

BECT 401 & BECP 401	DIGITAL ELECTRONICS	3L-1T-2P	5 Credits

COURSE OBJECTIVE(s):

The objectives of this course are to:

1. Introduce the concept of digital and binary systems
2. Be able to design and analyze combinational logic circuits.
3. Be able to design and analyze sequential logic circuits.
4. Understand the basic software tools for the design and implementation of digital circuits and systems.
5. Reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.

COURSE OUTCOME(s):

1. After successful completion of the course student will be able to
2. Develop a digital logic and apply it to solve real life problems.
3. Analyze, design and implement combinational logic circuits.
4. Classify different semiconductor memories.
5. Analyze, design and implement sequential logic circuits.
6. Analyze digital system design using PLD.
7. Simulate and implement combinational and sequential circuits.

Course Contents:

Module 1:

Number Systems Binary Codes: Number System and its arithmetic, conversion between bases, Boolean algebra, Canonical form, SOP & POS forms, Minimization of Boolean Functions: K Map (upto 5 variables), Quine-Mcclusky method, Error detection & correcting codes, Hamming codes, Binary codes.

Module 2:

Combinational Logic Circuits: Introduction to Combinational Circuits, Analysis and Design Procedure, Binary Adder, Subtractor, Parallel Adder/Subtractor, Carry Look Ahead Adder, Decoder, Encoder, Priority Encoder, Digital Multiplexer, Magnitude Comparator. Programmable Logic Devices, PLA & PAL.

Module 3:

Sequential Circuits Fundamentals: Basic Architectural Distinctions between Combinational and Sequential circuits, Flip Flops: SR, JK, D and T Type, Timing and Triggering Consideration, JK Master Slave, Excitation Table of all Flip Flops, Conversion from one type of Flip-Flop to another.

Counters: Asynchronous and Synchronous Counters, Design of Up Counters, Design of Down Counters, Mod Counter, Lock-Out table, Self-Starting Counter.

Module 4:

Finite State Machine: Mealy and Moore machines, State Table, State Diagram, Reduction of State Table, FSM Design Steps, Counter Design Using FSM.

Logic Families: Classification of Logic Families, Parameters: Propagation Delay, Power Dissipation, Fan-in, Fan-out, Noise Margin. TTL Family, TTL output configurations, ECL Family, IIL Family, MOS Family. Logic gate design using TTL and MOS.

Module 5:

Hazard, Fault Detection: Hazard and Fault Detection, Static Hazards, Dynamic Hazards, Determination of Hazards in Combinational Circuits. Fault Detection Using Fault Table and Path Sensitizing Methods.

Memories: Sequential Access Memories, Random Access Memories, RAM, ROM, PROM, EPROM, EEPROM, Static and Dynamic RAM cells using nMOS CMOS, Memory Size Expansion.

List of Experiments:

1. Introduction to Digital Electronics lab- nomenclature of digital 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/de-multiplexer and encoder using logic gates.
5. Implementation of 4x1 multiplexer using logic gates.
6. Implementation of 4-bit parallel adder using 7483 IC.
7. To design and verify operation of half adder and full adder.
8. To design & verify the operation of magnitude comparator.
9. Design and verify the 4-bit synchronous counter.
10. Design and verify the 4-bit asynchronous counter.

Textbooks/References:

1. M. Morris Mano and M. D. Ciletti, Digital Fundamental, 4th, Edition, Pearson.
2. Digital Systems: Principles and Design, Raj Kamal, Pearson.
3. Fundamentals of Digital Circuits A. Anand Kumar PHI 3rd Edition, 2014.
4. Digital Fundamental, Thomas L Floyd, 11th Edition

BEET-404	Power System-I	3L:1T:2P	5 Credits

COURSE OUTCOMES (COs):

At the end of this course students will demonstrate the ability to:

- Acquire the knowledge of Power System Components, its element, transmission line, OHTL etc.
- Acquire the knowledge of corona and insulator and its calculation
- Acquire the knowledge of Design of transmission line, EHV AC and HVDC Transmission,
- Acquire the knowledge of Insulated cables Grounding and Insulated cables
- Acquire knowledge of High and extra high voltage transmission.

Unit	Topics
I	**Power System Components:** Single line Diagram of Power system, Brief description of power system **Elements:** Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator Supply System Different kinds of supply system and their comparison, choice of transmission voltage **Transmission Lines:** Configurations, types of conductors, resistance of line, skin effect, Kelvin's law. Proximity effect
II	**Over Head Transmission Lines:** Calculation of inductance and capacitance ofsingle phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading
III	**Corona and Interference:** Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electrostatic and electromagnetic interference with communication lines **Overhead line Insulators:** Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency
IV	**Mechanical Design of transmission line:** Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers **Insulated cables:** Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.
V	**Neutral grounding:** Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices **Electrical Design of Transmission Line:** Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

List of Experiments

1. MATLAB Program to Simulate Ferranti Effect
2. MATLAB Program to Model Transmission Lines
3. To observe the voltage distribution across an Insulator String
4. To study of Sag and factors effecting on Sag of Transmission Line
5. Study of Corona Discharge and AC Breakdown Voltage for Different Electrode-Gap Geometry.
6. Three phase short circuit analysis in a Synchronous Machine using MATLAB/ SIMULINK.
7. Z-bus Building Algorithm using MATLAB.

Text/Reference Books:

1. W. D. Stevenson, “Element of Power System Analysis”, McGraw Hill
2. C. L. Wadhwa, “Electrical Power Systems” New age international Ltd. Third Edition
3. AsfaqHussain, “"Power System”, CBS Publishers and Distributors
4. B. R. Gupta, “Power System Analysis and Design” Third Edition, S. Chand & Co.
5. M. V. Deshpande, “Electrical Power System Design” Tata McGraw Hill
6. Soni, Gupta &Bhatnagar, “A Course in Electrical Power”, DhanpatRai& sons
7. S.N.Singh, “ Electric Power Generation, Transmission& distribution.” PHI Learning

BEET-405 & BEEP 405	Control System	3L:1T:2P	5 Credits

COURSE OUTCOMES (COs):

- Students will be able to learn the basics of various types of control systems and automatic systems.
- Students will be able to build the mathematical model of system from differential equation and vice versa and shall know the better effects of feedback due to parametervariations.
- Students will be able to apply the basic knowledge to formulate the input output relationship of various component used in control system and their applications in building control system.
- Students will be able to perform and study a time domain analysis of control system and different performance measures and finally know about behavior of the system.
- Students will be able to learn the concept of stability, poles and zeros, using routh Hurwitz criteria and relative stability by bode plot, polar plot, Nyquist plot and be able to design and analyze the given system in frequency domain.

Detailed Content

Module I: The Control System: Open loop & closed control; servomechanism, Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gainformula Reduction of parameter variation and effects of disturbance by using negative feedback

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

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

Module IV: Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles

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

List of Experiments

1. To study P, PI and PID temperature controller for an oven and compare theirperformance.
2. To design Lag, Lead and Lag-Lead compensators using Bode plot.
3. To study DC position control system
4. To study synchro-transmitter and receiver and obtain output V/S input characteristics.
5. To determine speed-torque characteristics of an ac servomotor.
6. To study behavior of separately excited dc motor in open loop and closed loopconditions at various loads.
7. To determine time domain response of a second order system for step input andobtain performance parameters.
8. To plot root locus diagram of an open loop transfer function and determine range ofgain 'k' for stability.
9. To plot a Bode diagram of an open loop transfer function.
10. To draw a Nyquist plot of an open loop transfer functions and examine the stability ofthe closed loop system.

Reference Books:

1. Norman S. Mise, Control System Engineering 4th edition, Wiley Publishing Co.
2. M.Gopal, “Control System; Principle and design”, Tata McGraw Hill.
3. M.Gopal,” Modern Control system”, Tata McGraw Hill.
4. D.Roy Choudhary, “Modern Control Engineering”, Prentice Hall of India.

BCSP-409	Computer Programming-II (Python)	0L:0T:4P	2 Credits

1. Write a Python program to display the current date and time.
2. Write a Python program which accepts the radius of a circle from the user and compute the area.
3. Write a Python program which accepts the user's first and last name and print them inreverse order with a space between them.
4. Write a Python program which accepts a sequence of comma-separated numbers fromuser and generate a list.
5. Write a Python program to display the first and last colors from the following list. Color_List = ["Red","Green","White" ,"Black"]
6. Write a Python program that accepts an integer (n) and computes the value of n+nn+nnn.
7. Write a Python program to print the calendar of a given month and year.
8. Write a Python program to calculate number of days between two dates. Sample dates: (2014, 7, 2), (2014, 7, 11)
9. Write a Python program to get the volume of a sphere with radius 6. Write a Python program to get the difference between a given number and 17, if the number is greater than 17 return double the absolute difference.
10. Write a Python program to calculate the sum of three given numbers, if the values are equal then return three times of their sum.
11. Write a Python program to get a new string from a given string where "Is" has been added to the front. If the given string already begins with "Is" then return the string unchanged.

V-Semester

BEET-501: Electrical Machine-I

Course Objectives	**Principles of magnetic circuits, transformations, machines and generators, synchronous machines and generators, induction machines, special machines, renewable energy production.** **1. To give information about conversion of electrical energy into mechanical energy and vice versa using electromagnetic fields, to explain different machines and generators, working principles, to build basis for more advanced studies in electrical machines and to introduce renewable energy resources.**	
Code	**Course outcome**	**Level**
CO1	Analyze theoretically, the performance characteristics for different electrical machines and obtain simple equivalent circuit for the synchronous machine.	L4
CO2	Examine the testing of different electrical machines soas to identify their applicability in different practical situations and the process of 'synchronization' of a generator to the live bus bar and method of starting a synchronous motor.	L4
CO3	Illustrate the constructional details and principle of operation of three phase and single-phase induction motors.	L3
CO4	Apply the knowledge about starting and speed controlof induction motors, testing and applications of induction motors.	L3
CO5	Illustrate the construction, operation and characteristics of commonly used special purpose machines.	L3

Unit-I

D.C. Machine-I: Basic construction of DC machines; types of DC machines and method of excitation; lap and wave windings; Emf equation; armature reaction and methods of limiting armature reaction; Commutation process and methods for improving commutation; Basic performance of DC generators and their performance characteristics; Metadyne and Amplidyne; permanent magnet DC motors; Brush less dc motors.

Unit-II

D.C. Machine-II: Basic operation of DC motors; Torque equation; Operating characteristics of DC motors, Starting of DC motors- 2point, 3 point and 4-point starters; speed control of DC motors; losses and efficiency of DC machines; testing of DC machines, direct testing, Swinburne's test andHopkinson's test. Application of DC machines.

Unit-III

Synchronous Machine-I: Construction; types of prime movers; excitation system including

brushless excitation; polyphase distributive winding, integral slot and fractional slot windings; emf equation, generation of harmonics and their elimination; armature reaction; synchronous reactance and impedance, equivalent circuit of alternator, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, mmf, ZPF and new A.S.A method.

Unit-IV

Synchronous Machine-II: Salient pole machines; two reaction theory equivalent circuit model and phasor diagram; determination of Xd and Xq by slip test; SCR and its significance; regulation of salient pole alternator, power angle equation and characteristics; synchronizing of alternator with infinite busbar,; parallel operation and load sharing; synchronizing current, synchronizing power and synchronizing torque coefficient; synchro scopes and phase sequence indicator; effect of varying excitation and mechanical torque.

Unit-V

Synchronous machine-III:

Synchronous motor operation, starting and stopping of synchronous motor, pull in torque, motor under load power and torque, reluctance torque, effect of excitation, effect of armature reaction, power factor adjustment, V curves, inverted V curves, synchronous motors as power factor correcting device, super synchronous and sub synchronous motors, hunting and damper winding efficiency and losses. Analysis of short circuit oscillogram, determination of various transient, sub transient and steady reactances and time constants, expression of transient and sub transient reactances in terms of self and mutual inductances of various winding, short circuit current, equivalent circuit. Single phase synchronous motors- hysteresis motor, reluctance motor. Repulsion motor, stepper motor, switched reluctance

REFERENCE BOOKS

1. M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
2. I.J. Nagrath& D.P. Kothari, Electric Machines, Tata McGraw Hill , New Delhi,
3. P.S. Bhimbra, Electrical Machinery, Khanna Pub.
4. P.S. Bhimbra, Generalized theory of Electrical Machines, Khanna publishers, Delhi,
5. Ashfaq Husain, Electric Machines, Dhanpat Rai, New Delhi
6. Syed A. Nasar, Electric Machines & Power Systems, Volume I , Tata McGraw Hill, New Delhi
7. A.E. Fitzerald, C. Kingsley & S.D. Umans , Electric Machinery Tata McGraw Hill

Course objectives	To model various power system components and carry out load flow, short circuit and stability studies.	
Code	Course outcome	Level
CO1	Create computational models for analysis power systems and able to understand per unit system	L5
CO2	Analyse a power system network under Symmetrical Conditions to discriminate Positive Sequence, Negative & zero sequence system.	L4
CO3	Evaluate load flow computations for an interconnected power system.	L5
CO4	Illustrate power system operation and transient control.	L5
CO5	Test the stability control of a power system	L4

UNIT-I

Representation of power system components:

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 machines, internal voltage of loaded machines under transient conditions

UNIT-II

Analysis of single line to ground fault, line to line fault and double line to ground fault on an unloadedgenerator and power system network with and without fault impedance. Formation of Zbus using singular transformation and algorithm, computer method for short circuit calculations.

UNIT-III

Load flows:

Introduction, bus classifications, nodal admittance matrix (YBUS), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method,line flow equation and fast decoupled method.

UNIT-IV

Stability and stability limit, steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step by step method. Factors affecting steady sate and transient stability and methods of improvement.

UNIT-V

Wave equation for uniform transmission lines, velocity propagation, surge impedance, reflection and transmission of traveling waves under different line loadings, Bewlay's Lattice diagram, protection of equipment and line against traveling waves.

REFERENCE BOOKS

1. L.P. Singh, "Advanced Power System Analysis & Dynamics", New Age International
2. Hadi Sadat, "Power System Analysis", Tata Mc Graw Hill.
3. A.R. Bergen and V. Vittal, "Power System Analysis", Pearson Publication

BEET-505 Electromagnetic Field theory

Course Objectives	• To introduce the basic mathematical concepts related to electromagnetic vector fields. • To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications. • To impart knowledge on the concepts of magnetostatics, magnetic flux density,scalar and vector potential and its applications. • To impart knowledge on the concepts of Faraday 's law, induced emf and Maxwell's Equation.	
Code	Course outcome	Level
CO 1	Students can analyze a coordinate of point in Cartesian, Cylindrical and spherical co-ordinate systems. Also interpret the physical interpretation of gradient,divergence and curl.	L4
CO 2	Evaluate the physical quantities of electrostatic fields (Field intensity, Flux density etc.) in dielectric media andfree space using the fundamental laws (Coulomb andGauss law).	L6
CO 3	To compute the magnetic field intensity and magnetic flux density due to finite and infinite length of conductor by using Biot-Savart and Ampere Circuit law.	L3
CO 4	Apply the phenomena of wave propagation in lossy di-electric, loss-less dielectric and perfect conducting medium.	L3
CO 5	Analyze the nature of electromagnetic wave propagation in guided medium by using of transmission line parameters.	L4

Unit--I

Coordinate systems and transformation: Cartesian coordinates, circular cylindrical coordinates, spherical coordinates Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stoke's theorem, Laplacian of a scalar

Unit-II

Electrostatics: 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 lines, 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 condition.

Electrostatic boundary value problems: Poisson's and Laplace's equations,

general procedures for soling Poisson's or Laplace's equations, resistance and capacitance, method ofimages.

Unit-III

Magnetostatics: 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. 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-IV

Waves and applications: Maxwell's equation, Faraday's Law, transformer and motional electromotiveforces, Displacement current, Maxwell's equation in final form.

Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free space, plain waves in good conductors,power and the pointing vector, reflection of a plain wave in a normal incidence**.**

Unit-V

Transmission lines: Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, The Smith chart, Some applications of transmission lines.

REFERENCE BOOKS

1. Hayt, W.H. and Buck, J.A., "Engineering Electromagnetic" Tata McGraw Hill Publishing
2. Mathew Sadiku, "Electromagnetic Field Theory", Oxford University Press.
3. Kaduskar, Principles of Electromagnetics, Wiley India
4. IDA, Engineering Electromagnetics, Springer
5. Kodali, Engineering Electromagnetic Compatability, John Wiley &sons

Departmental Elective
BEET- 503 (A) CAD of power system

Course Objectives	To introduce computer applications in the analysis of power systems To understand the solution methods and techniques used in power system studies	
Code	Course outcome	Level
CO1	Recent techniques and computer application for modeling of practical and large interconnected power system networks using programming languages	L2
CO2	Recent methodologies for simulation and analysis of power system networks like real and reactive power flows and optimal scheduling.	L5
CO3	Effect of outage of any important component of power system on the operation and reliability of power systems	L4
CO4	Algorithm required to find out parameters for monitoring and control of power system in real time from actual measurement data.	L4

Unit-I

NETWORK MATRICES: Evaluation of Bus Admittance matrix (YBUS), Bus Impedance matrix (ZBUS), Branch Impedance matrix (ZBT) and Loop Admittance matrix (ZLOOP) by singular and non-singular transformation.

Unit-II

SHORT CIRCUIT STUDIES: Formulation of ZBUS for single phase and three phase networks, transformation of network matrices using symmetrical components; short circuit studies using computer.

Unit-III

LOAD FLOW STUDIES: Representation of off load and on load tap changing and phase shifting transformer and dc link, decoupled and fast decoupled methods, sparsity technique, introduction to load flow of integrated ac/dc/ system.

Unit-IV

STSBILITY STUDIES: Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), digital computer solution of swing equation for single and multimachine cases using Runge-Kutta and predictor corrector method, effect of exciter and governor on transient

References Books:

1. G.W. Stagg and A. H. El-Abiad, “Computer methods in power system analysis”, McGraw Hill, 1971.
2. G. L. Kusic, “Computer aided power system analysis”, PHI, 1986.
3. L.P.Singh, “ Advanced power system analysis and dynamics”, Wiley Eastern 1980.

BEET- 503 (B) Applied Instrumentation

Course Objectives	To make students understand the Identification, classification, The students will be able to Learn the measurement systems, errors of measurement, construction, working principle and application of various transducers used for Displacement measurement, Temperature measurement, Level measurement, and Miscellaneous measurement.	
Code	Course outcome	Level
CO 1	Acquire the knowledge basic sensor characteristics.	L3
CO 2	Classify the different types of sensors and actuators	L4
CO 3	Apply and solve appropriate mathematical equations of temperature sensors	L3
CO 4	Apply and solve appropriate mathematical equations of pressure sensors	L3
CO 5	Apply and solve appropriate mathematical equations of level sensors and display devices	L3

Unit-I

Introduction to measurement: Definition, application and types of measurement
System Introduction to CRO, Different parts of CRO, Its Block diagram, Electrostatic focusing, Electrostatic deflection, post deflection acceleration, Screen for CRTs, Graticule, Vertical & Horizontaldeflection system, Time base circuit, Oscilloscope probes and transducers, Attenuators, Application of CROs, Lissajous patterns, Special purpose CRO Multi input, Dual trace, Dual beam, Sampling, Storage(Analog & Digital) Oscilloscopes.

Unit-II

R, L, C Measurement: Bridges: Measurement of resistance using Measurement of inductance and capacitance by A.C. bridges: Maxwell's bridge, Anderson bridge, Schering bridge, Hay's bridge, Wein'sbridge, Shielding and grounding, Q meter.

Unit-III

Non-Electrical Quantities (Transducer): Classification of Transducers, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezoelectric transducer, Photo emissive, Photo conductive, Photo voltaic, Photodiode, Photo Transistor, Nuclear Radiation Detector.

Unit-IV

Digital instruments: Advantages of digital instruments, over analog instruments, DA, AD conversion, Digital voltmeter, Ramp type DVM, Integrating DVM, successive approximation DVM, frequency meter. Display devices: Digital display system and indicators like CRT, LED, LCD, Nixies, Electro luminescent, Incandescent, Electrophoretic image display, Liquid vapors display dot matrix display, Analog recorders, XY recorders. Instruments used in computer-controlled instrumentation RS 232C andIEEE 488, GPIB electric interface.

Unit-V

Signal generator: Function generator, sweep frequency generator, Pulse and square wave generator, Wave Analyzers, Harmonic Distortion Analyzer, Spectrum Analyzer, frequency counter.

References Books:

1. John P. Bentley : Principles of measurement systems, Longman 1983
2. Johnson C.D: Process control instrumentation technology, 4/e, PHI, 1995
3. D.Patranabis : Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd. New Delhi,1999
4. Sheingold D. H.: Transducer interfacing hand book – a guide to analog signal conditioning, analogdevices Inc masschusetts, 1980.
5. Anderson N A : Instrumentation for process measurement and control :Chilton book company 1980.
6. H. S. Kalsi: Electronics Instrumentation, TMH.
7. K. Sawhney: Instrumentation and Measurements, Dhanpat Rai and Co.
8. Helfric and Cooper: Modern Electronic Instrumentation and Measurement Techniques; Pearson

BEET 503(C)- Electrical Engineering Materials

Course Objectives	Understand the quantum mechanics of electron in crystals. Understand the basic electrical and magnetic properties of crystalline solids and amorphous materials. Understand the difference between electronic structures and physical properties of semiconductors, metals, and dielectrics.	
Code	Course outcome	Level
CO1	Illustrate students with a moderate level understanding of the physics behind the crystal structure of material	L3
CO2	Employ the students with the understanding of the physics behind the dielectric materials	L3
CO3	Analyse the students with a thorough understanding of the electrical properties and characteristics of various materials, used in electrical appliance	L4
CO4	Analyse the students with a thorough understanding of the magnetic properties and characteristics of various materials, used in electrical appliance	L4

UNIT-I

Conducting Material: Classification and main properties, High resistivity alloy: Constant Mangann, Nichrome, Electrochemical, properties of copper, Aluminum, steel tungsten, Molybdenum, Platinum, Tantalum, Niobium, Mercurry, Nickel, Titanum, Carbon, Lead, thermal, Bitmetals, thermocouple, materials, specific resistance, conductance, variation of resistance with temperature, super conductors.

Unit-II

Semi-Conductor Materials: General conception, variation of electrical conductivity, Elements having semiconductor properties, general application, hall effect, energy levels, conduction in semiconductors, Intrinsic conduction, impurity conduction, P and N type impurities, electrical change, Neutrality, Drift, Mobility current flow in semiconductors P-N junction formation by alloying, Elasing (forward and reverse) of P-n junction, Reverse separation current, Zener effect, Junction, capacitance, hall defects and hall coefficient.

Unit-III

Magnetic Materials: Details of magnetic materials, reduction between B.H. and, soft and hard magnetic materials. Di-magnetic, Para magnetic and Ferromagnetic materials, electrical sheet steel, cast iron. Permanent magnetic materials. Dynamic and static hysteresis loop. Hysteresis loss, eddy current loss, Magnetization, magnetic susceptibility, coercive force, core temperature, rectangular hysteresis loop, Magnet rest square loop core materials, iron silicon, Iron alloys.

Unit-IV

Insulating Materials: General electrical mechanical and chemical properties of insulating material, Electrical characteristics volume and surface resistivity complex permittivity loss, and dielectric loss,equivalent circuits of an imperfect dielectric polarization and polarizability classification of dielectric. **Unit-V**

Mechanical Properties: Classification insulating materials on the basis of temperature rise. General properties of transformer oil, commonly used varnishes, solidifying insulating materials, resins, bituminous waxes, drying oils, Fibrous insulating materials, wood, paper and cardboard, insulating textiles, varnished adhesive tapes, inorganic fibrous material and other insulating materials, such asmica, ceramic, bakelite, ebonite, glass, PVC, rubber, other plastic molded materials.

REFERENCE BOOKS

1. TTTI Madras; Electrical Engineering Materials; TMH.
2. Electrical Engineering Material s & Devices; John Allison ; TMH
3. Materials for Electrical Engineering: B.M. Tareev
4. Indulkar and S. Thruvengadem; Electrical Engineering Materials; S. Chand
5. Dekkor AK; Electrical Engineering Materials; PHI

V-Semester Open Elective
BOCT- 504 (A) Digital Control System

Course Objectives	To study the stability analysis of digital control system. To study the canonical forms of digital control systems. To determine steady state performance of Digital control systems.	
Codes	Course Outcomes	Level
CO1	Demonstrate non-linear system behavior by phase plane and describing function methods	L4
CO2	Perform the stability analysis nonlinear systems by Lyapunov method develop design skills in optimal control problems	L3
CO3	Derive discrete-time mathematical models in bothtime domain (difference equations, state equations) and zdomain (transfer function using z-transform)	L4
CO4	Predict and analyze transient and steady-state responses and stability and sensitivity of both open- loop and closed-loop linear, time-invariant, discrete-time control systems	L5
CO5	Acquire knowledge of state space and state feedbackin modern control systems, pole placement, design of state observers and output feedback controllers	L3

UNIT I

Introduction to Discrete Time Control System Basic building blocks of Discrete time Control system, Sampling Theorem, Z transform and Inverse Z transform for applications for solving differential equations, Mapping between the S-plane and the Z plane, Impulse sampling and Data Hold.

UNIT II

Pulse Transfer Function and Digital PID Controllers The pulse transfer function, pulse transfer function of Closed Loop systems, Pulse transfer function of Digital PID controller, Velocity & Position forms of Digital PID Controller, Realization of Digital Controllers, Deadbeat response and ringing of poles

UNIT III

Design of Discrete Time Control System by conventional methods Stability analysis in Z-plane, Jury stability criterion, bilinear transformations, Design based on the root locus method, Digital Controller Design using Analytical Design Method.

UNIT IV

State Space Analysis of Discrete Time Control System State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values, Eigen Vectors and Matrix Diagonalization, Discretization of continuous time state space equations, Similarity transformations.

UNIT V

Pole Placement and Observer Design Concept of Controllability and Observability, Useful transformations in state space analysis and design, Stability improvement by state feedback, Design via pole placement, State observers. Optimal Control Quadratic Optimal Control and Quadratic performance index, Optimal state regulator through the matrix riccati equations, Steady State Quadratic Optimal Control.

Reference Books:

1. Discrete Time Control systems by K. Ogata, Prentice Hall, Second Edition.
2. Digital Control and State Variable Methods by M. Gopal, Tata McGraw Hill.
3. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition
4. Digital control of Dynamic Systems by G.F.Franklin, J.David Powell, Michael Workman 3rd Edition, Addison Wesley .
5. Digital Control Engineering by M. Gopal, Wiley Eastern Ltd.

BOET- 504 (B) Communication Engineering

Course objectives	To familiarize students with the fundamentals of analog and digital communication systems, to provide students with tools for communication signal analysis, to familiarize students with various techniques for amplitude modulation and demodulation of analog signals	
Codes	Course outcomes	Level
CO1	The fundamentals of basic communication system,types of noise affecting communication system and noise parameters	L 2
CO2	Need of modulation, modulation processes and different amplitude modulation schemes	L 4
CO3	Different angle modulation schemes with different generation and detection methods.	L 2
CO 4	Analyze concept of advanced modulation techniques	L 4
CO 5	Apply the knowledge of digital communication anddescribe the error control codes like block code, cyclic code	L 3

Unit I:

Introduction: Overview of Communication system, Communication channels, Need for modulation, Baseband and Passband signals, Amplitude Modulation: Double sideband with Carrier (DSB-C), Double side band without Carrier DSB-SC, Single Side Band Modulation SSB, Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator, Radio Transmitter and Receiver.

Unit II:

Angle Modulation, Tone Modulated FM Signal, Arbitrary Modulated FM Signal, Bandwidth of FM Signals using Bessel's Function, FM Modulators and Demodulators, Approximately Compatible SSB Systems, Stereophonic FM Broadcasting

Unit III:

Pulse Modulation, Digital Transmission of Analog Signals: Sampling Theorem and its applications, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation, Their generation and Demodulation, Digital Representation of Analog Signals Pulse Code Modulation (PCM), PCM System Issues in digital transmission: Frequency Division Multiplexing Time Division Multiplexing, T1 Digital System, TDM Hierarchy.

Unit IV:

Differential Pulse Code Modulation, Delta Modulation. Adaptive Delta Modulation, Voice Coders, Sources of Noises, Frequency domain representation of Noise, Super position of Noises, Linear filtering of Noises, Mathematical Representation of Noise.

Unit V:

Noise in Amplitude Modulation: Analysis, Signal to Noise Ratio, Figure of Merit. Noise in Frequency Modulation: Pre-emphasis, De-Emphasis and SNR Improvement, Phase Locked Loops Analog and Digital.

Reference Books:

1. B.P.Lathi,"ModernDigitalandAnalogcommunicationSystems",3rd Edition, Oxford University Press.
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley India.
3. H.P.Hsu & D. Mitra "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.

BOCT- 504 (C) Industrial Electronics

Course Objectives	To build on the knowledge gained by studying power electronic modules and systems as well as support electronics for control and automation and their application in various domains.	
Codes	Course Outcomes	Level
CO1	Acquire basic knowledge on the working of various semi-conductor converters	L 2
CO2	Develop analysis capability in SCR and Circuits	L 4
CO3	Develop design competence in signal and power using SCR family elements	L 2
CO 4	Acquire knowledge on basic power OPAMPS	L 3
CO 5	Acquire knowledge on basic PLC and its working	L 3

Unit-I

Power supply, rectifiers (half wave, full wave), performance parameters of power supplies, filters (capacitor, inductor, inductor-capacitor, pi filter), bleeder resistor, voltage multipliers. Regulated power supplies (series and shunt voltage regulators, fixed and adjustable voltage regulators, current regulator), switched regulator (SMPS), comparison of linear and switched power supply, switch mode converter (flyback, buck, boost, buk-boost, cuk converters).

Unit-II

Silicon controlled rectifies (SCR), constructional features, principle of operation, SCR terminology, turn-on methods, turn-off methods, triggering methods of SCR circuits, types of commutation, comparison of thyristors and transistors, thermal characteristics of SCR, causes of damage to SCR, SCR over voltage protection circuit, Line commutated converters (half wave rectifier with inductive and resistive load, single phase and three phase full wave rectifiers).

Unit-III

Other members of SCR family Triacs, Diacs, Quadracs, recovery characteristics, fast recovery diodes, power diodes, power transistor, power MOSFET, Insulated gate bipolar transistor (IGBT), loss of power in semiconductor devices, comparison between power MOSFET, power transistor and power IGBT.

Unit-IV

Applications of OP-AMP Basics of OP-AMP, relaxation oscillator, window comparator, Opcomp as rectangular to triangular pulse converter and vice- versa, Wien bridge oscillator, function generator, frequency response of OP-AMP, simplified circuit diagram of OP-AMP, power supplies using OP-AMP, filters (low-pass, high pass) using OP-AMP

Unit-V

Programmable Logic Controller (PLC)Functions, applications, advantages and disadvantages of PLC over conventional relay controllers, comparison of PLC with process control computer system, factors to be considered in selecting PLC, functional block diagram of PLC, microprocessor in PLC, memory, input and output modules (interface cards), sequence of operations in a PLC, status of PLC, event driven device, ladder logic language, simple process control applications of PLC, Programming examples.

REFERENCE BOOKS

1. Bishwanath Paul: Industrial Electronics and control, PHI Learning.
2. Rashid: Power Electronics- Circuits, devices and applications, Pearson Education.
3. Singh and Khanchandani: Power Electronics, TMH

BOCT- 504 (D) Innovation and Entrepreneurship

Course Objectives	To acquaint with the fundamental concept of Entrepreneurship. It deals withbasic theory of startups/businesses. It is important for the student to understand the value of pow Entrepreneurship and its operation.
Code	Course outcome
CO1	To describe Types of Entrepreneurs.
CO2	Describe basic operation and Major Motives of an Entrepreneur
CO3	Analyze Market Survey and Research.
CO4	Formulate a Good Business opportunity.

UNIT-1

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT-2

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT-3

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity.

UNIT -4

Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

TEXT BOOKS :

- Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
- Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

REFERENCES:

- Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
- Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
- Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
- EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

BEET 601 Power Electronics

Course Objectives	To acquaint with the fundamental concept of power electronics. It deals with basic theory of different power electronics switches. It is important for the student to understand the application of power and their operation.	
Code	Course outcome	Level
CO1	Relate basic semiconductor physics to properties of powerdevices, and combine circuit mathematics and characteristics of linear and non-linear devices.	L4
CO2	Describe basic operation and compare performance ofvarious power semiconductor devices, passive components and switching circuits	L3
CO3	Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing therequirements of application fields.	L6
CO4	Formulate and analyze a power electronic design at the system level and assess the performance.	L5
CO5	Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.	L5

Unit-I

Power semiconductor devices: Power semiconductor devices their symbols and static characteristic, characteristics and specifications of switches, type of power electronic circuits, Thyristor operation, V-I characteristic, two transistor model, methods of turn-on operation of GTO, MCT and TRIAC

Unit-II

Power semiconductor devices (contd.): protection of devices, series and parallel operation of thyristors, commutation techniques of thyristor.

DC-DC convertors: Principles of step-down chopper, step down chopper with R-L load, principle of step-up chopper, and operation with R-L load, classification of choppers.

Unit-III

Phase controlled converters: Single phase half wave-controlled rectifier with resistive and inductive loads, effect of freewheeling diode, single phase fully controlled and half controlled bridgeconverters. Performance parameters, three phase half wave converters, three phase fully controlled and half controlled bridge converters, Effect of source inductance, single phase and three phase dual converters.

Unit-IV

AC Voltage controllers: Principle of on-off and phase controls, single phase ac voltage controller with resistive and inductive loads, three phase ac voltage controllers (various configuration and comparison).

Cyclo converters: Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo converters, output voltage equation.

Unit-V

Inverters: Single phase series resonant inverter, single phase bridge inverters , three phase bridge inverters, introduction to 1200 & 1800 mode of operation, voltage control of inverters, harmonics reduction techniques, single phase and three phase current source inverters

TEXT BOOKS:

1. M.S. Jamil Asghar, “Power Electronics” Prentice Hall of India Ltd., 2004
2. A. Chakrabarti, Rai & Co. “Fundamental of Power Electronics & Drives” Ghanpat Rai &Co.
3. K. Hari Babu, “Power Electroncis” Switch Publications.

BECT -602 Microprocessor and Embedded System

Course Objectives	• To develop background knowledge and core expertise ofmicroprocessors, • To know the importance of different peripheral devices and their interfacing to microprocessors. • To write assembly language programs of microprocessors forvarious applications	
Code	**Course outcome**	**Level**
CO1	Examine the evolution of processor and architecture of 8085, 8086, 80286, 80386, 80486, microcontroller, Pentium processors.	**L 4**
CO2	Analyze the architecture of 8086 microprocessor along with the addressing mode and comparison with 8088	**L 4**
CO3	Comply simple programs for 8085/86 in assembly language	**L 5**
CO4	Interpret the interfacing of 8086 microprocessor	**L 6**
CO5	Employ analog to digital converter and set up their interfacing with 8086 microprocessor	**L 5**

Unit-I

Introduction to Microprocessor: Introduction to Microprocessor and its applications, Microprocessor Evolution Tree, Microprocessor Architecture (Hardware & Princeton), General Architecture of the Microprocessor and its operations, Component of Microprocessor system: Processor, Buses, Memory, Inputs-outputs (I/Os) and other Interfacing devices.

Unit-II

8-bit Microprocessor: Intel 8085 microprocessor: Pin Diagram, Internal architecture: ALU, Registers, Timing and control unit, interrupt: Instruction Set of 8085: Instruction format, op-codes, mnemonics, no. of bytes computation of the instruction, Machine cycles and T-states and Execution time computation of an instruction. Classification of instruction with their examples. Writing of assembly Language programs.

Unit-III

Architecture of Intel 8086: Pin Diagram, Bus Interface Unit, Execution unit, Register organization, Memory addressing, Memory Segmentation, Pipelining, Min & Max operating Modes 8086Instruction set: Format, Addressing Modes, Instruction Set Groups: Data transfer, Arithmetic, Logic, String, Branch control transfer and Processor control. Interrupts: Hardware and software interrupts.

Unit-IV

Fundamental of Programming: Program structure for microprocessors, Flowcharts of series, parallel, and controls structures. Assembler Level Programming: Memory space allocation for monitor and user program. Assembly language program using Debug or MASM assembler.

Unit-V

Peripheral Interfacing: Programmed I/O, Memory Mapped I/O, Interrupt Driven I/O, DMA I/O interface, Serial and Parallel communications. Peripheral Devices: DMA controller (Intel 8237), Programmable peripheral interface (Intel 8255), Programmable timer/counter (Intl 8253/8254),Programmable Interrupt Controller (Intel 8259).

&

Text Books:

1. Gaonkar, Ramesh S, “Microprocessor Architecture, programming and applications with the 8085” Pen ram International Publishing 5th Ed.
2. Avtar Singh& Walter A. Triebel “8088 & 8086 Microprocessor” Pearson Education.
3. Ray, A.K. &Burchandi, K.M., “Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing” Tata Mc. Graw Hill.

BECT-603: Digital Signal Processing

CO1	Acquire knowledge about the time domain representation and classification of discrete time signals and systems	L 2
CO2	Acquire knowledge about the time domain analysis of lineartime invariant discrete time systems and representation of total response in various formats.	L 4
CO3	Acquire knowledge about the application of discrete time Fourier transform, Discrete Fourier series and z-transform for discrete time signal representation and analysis of linear time invariant systems discrete time systems	L 2
CO 4	Acquire knowledge about the design methods for IIR and FIRfilters and their realization structures.	L 4
CO5	Acquire knowledge about the finite word length effects in theimplementation of digital filters	L 3

Unit 1:

DISCRETE FOURIER TRANSFORM: Frequency Domain Sampling: The Discrete Fourier Transform

Frequency Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT: Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT.

Unit 2:

EFFICIENT COMPUTATION OF DFT: Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, Efficient computation of the DFT of a 2N-Point real sequences, , Chirp Z-transform algorithm.

Unit 3:

DESIGN OF DIGITAL IIR FILTERS: Impulse invariant and bilinear transformation techniques for Butterworth and chebyshev filters; Direct form (I & II), cascade and parallel.

Unit 4:

DESIGN OF FIR FILTERS:- windowing, optimum approximation of FIR filters, multistage approach to sampling rate concession. Design of Hilbert transforms.

Unit 5:

ADAPTIVE WIENER FILTER AND LMS ALGORITHM: Application of adaptive filtering to echo cancellation and equalization.

APPLICATION OF DSP AND CODING: Implementation of LIT using DFI, Goertzel algorithm, FFT algorithms. Audio and Video coding, MPEG coding standardization, FFT spectral analysis, DCT.

Text / References:

1. Proakis, J.G. & Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", Prentice Hall (India).
2. Sanjit K. Mitra, "Digital Signal Processing", Third Edition, TMH, 2005
3. Oppenheim A.V. & Schafer, Ronald W., "Digital Signal Processing", Pearson Education.
4. DeFatta, D.J., Lucas, J.G. & Hodgkiss, W.S., "Digital Signal Processing", John Wiley & Sons

BEET -604(A) FACTS

Code	Course outcome	Level
CO1	Understand the operations of different FACTS devices	L2
CO2	Select the controllers for different Contingencies.	L3
CO3	Analyze the different FACTS devices in different stability conditions.	L4
CO4	Select an appropriate FACTS device for a particular application	L3

Unit-I: Introduction: Reactive power control in electrical power transmission lines - Uncompensated transmission line – series compensation – Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

Unit-II: Static Var Compensator (SVC) And Applications Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer Enhancement of power system damping.

Unit-III:
Thyristor Controlled Series Capacitor (TCSC) And Applications Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

Unit-V: Voltage Source Converter Based Facts Controllers Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability – prevention of voltage instability. SSSC-operation of SSSC and the control of power flow – modelling of SSSC in load flow and transient stability studies.

Text/References:-

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

BEET-604(B) Energy Management and SCADA

Code	Course outcome	Level
CO1	Employ the fundamentals of PLC, DCS, and SCADA for automation used in industry.	L3
CO2	Differentiate the hardware and software requirements of PLC and SCADA.	L4
CO3	Categorizes the basics of man-machine communication based on the communication system	L4
CO4	Construct the safety instrumented systems on the basis of the requirements of safety.	L6
CO5	Apply the concept of SCADA in different applications	L5

Unit-I

SCADA

Purpose and necessity, general structure, data acquisition, transmission & monitoring. general power system hierarchical Structure. Overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels- cables, telephone lines, power line carrier, microwaves, fiber optical channels and satellites.

Unit-II

Supervisory and Control Functions

Data acquisitions, status indications, majored values, energy values, monitoring alarm and event application, processing. Control Function: ON/ OFF control of lines, transformers, capacitors and applications in process industry - valve, opening, closing etc. Regulatory functions: Set points and feed back loops, time tagged data, disturbance data collection and analysis. Calculation and report preparation

Unit-III

MAN- Machine Communication

Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities.

Unit-IV

Data basis

SCADA, EMS and network data basis. SCADA system structure - local system, communication system and central system. Configuration- NON-redundant- single processor, redundant dual processor. Multicontrol centers, system configuration. Performance considerations: real time operation system requirements, modularization of software programming languages

Unit-V

Energy Management Center

Functions performed at a centralized management center, production control and load management economic dispatch, distributed centers and power pool management.

Text Books:

1. TorstenCergrell, " Power System Control Technology", Prentice Hall International.
2. George L Kusic "Computer Aided Power System Analysis",, Prentice Hall of India,
3. A. J. Wood and B. Woolenberg, "Power Generation Operation and Control", John Wiley & Sons.
4. Sunil S Rao, "Switchgear Protection & Control System" Khanna Publishers 11th Edition.

BEET- 603 (C) NCER

Code	Course outcome	Level
CO1	Create awareness among students about Non-Conventional sources of energy technologies	L3
CO2	Enable students to understand various renewable energy technologies and systems.	L3
CO3	To impart the knowledge of Storage technologies form the autonomous renewable energy sources	L3
CO4	Equip the students with knowledge and understanding of various possible mechanisms about renewable energy projects	L4

Unit 1: Physics of Wind Power:
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 2: Wind generator topologies:
Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3: The Solar Resource
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4: Solar photovoltaic:
Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit 5: Network Integration Issues and Solar thermal power generation:
Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and
Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

Open Elective
BOCT 605(A) Introductionto Smart Grids.

Code	Course outcome	Level
CO 1	Classify the basic terms of a Power System Grid; explain the importance and objectives of the various dispersed generation units	L3
CO 2	Analysis of various energy management policies; distinguish them according to their priorities	L4
CO 3	Describe and classify the modern and innovative application fields of dispersed generation units	L3
CO 4	Describe by drawing a block diagram and explain the operation of the basic part of a smart grid (namely the Micro-grid); quantify its operational, financial and environmental advantages.	L3
CO 5	Acquire the knowledge on power quality of the smart-grid system	L3

UNIT I Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

UNIT II Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

UNIT III Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.

UNIT IV Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin flim solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources

UNIT V Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring.

Reference Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19.
5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.

BOCT-605(B)Power Plant Engineering

Code	Course outcome	Level
CO 1	Able to get the basics of Power Plants.	L3
CO 2	Able to get the idea about the power generation by renewable and non-renewable energy resources	L3
CO 3	Able to know about the different types of cycles and natural resources used in power plants and their applications.	L3
CO 4	Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.	L3
CO 5	Discussing environmental and safety aspects of power plant operation	L3

Unit-I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit-II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbinepower plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit-III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor(BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), FastBreeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit-IV

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit-V

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

BOCT-603(C) Special Electromechanical Systems

CO1	The ability to formulate and then analyses the working of any electrical machine under loaded and unloaded conditions	L5
CO2	The skill to analyses the response of any electrical machine	L4
CO3	The ability to troubleshoot the operation of an electrical machine	L3
CO4	Compare accepted standards and guidelines to select appropriate electrical machines to meet specified performancerequirements.	L4
CO5	Demonstrate an understanding of the fundamental control practices associated with rotating machines (starting, reversing,braking, speed control etc.).	L4

Unit-1

Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power).

Unit 2

Single phase Induction Motors: Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor-start capacitor-run and shaded pole motors. Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications

Unit 3

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.

Unit 4

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators and applications

Unit 5

Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, Linear force, and applications

Text/Reference Books:

1. P.S. Bimbhra "Generalized Theory of Electrical Machines" Khanna Publishers.
2. P.C. Sen "Principles of Electrical Machines and Power Electronics" John willey &Sons,2001

BEEP 501- EMEC- II Lab

List of Experiments

1. To perform no load and blocked rotor tests on a three-phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three-phase induction motor and draw Torque -speed characteristics
3. To perform no load and blocked rotor tests on a single-phase induction motor and determine equivalent circuit.
4. To study speed control of three phase induction motor by varying supply voltage and by keeping V/f ratio constant.
5. To perform open circuit and short circuit tests on a three-phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
6. To determine V-curves and inverted V-curves of a three-phase synchronous motor.
7. To determine Xd and Xq of a three-phase salient pole synchronous machine using the slip test andto draw the power-angle curve.
8. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
9. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
10. To determine speed-torque characteristics of single-phase induction motor and study the effect ofvoltage variation.
11. To determine speed-torque characteristics of a three-phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
12. To draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
13. To determine steady state performance of a three phase induction motor using equivalent circuit.

BEEP 502 – Power system- II Lab

List of Experiments

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Load Flow Analysis - I: Solution of Load Flow and Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
5. Transient Stability Analysis of Multi machine Power Systems
6. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
7. Economic Dispatch in Power Systems.
8. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System

BEEP- 601 Power Electronics Lab

List of Experiments

1. To study triggering of (i) IGBT (ii) MOSFET (iii) Power Transistor
2. To study V-I characteristics of SCR and measure latching and holding currents.
3. To compare the R, RC &UJT trigger circuit for SCR.
4. To study the commutation circuit for SCR.
5. To study single phase fully controlled bridge rectifiers with resistive and inductive loads.
6. To study single phase fully controlled bridge rectifiers with DC motor load.
7. To study three-phase fully controlled bridge rectifier with resistive and inductive loads.
8. To study single-phase ac voltage regulator with resistive and inductive loads.
9. To study single phase cyclo-converter
10. To study the four-quadrant operation of chopper circuit
11. To study MOSFET/IGBT based single-phase bridge inverter.

BEEP 602- Microprocessors and Embedded Systems Lab

List of Experiments

A. Study Experiments (any two):

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor

B. Programming based Experiments (any four):

4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of Numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from 0F to 0C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

C. Interfacing based Experiments (any four):

10. To obtain interfacing of RAM chip to 8085/8086 based system
11. To obtain interfacing of keyboard controller
12. To obtain interfacing of DMA controller
13. To obtain interfacing of PPI
14. To obtain interfacing of UART/USART
15. To perform microprocessor based stepper motor operation through 8085 kit
16. To perform microprocessor based traffic light control

VI-Semester BEEP -607/ 707 Minor Project-I/II

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study takenup under Project-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&Dlaboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under Project-I;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee

TEE701: SWITCHGEAR AND PROTECTION

Unit I: Introduction to power system:

Introduction to protective system and its elements, function of protective relaying, protective zones, primaryand backup protection, desirable qualities of protective relaying, basic terminology.

Relays:

Electromagnetic, attraction and induction type relays, thermal relay, gas actuated relay, designconsiderations of electromagnetic relays.

Unit II: Relay Applications and characteristics:

Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relays.

Static relays:

Comparison with electromagnetic relays, classification and their description, over current relays, directionalrelays, distance relays, differential relays.

Unit III: Protection of transmission line:

Time graded protection, differential and distance protection of feeders, choice between impedance, reactance and MHO relays, Elementary idea about carrier current protection of lines, protection of bus, auto reclosing,pilot wire protection.

Unit IV: Circuit Braking:

Arc phenomenon, properties of arc, arc extinction theories, recovery voltage and restriking voltage, currentchopping, resistance switching, capacitance current interruption, circuit breaker ratings.

Testing of circuit breakers:

Classification, testing station & equipment, testing procedure, direct and indirect testing.

Unit V: Apparatus protection:

Types of faults on alternator, stator and rotor protection, negative sequence protection, loss of excitation andoverload protection. Types of fault on transformers, percentage differential protection, Undergound neutralsystem, grounded neutral system and selection of neutral grounding.

Circuit breakers:

Need of circuit breakers, types of circuit breakers, operating modes, principles of construction, details of AirBlast, Bulk Oil, Minimum Oil, SF6, Vacuum Circuit Breakers, DC circuit breakers.

Reference Books:

1. Power system protection & switchgear, Badriram & D.V. Vishwakarma, TMH
2. Switchgear & Protection, M.V. Deshpande, TMH

TEE702: ANN AND FUZZY LOGIC

Unit-I

Neural Networks-1(Introduction & Architecture): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory

Unit-II

Neural Networks-II (Back propogation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propogation algorithm, factors affecting back propagation training, applications.

Unit-III

Fuzzy Logic-I (Introduction) : Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit-IV

Fuzzy Logic –II (Fuzzy Membership, Rules) : Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzifications, Fuzzy Controller,

Unit-V

Application of Neural Network and Fuzzy logic: Application of neural network, case study, Inverted pendulum, Image processing. Introduction to neuro & fuzzy logic controller.

Reference Books:

1. Siman Haykin,"Neural Networks "Prentice Hall of India.
2. Moore, Digital control devices, ISA press, 1986.
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.

TEC701: OPTICAL FIBRE COMMUNICATION SYSTEMS

UNIT 1: INTRODUCTION:

Demand of Information Age, Block Diagram of Optical fiber Communication System, Technology used in OFC System, Structure and types of Fiber, modes and Configuration**,** mode theory forcircular guide modal equation, modes in optical fiber, linearly polarized modes, attenuation factors, pulsebroadening in optical fiber, single mode fiber, mode field diameter, single distortion in single mode fiber, Derivation of material dispersion and waveguide dispersion. Attenuation, Signal Degradation in Optical Waveguides, Pulse Broadening in Graded index fiber Waveguides, Mode Coupling.

UNIT 2: OPTICAL SOURCES:

LED: Visible LED, Infrared LED, LED structure and configuration, Loss mechanism, Application of LED, operating Characteristics materials for Visible LED.

LASER: Principle of LASER Action, Efficiency of LASER Diode, principles and structures, index guided and gains guided lasers, mode separation, quantum well laser, laser modulation.

UNIT 3: OPTICAL DETECTORS:

Optical Absorption in semiconductors, Types of Photo Diodes, Principle of photo detection, working and structures of p-i-n and APD photo detectors, noises in photo detectors, SNR, detector response time effects, comparison of various photo detectors.

UNIT 4: ANALYSIS AND PERFORMANCE OF OPTICAL RECEIVER: Receiver Sensitivity, Photodiode for optical receiver, Optical Receiver Design, recent receiver circuits, System configuration and power budget.

UNIT 5: OPTICAL NETWORKS:

WDM concepts and principles, passive components, SONET/SDH networks, performance of WDM.

SUGGESTED BOOKS

1. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005

LIST OF ELECTIVE – I

TEE 011: Utilization of Electrical Energy and Traction
TEE 012: Digital Control System
TIC011: Fiber Optics and Laser Instrumentation
TIC012: Analytical Instrumentation

LIST OF ELECTIVE – II

TEE 021: Modern Control System
TEE 022: Bio-Medical Instrumentation
TEE 023: Power Plant Engineering
TIC 023: System Design Using Microcontroller

LIST OF ELECTIVE – III

TEE 031: Power Quality Improvement Techniques
TEE 032: Power Converter Application
TEE 033: EHV AC & DC TRANSMISSION
TEC 033: Adaptive Signal Processing
TEC 034: Embedded Systems

TEE011: UTILIZATION OF ELECTRICAL ENERGY AND TRACTION

Unit I: Electric Heating

Advantage & methods of electric heating, Resistance heating, Electric arc heating, Induction heating,Dielectric heating,

Unit II: Electric Welding

Electric arc welding, electric resistance welding, Electric Welding control, Electrolyte Process: Principal ofElectro deposition, laws of Electrolysis, application Electrolysis.

Unit III: Illumination

Various definition, laws of Illumination, requirement of good lighting, Design of indoor lighting & outdoorlighting system.

Refrigeration and Air Conditioning: Refrigeration system, domestic Refrigerator, water cooler, Types of Air conditioning, Window airConditioner

Unit IV: Electric Traction – I

Types of electric traction, system of track electrification, Traction mechanics-types of services, speed timecurve 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

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.

Reference Book:

1. H. Pratap. "Modern electric traction" Dhanpat Rai & Sons.
2. C.L. Wadhwa,"Generation, Distribution and Utilization of Electrical Energy "NewAge International Publishers.

TEE012: DIGITAL CONTROL SYSTEMS

Unit I: Signal Processing in Digital Control

Basic digital control system, advantages of digital control and implementation problems, basic discrete timesignals, z-transform and inverse z-transform, modeling of sample-hold circuit., pulse transfer function, solution of difference equation by z-Transform method.

Unit II: Design of Digital Control Algorithms

Steady state accuracy, transient response and frequency response specifications, digital compensator designusing frequency response plots and root locus plots.

Unit III: State Space Analysis and Design

State space representation of digital control system, conversion of state variable models to transfer functionsand vice versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.

Unit IV: Stability of Discrete System

Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on rth plane. Lyapunov's Stability in the sense of Lyapunov, stability theorems for continuous and discrete systems, stability analysis using Lyapunov's method.

Unit: V Optimal digital control

Discrete Euler Lagrange equation, max. min. principle, otpimality & Dynamic programming, Different types of problem and their solutions.

Reference Books:

1. J.R.Leigh, "Applied Digital Control", Prentice Hall, International
2. C.H. Houpis and G.B.Lamont, "Digital Control Systems: Theory, hardware, Software", Mc GrawHill.
1. B.C.Kuo, "Digital Control System", Saunders College Publishing.
2. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill.

TIC011: FIBRE OPTICS AND LASER INSTRUMENTATION

UNIT 1

OPTICAL FIBRES AND THEIR PROPERTIES Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses –Dispersion – Connectors & splicers – Fibre termination – Optical sources – Optical detectors.

UNIT 2

INDUSTRIAL APPLICATION OF OPTICAL FIBRES Fibre optic sensors–Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes
– Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT 3

LASER FUNDAMENTALS Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT 4

INDUSTRIAL APPLICATION OF LASERS Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT 5 **HOLOGRAM**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components.

TEXT BOOKS

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, 1985.
2. R.K Singh, ` Optical Fibre Communication System`, Wiley India
. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

TIC012: ANALYTICAL INSTRUMENTATION

UNIT 1

ELECTROMAGNETIC RADIATION – different regions, their wavelengths, frequencies and energies - interaction of EM radiations with matter – atomic, molecular, electronic interaction - Basic principles of spectroscopy – emission and absorption of radiations – resonance - radiation sources – dispersing and resolving techniques – detectors - typical atomic emission and absorption spectrographs in the UV and visible region.

UNIT 2

MOLECULAR SPECTRA – electronic, vibrational and rotational energies and spectra characteristic bands of radicals, OH, CH, CO, etc., - IR absorption – spectroscopy – single and double beam spectrophotometers

- instrumentation techniques for analyzing solid, liquid and gaseous samples – sample handling techniques.

UNIT 3

MICROWAVE SPECTROSCOPY – NMR, ESR and EPR spectroscopy – basic principles – instrumentation techniques and applications - principles of ion optics – ion sources – single focusing and double focusing mass spectrometers – principles and application

UNIT 4

Principles of X-ray fluorescence spectrometry and flame photometry – detection of X-rays and nuclear radiations – ionization chamber - proportional counter – GM counter - scintillation counter - solid state detector - gamma ray spectrometers – isotope dilution and tracer techniques for quantitative estimation andanalysis.

UNIT 5

ELECTROCHEMICAL METHODS – electrical conductivity of liquids conductivity and water purity – practical measurements and application – sulphur dioxide monitor – determination of pH – oxygen analyzers. Principles of gas and liquid chromatography – process chromatography – operation of typical process chromatography.

REFERENCE BOOKS

1. H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle, Instrumental methods of Analysis, 6th edition - CBSPublishers and Distributers, 1986.
2. B.E.Noltingk (Edtr,) Jone's Instrument Technology, Vol. 2, Fourth Edition, Butterworths, 1986
3. D.A. Skoog and D.M. West, Principles of Instrumental Analysis, 2 nd edition, Holt-Saunders, 1980.

PEE751: POWER SYSTEM LAB

Note: - At least 10 experiments should be performed out of which 3 should be simulation based.

1. To determine direct axis reactance (x_d) and quadrature axis reactance (x_q) of a salient polealternator.
2. To determine negative and zero sequence reactance of an alternator.
3. To determine sub transient direct axis reactance (x_d) and sub transient quadrature axisreactance (x_q) of an alternator
4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator atvery low excitation
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays
8. To determine location of fault in a cable using cable fault locator
9. To study Ferranti effect and voltage distribution in H.V. long transmission line usingtransmission line model.
10. To study operation of oil testing set.
11. Simulation Based Experiments (using MATLAB or any other software)
12. To determine transmission line performance.
13. To obtain steady state, transient and sub-transient short circuit currents in an alternator
14. To obtain formation of Y-bus and perform load flow analysis
15. To perform symmetrical fault analysis in a power system
16. To perform unsymmetrical fault analysis in a power system

PEC751: OFC LAB

Design of following ckt using appropriate software like VHDL/ FPGA and OFC kits.

1. 3-input NAND gate.
2. Half adder, Full Adder
3. D-Latch, T Flip Flop
4. Serial in-serial out shift register, Bidirectional shift Register
5. 3 Bit synchronous counter
6. To set up Fiber Optic Analog link.
7. To set up fiber Optic Digital link.
8. Measurement of Propagation loss and numerical aperture.
9. Characterization of laser diode and light emitting diode.

- NOTE: The institution can add 2 more practical in above prescribed list.

TEE801: ELECTRIC DRIVES

Unit I: Fundamentals of Electric Drive:
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 II: Dynamics of Electric Drive:
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 III: Electric Braking:
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 ofdc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking

Unit IV: Power Electronic Control of DC Drives
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.Chopper control of separately excited dc motor and dc series motor.

Unit V: Power Electronic Control of AC Drives
Three Phase induction Motor Drive, Static Voltage control scheme, static frequency control scheme (VSI,CSI, and cyclo- converter based) static rotor resistance and slip power recovery control schemes.
Special Drives: Switched Reluctance motor, Brushless dc motor.

Reference Books:

1. M.Chilkin, “Electric Drives”, Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd.Singapore.
3. N.K. De and Prashant K.Sen, “Electric Drives”, Prentice Hall of India Ltd
4. V.Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill

TEE802: SCADA & ENERGY MANAGEMENT SYSTEM

Unit I: SCADA

Purpose and necessity, general structure, data acquisition, transmission & monitoring. general power systemhierarchical Structure. Overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels- cables, telephone lines, power line carrier, microwaves, fiber optical channels and satellites.

Unit II: Supervisory and Control Functions

Data acquisitions, status indications, majored values, energy values, monitoring alarm and event application processing. Control Function: ON/ OFF control of lines, transformers, capacitors and applications in processin industry - valve, opening, closing etc. Regulatory functions: Set points and feed back loops, time taggeddata, disturbance data collection and analysis. Calculation and report preparation.

Unit III: MAN- Machine Communication

Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, reportand printing facilities.

Unit IV: Data basis

SCADA, EMS and network data basis. SCADA system structure - local system, communication system and central system. Configuration- NON-redundant- single processor, redundant dual processor. Multi-control centers, system configuration. Performance considerations: real time operation system requirements, modularization of software programming languages.

Unit V: Energy Management Center

Functions performed at a centralized management center, production control and load management economic dispatch, distributed centers and power pool management.

Books Recommended:

1. Torsten Cergrell, " Power System Control Technology", Prentice Hall International.
2. George L Kusic "Computer Aided Power System Analysis",, Prentice Hall of India,
3. A. J. Wood and B. Woolenberg, "Power Generation Operation and Control", John Wiley & Sons.
4. Sunil S Rao, "Switchgear Protection & Control System" Khanna Publishers 11th Edition.

TEE021: MODERN CONTROL SYSTEM

Unit I: Introduction to control systems
Introduction to control systems, properties of signals and systems. Convolution integral, Ordinary differential equation, Transfer function, Pole zero concepts, effect of pole location on performancespecification.

Unit II: State Space analysis
State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Solution of state equation, concepts of controllability, observability,Controllability and Observability tests.

Unit III: Discrete time control systems
Sampling theorem, Sampled-data systems, the sample and hold element, pulse transfer function, The Z- transform, stability analysis.

Unit IV: Stability
Liapunov's method, generation of Liapunov's function, Popov's criteria, design of state observers and controllers, adaptive control systems, model reference.

Unit V: Optimal Control
Introduction, formation of optimal control problems, calculus of variation, minimization of functions, constrained optimization, dynamic programming, performance index, optimality principles, Hamilton – Jacobian equation, linear quadratic problem, Ricatti II equation and its solution, solution of two point boundary value problem

Reference Books:

1. B.D.O. Anderson and IB. Moore, " Optimal Control System: Linear Quadratic Methods", Prentice Hall International.
2. U. Itkis, "Control System of Variable Structure", John Wiley and Sons.
3. H. Kwakemaok and R. Sivan, "Linear Optimal Control System", Wiley Interscience.

TEE022: BIO –MEDICAL INSTRUMENTATION

Unit I: Basic Physiological system of body

Problem encountering measuring leaving system, bioelectric potential, biomaterial, Basic transducers principle, Active and passive transducers, transducer for biomedical applications, Generation, propagationand distribution of bioelectric potential (ECG, EEG and EMG)

Unit II: Bio Potential Electrode

Basic type (micro skin surface and needle electrodes), Biochemical transducer (PH, blood gas and specification electrodes), Cardiovascular System & Measurement, Heat and cardiovascular system and circulation block diagram blood pressure and, measurement, characteristics of blood flow and heart sound, Electrocardiography, ECG a lead, configuration, ECG recording and their types

Unit III: Nervous System

The anatomy of nervous system, neuronal communication, EPSP, IPSP, Organization of brain, Measurement from the nervous system, Systematic skin and body temperature measurement, Temperature measurement,Brief idea about ultrasonic measurements

Unit IV: Patient Care Monitoring

Element of intensive care, Organizational the hospital for patient-care monitoring, Pace makers-type, systems, mode and generators, Defibrillator-types. Biotelemetry and application of telemeter inpatient care

Unit V: Automation of Chemical Test

Instrumentation for diagnostic X rays, Interfacing computer with medical instrumentation and otherequipments, Bio medical computer application. Shock hazards from electrical equipments, methods of accident prevention.

Reference Books:

1. Cromwell- Biomedical Instrumentation and Measurements- PHI
2. Webster, J.G. –Bio- Instrumentation, Wiley (2004)
3. Ananthi, S. –A Text Book of Medical Instruments-2005-New Age International
4. Carr & Brown –Introduction to Biomedical Equipment Technology – Pearson
5. Pandey & Kumar-Biomedical Electronics and Instrumentation. - Kataria

TEE023: POWER PLANT ENGINEERING

UNIT 1

INTRODUCTION : Piping and instrumentation diagram of a thermal power plant, basic process on a boiler, Fuel measurement- review of pressure and temperature measurement steam and water flow measurement – instrument applications in power stations: review of indicating and recording instrument applications in power stations: review of indicating and recording instruments, water level gauge for boiler drums, closed circuit television instrument, gas analysis meters, smoke instruments, dust monitor- measurement of impurities in feed water and steam generator coolant controls and instruments, instrument maintenance aspects.

UNIT 2

BOILER CONTROL-I: Boiler control objectives-combustion of fuels (gaseous liquid, and solid), excessair, combustion chemistry and products of combustion, requirement for excess combustion, air-circulation of efficiency of boiler: input/output method-stream temperature control systems super heaters and de- superheaters.

UNIT 3

BOILER CONTROL-II: Feed water supply and boiler water circulation system-drum level control systems-boiler draft systems-measurement and control of furnace draft measurement and control ofcombustion-draft and air flow control related functions.

UNIT 4

FLUE GAS ANALYSIS TRIMMING OF COMBUSTION CONTROL SYSTEMS: Combustion control for liquid and gaseous fuel boilers coal or solid fuel strokes combustion control for stoker-fired boilers- pulverized coal-fired boilers. Turbine monitoring and control: speed, vibration, shell temperature monitoring.

UNIT 5

NUCLEAR POWER PLANT INSTRUMENTATION: Piping and instrumentation diagram of differenttypes of nuclear power plants-radiation detection instruments process sensors for nuclear power plants- spectrum analyzers-nuclear reactor control systems and allied instrumentation.

REFERENCE BOOKS:

1. A.Sherryet. Al. (Editors), Modern power station practice, Vol.6 (Instrumentation controls andtesting), Pergamon Press, 1971.

TIC023: SYSTEM DESIGN USING MICROCONTROLLERS

UNIT 1

REVIEW OF MICROCONTROLLERS: Features of Typical Microcontroller – on Board peripherals – Processor Selection criteria – Microcontroller Design Specifications – Word length – Performance Issues -Power consumption – Package Types – Electrical requirements – Reset Hardware – oscillator Design – power Consideration - Development Tools – Firmware Development options – Assembly Language Vs High level Language Programming.

UNIT 2

MCS51 MICROCONTROLLER AND INTERFACING: Intel MCS51 Architecture – Derivatives - Special Function Registers (SFR), I/O pins, ports and circuits, Instruction set, Addressing Modes, AssemblyLanguage Programming, Timer and Counter Programming, Serial Communication, Connection to RS 232,Interrupts Programming, External Memory interfacing , Introduction to 16 bit Microcontroller

UNIT 3

PIC MICROCONTROLLER AND INTERFACING: Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion, I 2C BusOperation Serial EEPROM, Analog to digital converter, UART-Baud Rate-Data Handling-Initialization, Special Features - serial Programming- Parallel Slave Port.

UNIT 4

SOFTWARE DEVELOPMENT AND TOOLS: Embedded system evolution trends. Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler- cross compilers and Integrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

UNIT 5

REAL TIME OPERATING SYSTEMS: Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS. System Design Issues – Design of IndustrialControl System.

REFERENCES:

1. Burns, Alan and Wellings, Andy, " Real-Time Systems and Programming Languages ", Second Edition.Harlow: Addison-Wesley-Longman, 1997.
2. Raymond J.A. Bhur and Donald L.Bialey, " An Introduction to real time systems: Design to networkingwith C/C++ ", Prentice Hall Inc. New Jersey, 1999.
3. Grehan Moore, and Cyliax, " Real time Programming: A guide to 32 Bit Embedded Development.Reading " Addison-Wesley-Longman, 1998.
4. Heath, Steve, " Embedded Systems Design ", Newnes 1997.

TEE031: POWER QUALITY IMPROVEMENT TECHNIQUE

Unit I: Power Quality Terms and Definitions
Introduction, transients, sag and swell, short duration/long duration voltage variations, voltage imbalance, waveform distortion, voltage fluctuations, power frequency variation.
Power Quality Problems:
Poor load power factor, loads containing harmonics, notching in load voltage, DC offset in loads, unbalanced loads, disturbance in supply voltage.
Unit II: Fundamentals of Harmonics: Representation of harmonics, waveform, harmonic power, measures of harmonic distortion; current and voltage limits of harmonic distortion: IEEE, IEC, EN, NORSOK
Causes of Harmonics: 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms andtheir harmonic spectrum; Input supply harmonics of AC regulator, integral cycle control, cycloconverter, transformer, rotating machines, ARC furnace, TV and battery charger.

Unit III: Effect of Harmonics: Parallel and series resonance, effect of harmonics on static power plant- transmission lines, transformers, capacitor banks, rotating machines, harmonic interference with ripple control systems, power system protection, consumer equipments and communication systems, power measurement.
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Unit IV: Elimination/Suppression of Harmonics: High power factor converter, multi-pulse convertersusing transformer connections (Delta, polygon)
Passive Filters: Types of passive filters, single tuned and high pass filters, filer design criteria, double tunedfilters, damped filters and their design.

Unit V: Active Power filters: Compensation principle, classification of active filters by objective, systemsconfiguration, power circuit and control strategy.
Shunt Active Filter: Single phase active filter, principle of operation, expression for compensating current,concept of constant capacitor voltage control; Three phase active filter: Operation, analysis and modeling; Instantaneous racavitve power theory
Three phase series active filters: Principle of operation, analysis and modeling.
Other Techniques: Unified power quality conditioner, voltage source and current configurations, principleof operation for sag, swell and flicker control.

.
Reference books:

1. C. Sankarm,"Power Quality" CRC Press USA.
2. Barry W. Kennedy, "Power Quality Primer "McGraw Hill.
3. Wilson E. Kazibwe,"Electrical power quality controls techniques" Van Nostrand Reinhold.

TEE032: POWER CONVERTER APPLICATIONS

Unit I: HVDC Transmission

Schematic diagram; modes of operation, twelve pulse line commutated converters, effect of source inductance; control of HVDC converters, converter faults and protection, harmonic filters

Unit II: FACT Controllers

Principal of power transmission, principal of shunt compensation- and series compensation-TCR, TCS, SVC, STATCOM, Series compensator- TSSC, FCSC, TCSC, SSVC, phase angle compensator, unified power flow controller (UPFC), comparison of compensator

.

Unit III: Power Supplies

Desirable specification of power supply, draw back of linear power supply. Switch mode power supply (SMPS)-schematic diagram, fly back converters, forward converter, push pull converters, half bridge and full bridge converter; uninterruptible power supply,(UPS)-configuration of line and online UPS, switch mode and resonant power supplies, air craft power supply.

Unit IV: Industrial Applications

High frequency inverters for induction and dielectric heating, ac voltage controllers for resistance heating and illumination control, high frequency fluorescent lighting, electric welding control.

Unit V:

Interconnection of Renewable Energy Sources to the Utility Grid, Photovoltaic array interconnection, windand small hydro interconnection, interconnection of energy storage system, DC circuit breaker, single phaseand three phase ac switches, Excitation control of synchronous generator.

Reference Books:

1. K.R. Padiyar, “HVDC Power Transmission: Technology and System Reactions” NewAge International
2. Ned Mohan, T.M. Undeland and William P. Robins, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons.
3. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications” Prentice Hallof India.

TEE033: EHV A.C. & D.C. TRANSMISSION

Unit I: Introduction
Need of EHV transmission, standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC &DC transmission.

Unit II: EHV AC Transmission
Corona loss formulas, corona current, audible noise- generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferro resonance, reduction of switching surges on EHV system, principle of half wave transmission.

Unit III: Extra High Voltage Testing
Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement ofhigh voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines, Design factorsunder steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollutionon performance of EHV lines.

Unit IV: EHV DC Transmission-I
Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters, principle of dc link control, converter controls characteristics, firingangle control, current and excitation angle control, power control, starting and stopping of dc link.

Unit V: EHV DC Transmission- II
Converter faults, protection against over currents and over voltage, Smoothing reactors, generation of harmonics, ac and dc filters, multi –terminal dc systems (MTDC): Types, control, protection and application

Reference books:
1. M.H Rashid, “Power Electronics: Circuit, Devices and Applications “Prentice hall of India.
2. S . Rao, “EHV AC & HVDC Transmission Engineering and practice” KhannaPublishers.

TEC 033: ADAPTIVE SIGNAL PROCESSING

UNIT 1

INTRODUCTION: Definition and characteristics, general properties open and closed loop adaptation.

UNIT 2

ADAPTIVE LINEAR COMBINER: General description, input signal and Weight vectors, desired response and error performance function, gradient and minimum mean square, alternative definition of gradient, decorelection of error and input components.

UNIT 3

THEORY OF ADAPTATION WITH STATIONARY SIGNALS: Input correlation matrix, Eigen values and eigenvectors of the correlation matrix, and their geometrical significance. Basic ideas of gradient search methods, gradient search by newton's method and method of steepest descent, gradient component estimation by derivative measurement, effects of gradient noise, on weight vector solution, excess MSE, time constant and mis-adjustment, performance comparison of Newton and S.D. methods.

UNIT 4:

ADAPTIVE ALGORITHMS: Least mean square algorithm, convergence, learning curve noise in Weight vector misadjustment and performances of LMS algorithms, sequential regression algorithm, adaptive recursive LMS algorithm, random search algorithm.

RECURSIVE LEAST SQUARE ALGORITHM: Preliminaries, matrix inversion lemma, exponentially weighted RLS algorithm, update recursion for the sum of weighted error squares, convergence analysis of RLS algorithm

UNIT 5:

ADAPTIVE FILTER STRUCTURES: Lattice structures, all poles and all zeroes' versions, adaptive lattice predictor. Lattice LMS algorithms, and lattice SER algorithms, adaptive filters with orthogonal signals, DFT and lattice preprocessors.

ADAPTIVE FILTER APPLICATIONS: (i) Adaptive modeling and systems identification. (ii) Inverse adaptive modeling, equalization and deconvolution

SUGGESTED BOOKS:

1. Adaptive Signal Processing, Widrow and Stearns, Pearson Education
2. Adaptive Filter Theory, Simon Haykin, Pearson Education

TEC 034: EMBEDDED SYSTEMS

UNIT 1

INTRODUCTION: Embedded systems and its applications, Embedded Operating system, Design parameters of an embedded system and its significance, design life cycle, tools introduction, hardware and software partitioning and co-design.

UNIT 2

HARDWARE FUNDAMENTALS FOR THE EMBEDDED DEVELOPERS: Digital circuit parameters- Open collector outputs Tristate outputs I/O sinking and Sourcing, PLD's, Watchdog Timers, Hardware design and development.

CUSTOM SINGLE PURPOSE PROCESSORS: Optimizing program, FSMD, Data path & FSM. **GENERAL PURPOSE PROCESSORS AND ASIP'S** (Application Specific Instruction set Programming): Softwareand operation of general purpose processors-Programmers View Development Environment-ASIPs Microcontrollers-DSP Chips.

UNIT 3

INTRODUCTION TO MICROCONTROLLERS AND MICOPROCESSORS: Embedded versus external memory devices, CISC and RISC processors, Harvard and Von Neumann Architectures. **RTOS** -Tasks, states, Data, Semaphores and shared data, Operating system services, Message queues, Mailboxes.

UNIT 4

ADVANCED PROCESSOR-(only architectures) 80386, 80486, ARM and DUAL CORE, Core toDUO, i3, i5, i7 (References)

COMMUNICATION BASICS: Microprocessor Interfacing I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel protocols and wireless protocols.

UNIT 5

REAL WORLD INTERFACING: LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Keyboard, Latch Interconnection, PPI.

SUGGESTED BOOKS:

1. Embedded System Design-Frank Vahid/Tony Givargis, John Willey@2005.
2. Microcontroller (Theory and Applications) Ajay V Deshmukh, Tata McGraw-Hill@2005.
3. An Embedded Software Primer-David E.Simon, Pearson Education @ 1999.

REFERENCES:

4. The 8051 Microcontroller and embedded systems-Muhammad Ali Mazidi and Janice Gillispie.

PEE851: ELECTRIC DRIVES LAB

Note: - Minimum 10 experiments are to be performed from the following out of which atleast three should be simulation based.

1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter.
2. To study speed control of separately excited dc motor by varying armature voltage using singlephase half-controlled bridge converter.
3. To study speed control of separately excited dc motor using single phase dual converter (StaticWard-Leonard Control)
4. To study speed control of separately excited dc motor using MOSFET/IGBT chopper
5. To study closed loop control of separately excited dc motor
6. To study speed control of single-phase induction motor using single phase ac voltage controller.
7. To study speed control of three phase induction motor using three phase ac voltage controller
8. To study speed control of three phase induction motor using three phase current source inverter
9. To study speed control of three phase induction motor using three phase voltage sourceinverters
10. To study speed control of three phase slip ring induction motor using static rotor resistancecontrol using rectifier and chopper
11. To study speed control of three phase slip ring induction motor using static scherbius slippower recovery control scheme
12. Simulation Based Experiments (using MATLAB or any other software)
13. To study starting transient response of separately excited dc motor
14. To study speed control of separately excited dc motor using single phase fully / half-controlled bridgeconverter in discontinuous and continuous current modes.
15. To study speed control of separately excited dc motor using chopper control in motoring andbraking modes.
16. To study starting transient response of three phase induction motor
17. To study speed control of three phase induction motor using (a) constant/V/F control (b)Constant Voltage and frequency control.