CURRICULUM & SYLLABI
2019-2020
B. TECH. IN ELECTRICAL ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
JAMIA MILLIA ISLAMIA
NEW DELHI-110025

B. TECH. ELECTRICAL ENGINEERING COURSE STRUCTURE UNDER THE CHOICE BASE CREDIT SYSTEM (CBCS)

Effective from July-2018

Abbreviation

BS	Basic Science	**L**	Lecture
ES	Engineering Science	**T**	Tutorial
CBCS	Choice Based Credit System	**P**	Practical
DC	Departmental core	**CCA**	Continuous Class Assessment
DE	Departmental electives	**MSE**	Mid SemesterEvaluation
		ESE	End Semester Evaluation

B. TECH. ELECTRICAL ENGINEERING –II YEAR

S. No	Course No.	Course Name	Type	Credit	Periods Per week			Examination Scheme (Distribution of Marks)			
					L	T	P	CCA	MSE	ESE	Total
Third Semester											
1.	EE-301	Transformer and Induction Machine	DC	3	2	1	-	8	22	45	75
2.	EE-302	Network Analysis	DC	3	2	1	-	8	22	45	75
3.	EE-303	Analog Electronics	ES	3	2	1	-	8	22	45	75
4.	EE-304	Signals and System	ES	3	2	1	-	8	22	45	75
5.	EE-305	Electromagnetic Field Theory	CBCS	4	3	1	-	10	30	60	100
6.	BS-301	Engineering Mathematics- III	BS	3	2	1	-	8	22	45	75
PRACTICAL (LAB.)											
7.	EE-331	Transformer and Induction Machine Lab.	DC	1	-	-	2	15	-	10	25
8.	EE-332	Network Analysis Lab.	DC	1	-	-	2	15	-	10	25
9.	EE-333	Analog Electronics Lab.	ES	1	-	-	2	15	-	10	25
			Total	**22**	**13**	**6**	**6**			**Total**	**550**
Fourth Semester											
1.	EE-401	DC and Synchronous Machine	DC	3	2	1	-	8	22	45	75
2.	EE-402	Digital Electronics	ES	3	2	1	-	8	22	45	75
3.	EE-403	Fundamentals of Power Systems	DC	3	2	1	-	8	22	45	75
4.	EE-404	Programming Languages	ES	3	2	1	-	8	22	45	75
5.	EE-405	Computer Architecture	CBCS	4	3	1	-	10	30	60	100
6.	BS-401	Engineering Mathematics-IV	BS	3	2	1	-	8	22	45	75
PRACTICAL (LAB./SEMINAR)											
7.	EE-431	DC and Synchronous Machine Lab.	DC	1	-	-	2	15	-	10	25
8.	EE-432	Digital Electronics Lab.	ES	1	-	-	2	15	-	10	25
9.	EE-434	Programming Languages Lab	ES	1	-	-	2	15	-	10	25
			Total	**23**	**14**	**5**	**8**			**Total**	**550**

Refer ordinance 15-C (XV-C) clause 3(2).

- The Mid Semester Evaluation shall have a weightage of 40% while the remaining 60% weightage will be for End Semester Examination.
  - (i) 30% for two mid semester tests, both of equal weightage;
  - (ii) 10% for other modes of sessional evaluation (to be specified by the Faculty Committee and notified before the commencement of teaching of each course).

There will be no Mid Semester practical tests. In a practical course/ project/ seminar/ industrial training/ field work, the End Semester Examination shall have a weightage of 40% while the performance of the student as evaluated by the teacher concerned during the semester (i.e. Mid Semester Evaluation) shall have a weightage of 60%.

B. TECH. ELECTRICAL ENGINEERING COURSE STRUCTURE UNDER THE CHOICE BASE CREDIT SYSTEM (CBCS)

Effective from July-2019

Abbreviation

BS	Basic Science	**L**	Lecture
ES	Engineering Science	**T**	Tutorial
CBCS	Choice Based Credit System	**P**	Practical
DC	Departmental core	**CCA**	Continuous Class Assessment
DE	Departmental electives	**MSE**	Mid SemesterEvaluation
		ESE	End Semester Evaluation

B. TECH. ELECTRICAL ENGINEERING –III YEAR

Fifth Semester											
S. No	Course No.	Course Name	Type	Credit	Periods Per week			Examination Scheme (Distribution of Marks)			
					L	T	P	CCA	MSE	ESE	Total
1.	EE-501	Switchgear and Protection	DC	3	2	1	-	8	22	45	75
2.	EE-502	Power Electronics	DC	3	2	1	-	8	22	45	75
3.	EE-503	Communication Systems	DC	3	3	1	-	10	30	60	75
4.	EE-504	Electrical Measurement	DC	3	2	1	-	8	22	45	75
5.	EE-505	Power Systems Analysis	DC	3	2	1	-	8	22	45	75
6.	EE-506	Electrical Power Generation	CBCS	4	3	1	-	8	22	45	100
PRACTICAL (LAB.)											
7.	EE-531	Switchgear and Protection Lab	DC	1	-	-	2	15	-	10	25
8.	EE-532	Power Electronics Lab	DC	1	-	-	2	15	-	10	25
9.	EE-533	Communication Systems Lab	ES	1	-	-	2	15	-	10	25
			Total	**22**	**13**	**6**	**6**			**Total**	**550**
Sixth Semester											
1.	EE-601	Control Systems	DC	3	2	1	-	8	22	45	75
2.	EE-602	Electrical and Electronics Instrumentation	DC	3	2	1	-	8	22	45	75
3.	EE-603	Microprocessor and its Applications	ES	3	2	1	-	8	22	45	75
4.	EE-604	Electric Drives	DC	3	2	1	-	8	22	45	75
5.	BS-601	Engineering Mathematics-V	BS	2	2	-	-	5	15	30	50
6.	-	Elective I	CBCS	4	3	1	-	10	30	69	100
Elective-I	EE-607 Digital Communication/EE-608 Programmable logic controller/EE-609 Data Structure										
PRACTICAL (LAB./SEMINAR)											
7.	EE-631	Control Systems Lab	DC	1	-	-	2	15	-	10	25
8.	EE-632	Electrical Measurement Lab	DC	1	-	-	2	15	-	10	25
9.	EE-633	Microprocessor Lab	ES	1	-	-	2	15	-	10	25
10.	EE-640	Seminar	DC	1	-	-	2	15	-	10	25
			Total	**23**	**13**	**6**	**8**			**Total**	**550**

Effective from July 2018, Final Year Batch

Category of Courses

DC: Departmental core
CBCS: Choice Based Credit System
SEC: Skill Enhancement Courses
AECC: Ability Enhancement Compulsory Course
DE: Departmental electives

Abbreviation

L Lecture
T Tutorial
P Practical
CCA Continuous Class Assessment
MSE Mid SemesterEvaluation

B. TECH. ELECTRICAL ENGINEERING –IV YEAR

S. No	Course No.	Course Name	Type	Credit	Periods Per week			Examination Scheme (Distribution of Marks)			
					L	T	P	CCA	MSE	ESE	Total
Seventh Semester											
1.	EES-701	Advanced Power Systems	**DC**	4	3	1	-	10	40	60	100
2.	EES-702	HVDC Transmission	**AECC**	4	3	1	-	10	40	60	100
3.	EES-703	Micro Controllers & Its Application	**CBCS**	4	3	1	-	10	40	60	100
4.	-	Elective-II	**DE**	4	3	1	-	10	40	60	100
Elective-IIEES-705 Soft Computing/ EES-706 / EES-707 High Voltage Engineering/ EES-708 Special Electrical Machines/ EES-709 Bio Medical Instrumentation											
PRACTICAL (LAB.)											
5.	EES-731	Power Systems Lab	**DC**	2	-	-	4	30	-	20	50
6.	EES-730	Industrial Training*	**SEC**	2	-	-	4	30	-	20	50
7.	EES-750	Minor Project	**DC**	6	-	-	12	90	-	60	150
			Total	**26**	**12**	**4**	**20**			**Total**	**650**
Eighth Semester											
1.	EES-801	Industrial Management	**DC**	4	3	1	-	10	40	60	100
2.	EES-802	Control Systems-II	**AECC**	4	3	1	-	10	40	60	100
3.	-	Elective-III	**CBCS**	4	3	1	-	10	40	60	100
4.	-	Elective-IV	**DE**	4	3	1	-	10	40	60	100
Elective-III EES-803Process Control/ EES-804 Electrical Machine Design /EES-805 Advanced Protective Relays/ EES-806 Utilization of Electrical Energy/ EES-810 SCADA & Smart Grid											
Elective-IV EES-807 Data Communications and Computer Networks, EES-808Advanced Microprocessors/EES-809- Digital Signal Processing											
PRACTICAL (LAB./SEMINAR)											
05	EES-840	Smart Grid - SCADA Lab	**SEC**	2	-	-	4	30	-	20	50
06	EES-850	Major Project	**DC**	8	-	-	16	120	-	80	200
			Total	**26**	**12**	**4**	**20**			**Total**	**650**

EE-301: Transformer and Induction Machine

Credit	L	T	P
3	2	1	-

UNIT I

TRANSFORMER: General constructional features of transformers, types of transformers, e.m.f. equation, working principle. Voltage, current and impedance relationships. Phasor diagram on no-load and full-load. Exact and approximate equivalent circuits. Open circuit and short circuit tests. Per-unit representation. Voltage regulation, conditions for maximum regulation, zero regulation and minimum regulation. Significance of voltage regulation in power and distribution transformers.

UNIT II

TRANSFORMER: Losses and efficiency, condition for maximum efficiency. Efficiency consideration in power and distribution transformers. All-day efficiency. Phasing out in three-phase transformer units. Polarity test. Single-phase transformers connected as three-phase bank. Comparison of 3-phase unit with 3-phase bank. Star/star, delta/delta, star/delta, delta/star and open delta connections. 3-phase to 2-phase and 3-phase to 6-phase conversions. Need and conditions for parallel operation, load sharing with equal and unequal voltage ratios, effect of per-unit impedance and X/R ratio, proportional load sharing.

UNIT III

TRANSFORMER: Principle of working and comparison of autotransformer with two-winding transformer. Advantages of tertiary winding in a three-winding transformer. Harmonics and magnetizing inrush in transformer.

3-PHASE INDUCTION MOTOR: General constructional features. Qualitative description of working of 3-phase induction motor from rotating field viewpoint. Stator fed and rotor fed induction motor. Steady state analysis: Equivalent circuit, phasor diagram, power flow diagram. Steinmetz IEEE equivalent circuit.

UNIT IV

3-PHASE INDUCTION MOTOR: Thevenin's equivalent model, torque-speed equation and characteristic, motoring, generating and braking regions, starting torque, maximum torque. Concept of leakage reactance and its importance in machine performance and design. Effect of rotor resistance on performance of induction motor. Deep-bar rotor and double-cage rotor. Starting, speed control and braking.

UNIT V

3-PHASE INDUCTION MOTOR: No-load and blocked-rotor tests, circle diagram, prediction of performance by circle diagram. Effect of space harmonics and time harmonics, crawling and cogging. Open, semi-closed, closed slots and their effect on motor performance.

SINGLE PHASE INDUCTION MOTOR: Double revolving field theory, principle of operation based on double revolving field theory, forward torque and backward torque, torque-speed characteristic. Equivalent circuit based on double revolving theory. Starting methods: Resistance-start split-phase, capacitor-start, capacitor-run, 2-value capacitor type motors, shaded pole motor, characteristics and applications.

TEXT/REFERENCE BOOKS.

1. I.J. Nagrath and D.P. Kothari, "Electrical Machines", Tata McGraw Hill, New Delhi.
2. Ashfaq Husain, "Electric Machines", Dhanpat Rai & Co.
3. George McPherson, "An Introduction to Electric Machine and Transformers", John Wiley, New York.
4. A.E. Fitzgerald, C. Kingsley and S.D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi.

EE-302: Network Synthesis

Credit	L	T	P
3	2	1	-

UNIT-I

Network graph, properties of tree in a graph, incidence matrix, cut- set matrix, tie- set matrix and their properties, No. of possible trees of graph, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Reciprocity theorem, duality.

UNIT-II

Transfer function, transient and steady state system, transient response, natural response, zero state response, initial condition, complete response: inductance, capacitance, RL, RC and RLC network their Continuity relationship, their response to sinusoidal input, to exponential excitation, second order response.

UNIT-III

Two port networks, synthesis, impedance parameters, admittance parameters, transmission parameters, inverse transmission parameters, hybrid parameters, inverse hybrid parameters, their reciprocity and symmetry conditions, inter- relationship between the parameters, inter-connection of two port networks, cascaded connection, series, parallel, series –parallel connection.

UNIT-IV

Network functions, driving point impedance function, voltage transfer function, ladder network, poles- zeros, necessary condition for transfer function, necessary conditions for driving function, effect of pole position on stability, significance of pole zero position, time-domain and frequency response from pole- zero plot.

UNIT-V

Driving point immitance function: properties, physical realizability, Synthesis: Hurwitz polynomial and properties, positive real function and properties, LC, RC, RL- network and their synthesis using Foster –I, II and Cauer –I, II form.

TEXT/REFERENCE BOOKS.

1. A. Sudhakar, Shyammohan S. Palli, "Circuits & Networks – Analysis and Synthesis", Tata Mc Graw Hill Co.,3rd Edition,New Delhi.
2. Network Analysis by Mac Van Valkenberg
3. Network analysis and synthesis by F. F. Kuo
4. Network analysis and synthesis by C. L. Wadhwa
5. Fundamentals of Network analysis and synthesis by Behrouz Peikari

EE-303: Analog Electronics

Credit	L	T	P
3	2	1	-

UNIT-II

JFET: characteristics and equations. Common Source, Common Gate configurations and Source follower. MOSFET: Depletion type MOSFETs and Enhancement type MOSFETs. VMOS and CMOS. Biasing and small signal AC analysis of FETs.

UNIT-II

Darlington pair, Emitter follower, Current mirror, Differential amplifier (Emitter-coupled), calculation of Adm, Acm and CMRR. Amplifier fundamentals, Op-amp basics and its equivalent circuit, Input offset voltage and current, Input bias current, Gain bandwidth product, Slew rate.

UNIT-III

Non-inverting, Buffer, Inverting, Summing, Differentiating, Integrating amplifier, Logarithmic, Anti-logarithmic, Instrumentation amplifier. Schmitt trigger circuit, Precision rectifier, Peak detector, and Active filter.

UNIT-IV

Power Amplifier: Introduction and definition. Series fed class-A amplifier, Transformer coupled class-A amplifier, Class-B, Class-C, and class-D power amplifier. Push-Pull amplifier circuit. Distortion and efficiency of Power Amplifier.

UNIT-V

Feedback concept and types of feedback, Feedback connections. Effect of negative feedback on amplifier's input impedance, output impedance, gain, stability and bandwidth. Barkhausen's criterion for oscillation, Phase-shift oscillator, Wien's bridge oscillator, 555 timer, Voltage controlled oscillator.

TEXT/REFERENCE BOOKS.

1. Robert Boylested, Louis Nashelky, "Electronic Devices and Circuit Theory", Pearson Education, New Delhi, India.
2. Sergio Franco, Design with Operational Amplifier and Analog Integrated Circuits, McGraw Hill Book Company, New Delhi, India.
3. Jacob Millman, Christor C. Halkias, "Electronic Devices and Circuits", McGraw Hill Book Company, New Delhi, India.
4. E. Norman lurch, "Fundamental of Electronics", John Wiley and Sons, New York, USA. Donald L.Schilling, CharlesBelove, "Electronic Circuits: Discrete and Integrated,"
5. McGraw Hill Book Company, New Delhi, India.

EE-304 Signals and System

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Morphology of signals and their classifications. Even and odd functions, orthogonal function, definition of Step, impulse, ramp functions. Other non-sinusoidal signals and wave forms as the sum of standard functions. Fourier series representation of signals.

UNIT-II
Fourier Integral and Fourier transform and its properties. Parsevel's theorem. System representation using differential equations, transfer function, impulse response. Poles and zeroswith their concepts and significance

UNIT-III
Analysis of continuous-time Linear Time Invariant (LTI) system using Laplace Transform. Frequency response of LTI systems, zero input response, forced input response. Stability of LTI system, pole criteria for stability.

UNIT-IV
Introduction to Z-transform, Inverse Z- transform and their properties, region of convergence. Poles and zeros. Difference equation, transfer function, pulse response. Application of Z-transform for the analysis of discrete-time LTI systems.

UNIT-V
Correlation: Energy signals, power signals, autocorrelation, cross-correlations its properties and examples. Power spectral density, it's definition and derivations.

TEXT/REFERENCE BOOKS.
1. S. Hykin, Barry Van Veen "Signals and System", John Wiley & Sons.
2. Robert A Gabel, "Signal and Linear Systems", John Wiley & Sons.
3. Mahmood Nahvi, "Signals and Systems", Mc Graw Hill Education.
4. Material from internet.

EE-305 Electromagnetic Field Theory

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-1
Vector Analysis, coordinate systems, vector operator, curl, divergence theorem, Stoke's theorem, Coulomb's law, electric field intensity, field due to continuous volume charge distribution, field of a line charge, field of a sheet of charge.

UNIT-II
Electric flux density, Gauss's law, symmetrical charge distributions, differential volume element, divergence, Maxwell's first equation, energy expended in moving a point charge in an electrostatic field, line integral, definition of potential; and potential difference, potential field of a charge, potential field of a system of charges, potential gradient, the dipole, energy density in electric field.

UNIT-III
Current and current density, continuity of current, metallic conductors, conductor properties and boundary conditions, semiconductors, nature of dielectric materials, boundary conditions for perfect dielectric materials, capacitance, several capacitance examples, capacitance of two wire line, Poisson's and Laplace's equations, unique Theorem, examples of the solution of Laplace's and Poisson's equations, product solution of Laplace equation.

UNIT-IV
Boit Savart law, Ampere's circuital law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivations of steady magnetic field laws, force on a moving charge, force on differential current element, force between differential current elements, force and torque on a closed circuit.

UNIT-V
Faraday's law, displacement current, Maxwell's equations in point forms and in integral forms, Application of Maxwell's equations, EM waves and propagation of energy. Wave equation for free space. Plane and uniform plane wave. Poynting vector and power, Intrinsic impendance of media for uniform plane wave.

TEXT/REFERENCE BOOKS.

1. William H. Hayt (Jr.), "Engineering Electromagnetics", McGraw Hill Book Co., New Delhi.
2. N.Narayana Rao, "Elements of Engineering Electromagnetics", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Joseph A. Edminister, "Electromagnetics", Schaum's Outline Series in Engineering, McGraw Hill Co., New Delhi.
4. David K. Cheng, "Field and Wave Electromagnetics", Second Latest Edition, Addison Wesley Publishing Company Inc. Reading, Massachusetts, U.S.A.

BS-301: Engineering Mathematics –III

Credit	L	T	P
3	2	1	-

UNIT I

Review of Gradient, Curl, Divergence, vector identities and directional derivatives: Line, Surface and volume integrals, Green's theorem in xy- plane, Gauss divergence theorem and Stoke's curl theorem (without proof), and related problems.

Extremals of functions (by mean of Euler- Poisson equation), Isoperimetric problems, Beta and Gamma functions, Dirichlet&Liouville's multiple integrals of first, second and third kinds Representation of a definite integrals in Legendre & Jacobi forms of Elliptic Integrals of first, second and third kinds.

UNIT II

Review of Theorem on Probability, conditional probability; Law of total probability, Baye's Theorem and related problems; Random variable and Probability distribution, mean & variance of Binomial & Poisson distributions, Normal, Gamma and ,Beta distribution and related problems, Moments generating function, measures of Skewness& Kurtosis, Correlation and Regression Analysis.

UNIT III

Fourier's series (full range and half range) for arbitrary period, Representation of a function in terms of Fourier integral, Fourier Sine integral and Fourier Cosine integral, Infinite complex Fourier transform, Finite & infinite Fourier sine & cosine transforms and their inverse transforms, Properties of different transforms and associated theorems, application in integral equations and boundary value problems.

UNIT-IV

Generating functions, Recurrence relations and orthogonal properties for Bessel's functions $J_n(x)$ and Legendre's polynomials $P_n(x)$, Jacobi series, Fourier-Bessel series and Fourier-Legendre series, Differential equations reducible to Bessel form, Rodrigue formula for $P_n(x)$ and related problems

UNIT-V

Test for convergence and divergence of infinite series using comparison test, D'Alembart's ratio test, Logarithmic test, Raabe's test, Cauchy n^{th} root test, Leibnitz test for convergence of alternating series, Absolute & conditional convergence and uniform convergence.

TEXT/REFERENCE BOOKS.

1. A.B. Mathur& V.P. Jaggi: "Advanced Engineering Mathematics"
2. B.S. Grewal: "Higher Engineering Mathematics".
3. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics"
4. H.C. Taneja :"Engineering Mathematics Volume I, II".
5. Erwin Kreyszig : "Advanced Engineering Mathematics"

EE-401: DC and Synchronous Machine

Credit	L	T	P
3	2	1	-

UNIT I

DC Machine: Basic parts, induced e.m.f., developed torque, lap winding, wave winding, equalizer connection. Armature flux distribution and its effects, brush shift, demagnetizing and cross magnetizing m.m.f., commutation, interpoles and compensating winding. Determination of compensating winding m.m.f. Determination of interpolem.m.f. for compensated and uncompensated DC machines.

UNIT II

DC Generator: Types, magnetization characteristics, self-excitation principles. External and internal characteristics of separately excited and self excited DC generators. Applications. Parallel operation of DC generators.

DC Motor: Types, load characteristics of separately excited, shunt, series and compound motors. Applications. Starting, speed control and braking.

UNIT III

DC Machine: Power balance, losses and efficiency, condition for maximum power output and maximum efficiency. Testing- Swinburne's, Hopkinson's, Field's and retardation tests; separation of losses.

Synchronous Machine: General constructional features, principle of operation, types of rotor, e.m.f. equation, short pitch winding and pitch factor, distributed winding and distribution factor. Cylindrical rotor machine- interaction between excitation flux and armature m.m.f., steady state equivalent circuit and phasor diagram, transition from generator action to motor action.

UNIT IV

Synchronous Machine: Steady state power flow and power angle characteristics. Effect of variation in excitation at constant load, V-curves, inverted V-curves and generator compounding curves. Open-circuit, short-circuit and zero power factor (lagging) tests. Short Circuit Ratio (SCR). Voltage regulation of alternator and its determination by synchronous impedance, m.m.f., Potier's triangle and American Standards Association methods.

UNIT V

Synchronous Generator: Synchronization and parallel operation of synchronous generators (Alternators). Governor characteristics and load sharing. Synchronizing current, synchronizing power and synchronizing torque.

Synchronous Motor: Starting methods of synchronous motor. Operation as synchronous condenser.

Salient-pole machine: Two reaction theory. Operation under balanced steady-state conditions in generator and motor modes. Power angle equations and characteristics. Determination of $X_d$and X_q by slip test.

TEXT/REFERENCE BOOKS.

1. I.J. Nagrath and D.P. Kothari, "Electrical Machines", Tata McGraw Hill, New Delhi.
2. Ashfaq Husain, "Electric Machines", Dhanpat Rai & Co.
3. George McPherson, "An Introduction to Electric Machine and Transformers", John Wiley, New York.
4. A.E. Fitzgerald, C. Kingsley and S.D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi

EE-402: Digital Electronics

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Introduction to Logic Gates, Boolean Algebra and Minimization Techniques for BooleanExpressions, Introduction to codes: ASCII, Excess-3, Gray, Hamming codes.

UNIT-II
Binary Half-Adder, Full-Adder, Subtractor, Parity Checker/Generator, Multiplexer/Demultiplexer, Encoder, Decoder, Digital to Analog Converter, Weighed Register: R-2R Ladder Network: Analog to Digital Conversion, Successive Approximation Type, Dual Slope Type.

UNIT-III
Introduction to Asynchronous Systems, Flip-Flop: RS, T, D, JK, Master-Salve JK, RippleCounters-Shortened modulus. Up and down counter designs, Applications of Ripple counter.

UNIT-IV
Parallel Counters, Type T Counter Design, Non-Sequential Counting (Skipping States), Type D Counter Design, Shift Registers, Ring Counters, Type JK Counter Design, Asynchronous Sequential Circuits Design.

UNIT-V
Diode Transistor Logic (DTL), Transistor Transistor Logic (TTL), Typical TTL NAND Gate,Function of the Input Transistor, Volt-Ampere Characteristics, Fan-In and Fan-Out Calculations, Output Stages: Totem Pole and Modified Totem Pole, Introduction to Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL) and MOS-logic, Comparison of Various Logic Families.

Additional topics:

1. Generation of Control signals using Flip-Flop
2. Simulation using PSIM

TEXT/REFERENCE BOOKS.

1. Morris Manno, “Digital Circuits and Logic Design”, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Reference book names + websites
3. Herbert Taub and Donald Schilling, “Digital Integrated Electronics”, McGraw Hill Book Co.
4. William H.Gothman, “Digital Electronics-An Introduction to Theory and Practice”, Prentice Hall of India Pvt. Ltd., New Delhi.

Websites

1. www.nptel.ac.in
2. www.electricalcircuits.com

EE-403: Fundamentals of Power Systems

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I

Line parameters, Resistance, calculation of inductance of single phase and three phase line with equilateral and un- symmetrical spacing, transposition, GMD, GMR, Capacitance calculation of two wire three phase line with symmetrical and un- symmetrical spacing, skin effect and proximity effect.

UNIT-II

Representation of short and medium lines, nominal T and Pie method, solution for long line, ABCD parameters, receiving and sending end voltage, regulation and efficiency.

UNIT-III

Ferranti effect, corona, disruptive critical voltage, visual corona, corona power loss, interference between power and communication circuits, types of insulators and their constructional features, potential distribution in string of suspension insulator, method of equalizing the potential, string efficiency, single and bundle conductors.

UNIT-IV

Types and construction of cables, insulation resistance of a cable, capacitance and grading in cables, current rating of power cable, dielectric stress, overhead lines versus underground cables, types of towers and poles used, standard clearance, sag calculation in conductor suspended on level supports and support at different levels, effect of wind, ice, tension and sag at erection.

UNIT-V

Substation classification, layout, scheme of bus-bar arrangement, single line diagram of typical sub- station showing location of different components and their functions, grounding and testing of installation.

TEXT/REFERENCE BOOKS.

1. William D. Stevensen, Jr., “Elements of Power System Analysis”, Mc Graw Hill Co., Singapore.
2. H. Cotton and Barber, “The Transmission and Distribution of Electrical Energy”, B. I. Publications Pvt. Ltd., New Delhi.
3. I. J. Narath and D. P. Kothari, “Modern Power System Analysis”, Tata Mc Graw Hill Publishing Co., New Delhi.
4. C. L. Wadhwa, “Electrical Power System”, Wiley Eastern Ltd., New Delhi.
5. Hadi Sadat, “Power System Analysis”, Tata Mc Graw Hill Publishing Co., New Delhi.

EE-404: Programming Languages

Credit	L	T	P
3	**2**	**1**	**-**

UNIT - I
Introduction to Procedure Oriented and Object-Oriented programming: elements of object oriented programming, C++ fundamentals – data types, operators and expressions, control construct, arrays, functions.

UNIT - II
Classes and objects – Encapsulation, Abstraction, Polymorphism, Classes, Object as function arguments, returning object from function. Constructors and destructors. Inheritance.

UNIT – III
MATLAB environment: MATALAB Desktop overview, everything is matrix, defining data types, display formats, predefined variables, complex numbers, Built-in Functions, input and output statements.

UNIT - IV
Control Constructs: sequential, selection and iteration using IF-END, IF-ELSE-END, ELSEIF, SWITCH-CASE, FOR LOOPS, WHILE loops.
MATLAB applications: Polynomial in MATLAB, solving equations, numerical integration, differential.

UNIT – V
Graph and Figure plotting, Handling graphics window, plotting 2D and 3D graphs. File input and output: Opening and closing files, writing formatted output to files, reading formatted data from files, Introduction to Simulink.

Additional topics:
GUI with Matlab

TEXT/REFERENCE BOOKS.
1. E. Balaguruswamy, “Object Oriented Programming with C++”, TataMcGraw Hill, New Delhi.
2. David Kuncicky, “MATLAB Programming”, Pearson Education, 2003.
3. Turbo C++, Robert Lafore
4. C++ by Balagurusamy, Tata McGraw Hill.
5. ManaullahAbid, Programming in C, MATLAB and Simulink, CAD PLAN, 2012
6. Marc E. Herinter, “Programming in MATLAB”, Thomson Learning, 2001.
7. RK Bansal, “MATLAB and Its Application in Engineering”, Pearson 2012

Websites
www.tobefilled.com

EE-405: Computer Architecture

Credit	L	T	P
4	**3**	**1**	**-**

UNIT –I

Introduction, Regiter section, General purpose register design. Adder and Subtractor design, Fast adder design, ALU design, Multiplication of unsigned and signed integer, Array multiplier, Division of unsigned integer.

UNIT – II

Introduction, Basic concepts of register transfer language (Micro operation), control unit design, Hardwired control, Multiplier control unit, CPU control unit, Micro programmed control, Basic concepts control memory.

UNIT – III

Introduction Characteristics of memory system, memory unit, Randon access memory (RAM), Bipolar memory cell, dynamic memory cell, Internal organization of RAM, Main Memory design, Cache memory, Associative memory, concepts, Associative memory cell.

UNIT – IV

Basic concepts, Programmed I/O, Standard I/O versus memory mapped I/O, Unconditional and conditional programmed I/O, Interrput I/O, Direct memory access (DMA), Virtual memory and memory management concepts, Magnetic taps and Disk.

UNIT –V

Introduction, parallelism in conventional computers, Type of parallel processors, Array processors, Systolic arrays wave front array processors pipeline processing, basic concepts pipeline structure. Arithmetic pipeline, Instruction pipeline.

TEXT/REFFERENCE BOOKS

1. Morris Mano, “Computer System Architecture”, Pearson, 2007.
2. Mohamed Rafiquzzaman, “Modern Computer Architecture”, Galgotia Publications, 1988
3. John P.Hayes, ‘Computer architecture and Organization’, Tata McGraw- Hill,Third edition, 1998.
4. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, “ Computer Organization“, V edition, McGraw-Hill Inc, 1996

BS-401: Engineering Mathematics-IV

Credit	L	T	P
3	2	1	-

UNIT-I
Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using.Lagrange's formula, method of successive approximation and double interpolation.

UNIT-II
Numerical successive differentiation using Forward, Backward, Central difference interpolation formulae. Newton's divided difference formula. Review of Trapezoidal, Simpson's 1/3 and 3/8 rules, Numerical integration using Boole's rule, Weddle's rule, Gauss-Legendre, Lobatto, Radau and Gauss-Chebyshev rules. Errors in Quadrature formulae, Romberg integration and Numerical double integration.

Unit-III
Bisection, Regula-False position, Newton-Raphson&Graeffe's Root-Squaring method for the solution of non-linear algebraic & transcendental equations involving one variable, rate of Convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two variables.

UNIT-IV
Gauss Elimination & Gauss-Jordan methods, III conditioned linear system, Gauss-Seidal and Crout methods for the solution of a system of linear equations in four unknowns; General curves (linear, quadratic, exponential and other non-linear functions) fitting using methods of least squares.

UNIT-V
Numerical approximate solutions of a system of simultaneous and higher order differential equation using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta, Fehlberg method, Modified Euler and Milne methods; Solution of boundary value problems using finite differences method and cubic spline method.

***NOTE*1**: Programming of a computer oriented numerical methods using C/C++
***NOTE* 2:** In a total of five questions to be set in final examination, 50% question would be on Numerical methods and remaining 50% would be on computer applications of Numerical methods using C/C++ Language.

TEXT/REFFERENCE BOOKS

1. M.K. Jain, S.R.K. Iyengar& R.K. Jain: "Numerical Methods for Scientific and Engineering Computation", 4th Edition, New Age International Publisher, Daryaganj, New Delhi-01
2. S.S.Sastry: "Introductory Methods of Numerical Analysis", 4th edition, Prentice Hall of India, Jhilmil House, Patparganj, New Delhi.
3. Steven C. Chapra& Raymond P. Canal "Numerical Methods for Engineers", Tata McGraw Hill Book Co.
4. V. Rajaraman, "Computer Oriented Numerical Methods", Prentice Hall of India Pvt. Ltd.
5. Madhumangal Pal, "Numerical Analysis for Scientists & Engineers, Theory & C Programs", Narosa Publishing House, Daryaganj, New Delhi -110002
6. Shanta Kumar M, "Computer Based Numerical Analysis", Khanna Publishers, Delhi-110002
7. B.S. Grewal, "Numerical Methods in Engineering & Science with Programming in C/C++", Khanna Publishers.

EE-501: Switchgear and Protection

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Fuse, H.R.C. fuse, Isolators, Theory of arc formation, properties of arc, Arc interruption theories. Circuit constants and circuit conditions, Restriking voltage transient Rate of Rise of Restrikingvoltage(RRRV), Current Chopping, Duties of switch-gear, Resistance switching , Circuit breaker rating.

UNIT-II
Construction and Operation of Air-break circuit breakers (CBs), Oil CBs, Single and Multi-break construction, Air-blast CB, Recent development in circuit breakers, Vacuum Breaker, Sulpher Hexa-phloride CB's, DC circuit breaker, Comparative merits and demarits of CBs.

UNIT-III
Need for protective relaying, Protective Zones, Primary and back up protection, Desirable Properties of protective relaying, Principle and operation of Electromagnetic and Induction type Relays, Relay settings, Directional, Distance, Differential, Overcurrent and earth fault relays, Static Relays, Numerical Relays/IEDs (Intelligent Electronic Devices).

UNIT-IV
Scheme of protection of Generator, Transformer, Bus-Zone, Transmission line. Merz-Price circulating current scheme, Restricted earth fault protection, Negative Sequence Protection, Bucholz relay, Translay scheme, pilot protection.

UNIT-V
Lightning and switching surges, dynamic overvoltages, ground wire, transmission reflection, refraction and attenuation of surges, spark gap, arresters, surge absorbers, BIL, insulation coordination, grounding of power system.

Additional topics:
Substation Automation SCADA System

TEXT/REFFERENCE BOOKS
1. Suni S. Rao, "Switchgear and Protection", Khanna Publishers, New Delhi.
2. C. R. Masion, "The Art and Science of Protective Relaying", New Age International,
3. New Delhi.
4. C. L. Wadhva, "Electrical Power Systems", New Age International, New Delhi.
5. C. L. Wadhwa, Generation, distribution and utilization of electric energy, New Age Publications, New Delhi.

Websites:
www.nptel.ac.in
http://www.mnre.gov.in/

EE-502: Power Electronics

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Introduction, Devices: Diodes-silicon, fast recovery, Schottky diode, SCR,TRIAC, SCS, GTO, PUT, SUS, CUJT, LASCR, Mosfet, IGBT with their V-I characteristics. SCR: Operating principle, Gate Characteristics, Two transistor model, over-current and over voltage protection,snubber circuits, methods of turning on (triggering) and turning off (commutation).

UNIT-II
Half-wave and full-wave controlled rectifiers with resistive and reactive load,battery load Freewheeling diode. Detailed derivation of rms, average value, harmonic factor, displacement factor, THD, crest factor. Three phase half wave and full wave controlled rectifiers. Effect of Source impedance.

UNIT-III
Voltage-driven inverter, current-driven inverter, Single-phase inverter with resistive load, inductive load: Bridge, Parallel, Centre tapped. Mc-Murrey-Bedford inverter,Zero current switching(ZCS), Zero voltage Switching (ZVS). Introduction of resonant inverters. Three phase bridge inverter, 120-180 degree conduction.

UNIT-IV
Principle of chopper, Step down-Step up chopper, Step down chopper with RL load without linear approximation, Chopper classification: First Quadrant, Second Quadrant, Third and Fourth Quadrant, Fourth Quadrant, All Four Quadrant Chopper. Buck, Boost, Buck-boost DC-DC converters. Morgan and Jones Chopper.

UNIT-V
AC Voltage Controllers: Single and three phase ac voltage controllers. Cycloconverters: Singlephaseto single-phase, three-phase to single-phase, three-phase to three-phase cyclo-converter circuit and their operation. Various PWM Techniques.

Additional topics:

Control Analysis of Converters
Simulation using PSIM

TEXT/REFFERENCE BOOKS

1. M. H. Rashid, “Introduction to Power Electronics”, Pearson Education India, New Delhi.
2. Reference book names + websites
3. P. C. Sen, “Power Electronics” Tata McGraw Hill Book Co., New Delhi.
4. G. K. Dubey, S.R. Doradla, A.Joshi and R.M.K. Sinha, “Thyristorised Power Controllers” Wiley Eastern Ltd., New Delhi.

Websites

www.nptel.ac.in
www.electricalcircuits.com

EE-503: Communication Systems

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Need for modulation, Amplitude modulation, modulation index, SSB-SC, DSB-SC and vestigial
side band: generation and detection, Calculation of power.

UNIT-II
Concept of frequency and phase modulation, frequency deviation and modulation index. FM spectra, carlson'srule.Generation of Narrow-band and Wide-band FM: Armstrong method, direct method and indirect method. Demodulation of FM.

UNIT-III
Sampling theorem, time-division multiplexing, pulse modulation, pulse width modulation (PWM), pulse position modulation (PPM), pulse code modulation (PCM), quantization, encoding, quantization error, companding and expanding, delta-modulation and adaptive delta modulation, performance of digital systems.

UNIT-IV
TRF receiver, disadvantages of TRF receiver, superheterodyne, advantages, performance of radio receivers, sensitivity, image frequency and its rejection, double spotting, AGC, AFC, AMand FM transmitters, their elementary circuits and block diagram representations.

UNIT-V
Introduction, optical fiber v/s metallic cable, Types of optical fiber: step index and graded index,multimode and single mode, Attenuation and dispersion in fibers, LEDs and Laser diode, Opticaldetectors: PIN and APDs, optical sources, optical coupling, splicing.

TEXT/REFFERENCE BOOKS

1. Simon Haykin, "Communication Systems", New Age International, New Delhi.
2. B. P. Lathi, "Communications Systems", New Age International, New Delhi.
3. George Kennedy, "Electronic Communication Systems", McGraw Hill Book Co., Singapore.
4. Herbert Taub and Donald L.Schilling, "Principles of Communication Systems", McGraw Hill, Kogakusha Ltd., Tokyo.
5. WayeTomasi, "Electronics Communication System", Pearson Education India.

EE-504: Electrical Measurement

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Units, dimensions, classification of errors, accuracy and precision, statistical analysis of errors, standards for measurement, temperature, emf, resistance, current, inductance, capacitance. Methods of measurements. Classification of instruments- absolute, secondary, indicating, recording, integrating.

UNIT-II
Instruments for voltage and current measurement, control, balancing and damping forces of instruments, D Arsonval galvanometer- construction and operation, PMMC (Permanent magnet moving coil), moving iron, dynamometer type instruments. Electrostatic and induction type instruments. Use of rectifier for measuring instruments.

UNIT-III
Extension of range of voltmeter and ammeter. Current transformer (CT) and Potential transformer (PT) - theory, ratio and phase angle error, design considerations, characteristics, effect of power factor, secondary burden. Industrial current sensors (Hall Effect).

UNIT-IV
Power in ac circuits, construction and operation of dynamometer and induction type wattmeter. Measurement of power using wattmeter for single phase circuits and three phase circuits. Measurement of reactive power (CT and PT).

UNIT-V
Measurement of energy- single phase induction type watt-hour meter and clock meters. Polyphase watt-hour meters. Ac energy meter testing. Meters for special purposes- prepayment meters, maximum demand indicator, power factor meter, frequency meter and synchroscope.

TEXT/REFFERENCE BOOKS

1. W D Cooper, A D Helfric, “Electronic Instruments and Measurements”, Prentice Hall of India, New Delhi.
2. E W Golding and F C Widdis, “ Electrical Measurements and Measuring Instruments”, JOBS Publications.
3. A.K.Sawhney, “A Course in Electrical and Electronic Instruments and Measurements”, Dhanpat Rai and Sons, Delhi.

EE-505: Power Systems Analysis

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Typical transmission and distribution scheme. DC 2-Wire and 3-wire, A.C single-phase, 3-phase and 4 wire system, comparison of copper efficiency, Kelvin's law, D.C. distributor fed at one end, three wire D.C. distributor fed at one end, distributor fed at both ends, uniformly loaded distributor, ring mains, stepped mains, A.C. distribution. Standard voltages and advantages of high voltage transmission. Comparison of D.C. and A.C. transmission

UNIT-II
One line diagram, impedance and reactance diagram, per unit representation of single phase and three phase system, change of base, per unit impedance of a transformer, Network model formulation, Formulation of Y-Bus and Load flow equation formulation, Classification of Buss.

UNIT-III
Load Flow Solution Techniques, Gauss-Siedal method, Newton-Raphson method, Fast decoupled load flow equation, comparison of solution methods.

UNIT-IV
Symmetrical 3-phase fault. Short-circuit current and reactance of synchronous machines. Fault current in unloaded systems. Internal voltage of loaded machines. Short-circuit currents by method of internal voltage and Thevenin's theorem. Symmetrical components of three-phase unbalanced phasors, Power in terms of symmetrical components, Phase-shift in Star-Delta transformer banks, Sequence impedance and sequence network. Zero-sequence equivalent circuits for various three-phase transformer connections.

UNIT-V
Inter-connection of sequence network for various faults: line-to-ground fault, line-to-line fault, double-line to ground fault, Fault through impedance. Introduction to computer calculations of fault current problems.

Additional topics:

Economic Operation of Power System
Stability Analysis

TEXT/REFFERENCE BOOKS

1. William D. Stevenson, Jr., "Elements of Power Systems Analysis", McGraw Hill Book Co., Singapore.
2. H. Cotton and Barber, "The Transmission and Distribution of Electrical Energy", Third Edition, B.I. Publications Pvt. Ltd., New Delhi.
3. I. J. Nagrath and D.P. Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Co., New Delhi.
4. C. L. Wadhwa, "Electrical Power System", New Age International, New Delhi.
5. HadiSaadat, "Power System Analysis", Tata McGraw Hill Pubishing co. New Delhi

Websites

www.electricaltutorials.com.
www.epsinc.com
www.electrical4u.com

EE-506: Electrical Power Generation

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I

Cost of Power Generation: running cost and fixed cost, Method for providing for depreciation factor affecting cost of generation. Load Factor, Load Curve, Demand Factor, Diversity Factor. Number and size of generation units: plant capacity factor and plant use factor. Tariffs: Flat-rate, Two part, Block rate, Maximum Demand and Power Factor, Tariff Economics of Power Factor improvements.

UNIT-II

Selection of site, Thermal Power Plants: Types and their relative merits, Boilers accessories, Economisers, Preheater and Super Heater. Fuel, Combustion Equipment: Types of Steam Turbines, Condensers, Pumps, Cooling Towers. Layout of Plant, Pollution Control Equipments. Elements of Nuclear Power Plant. Nuclear Reactor- it's components and their functions. Types of Nuclear Reactor, Boiling water, Pressurized water fast breeder reactor and Candu Reactor, their advantages and disadvantages.

UNIT-III

Hydro-Electric Power Plant: Selection of site. Classification based on: quantity of water available, Nature of load, Available head, Layout, it's main parts and their function: reservoir, Dam, spillways, intake,forebay, Penstock, Search tank, Prime-mover, Draft-tube. Governing of turbines, Types of Turbines and their characteristics, Comparison of various types of plants.

UNIT-IV

Advantages of coordinated operation of different types of power plants, hydro-thermal scheduling – short term and long term.

UNIT-V

Tidal, Wind, Geo-Thermal, Wave, Magneto-Hydro Dynamic (MHD), Photo-voltaic and Solar Power used for generation. Recent advances such as biogasgeneration, hydrogen, fuel cell.

Additional topics:

Biogas generation, hydrogen, fuel cell
Types of Turbines and their characteristics.

TEXT/REFFERENCE BOOKS

1. M. V. Deshpandae, "Elements of Electrical Power Station Design", A. H. Wheeler and Co. Pvt. Ltd. Allahabad.
2. B. G. A. Shrotzki and W. A. Vopal, "Power Plant Engineering and Economics",McGraw Hill Book Co.
3. C. L. Wadhwa," Generation Distribution and Utilization of Electrical Engineering", New Age International, New Delhi.
4. C. L. Wadhwa, "Electrical Power Systems", New Age International, New Delhi.

Websites

www.nptel.ac.in

EE-601 Control Systems

Credit	L	T	P
3	2	1	-

UNIT-I

Introduction, Terminology and basic structure, Industrial control examples, Mathematicalmodeling of mechanical, electrical, thermal, hydraulic and pneumatic systems. Industrial controldevices: Potentiometers, tacho-generators, DC and AC servo-motors, Open and closed loop
systems : their merits and demerits.

UNIT-II

Transfer Functions of linear systems, Block Diagram representation, Block Diagram reductiontechniques, Signal Flow Graphs and Mason's Gain Formula. Time Response analysis of secondorder systems, Performance specifications in time domain. Steady state errors and errorconstants, static error coefficients.

UNIT-III

Stability concept, Necessary conditions for stability. Routh stability criterion, Hurwitz's stabilitycriterion. Root locus plots, examples, general rules for constructing root loci, analysis of controlsystem by root loci. Sensitivity of the roots of the characteristic equation. Relative stabilityanalysis.

UNIT-IV

Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins, Constant M and N circleand Nichol's chart.

UNIT-V

Concept of state, State-variable, State model, State models for linear continuous-time function,control system analysis using state-variable methods, state variable representation, conversion ofstate-variable modes to transfer functions, conversion of transfer function to canonical state variable models, solution of state equation, concepts of controllability and observability.Equivalance between transfer function and state variable representation.

TEXT/REFFERENCE BOOKS

1. Gopal, M., "Control Systems: Principles and Design", Tata McGraw Hill Book Co., New
1. Delhi.
2. Gopal, M., "Digital Control Systems and State Variable techniques", Tata McGraw Hill
3. Book Co., New Delhi.
4. Kou, B.C., "Automatic Control System", Prentice Hall of India Pvt. Ltd., New Delhi.
5. Ogata, K., "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., New Delhi.
6. Nagrath and Gopal, "Modern Control Systems" New Age International, New Delhi.

EE-602: Electrical & Electronics Instrumentation

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I

Classification of resistance and measurement challenges. Measurement of medium resistance- voltmeter ammeter method, substitution, Wheatstone bridge methods and Ohmmeters. Measurement of low resistance voltage drop method, potentiometer method, Kelvin double bridge method, necessary precautions for precision and accuracy.
Measurement of high resistance- direct deflection method, loss of charge method and Meg-ohm bridge.

UNIT-II

Maxwell's bridge, Hay's bridge, Anderson bridge, De Sauty's bridge, Modified De Sauty's bridge, Schering bridge and Wien bridge. Application of ac bridges in measurement of resistance, capacitance, inductance, mutual inductance and frequency

UNIT-III

Classification of transducers, Transducers: RTD, thermistor, thermocouple, strain gauge, LVDT, Piezoelectric transducer. Application of transducers in measurement of pressure, force, temperature, speed and other industrial parameters.
Signal conditioning issues; Signal level and bias adjustment, linearization, conversions, filtering and impedance matching, and concept of loading. Basic instrumentation amplifier.

UNIT-IV

Magnetic measurements, magnetometer, ballistic galvanometer, fluxmeter, Hall-effect devices (flux measurement). Separation of iron losses, methods of iron loss measurement. Working and construction, application in measurement voltage and current (ac and dc), significance of lissajous figures in measurement of frequency and phase angle. Other measurement applications of oscilloscope.

UNIT-V

Electronic voltmeters, digital volt meter (DVM), multimeters, Q-meter, spectrum analyzer, ultrasonic measurements, introduction to data acquisition

TEXT/REFFERENCE BOOKS

1. Golding and Widdis: Electrical measurements & measuring instruments, Wheeler Books.
2. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques.
3. A. K. Sawhney , Electrical & Electronic Measurements and instrumentation, Dhanpat Rai & Sons, 2009.
4. H S Kalsi, Electronic Instrumentation, TMH Publications, 2012

EE-603 Microprocessor and Its Applications

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Introduction to microprocessor, 8085 microprocessor: Architecture, instruction set, interrupt structure, and brief assembly language programming.

UNIT-II
Pin diagram and description of various signals, architecture, block diagram and details of sub-blocks such as EU, BIU; memory segmentation and physical address computations, program relocation, addressing modes, Interrupts and their description.

UNIT-III
Instruction execution timing, assembler instruction format, data transfer instructions, arithmetic instructions, branch instructions, looping instructions, NOP and HLT instructions, flag manipulation instructions, logical instructions, shift and rotate instructions, directives and operators.

UNIT-IV
Assembly language fundamentals, largest and smallest numbers in data array, sum of a series of 16 bit numbers, multibyte addition, 16 bit multiplication, division by 8 bit and 16 bit divisor, square root determination, BCD to hex conversion, factorial of given number.

UNIT-V
Serial and parallel I/O Chips (8251 and 8255), Programmable DMA Controller (8257), Programmable interrupt controller (8259), keyboard display controller (8279), Introduction to DMA process and DMA controller (8237), Data acquisition using A/D and D/C converters.

TEXT/REFFERENCE BOOKS

1. Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8057, 8096 by Krishna kant; published by Prentice Hall of India, 2007.
2. James L. Antonakes, “An Introduction to the Intel Family of Microprocessors”, Published by Pearson Education Asia, Third Edition, 2002.
3. Advanced Microprocessors and Interfacing: Intel 8086 to Pentium 4 Processors by Badri Ram; published by Tata McGraw Hill Company Ltd. 2002.
4. Microprocessors-Theory and applications: Intel and Motorola by M. Rafiquzzaman; published by Prentice Hall of India, 2001.
5. A text of Microprocessors and Microcontrollers by R.S. Kaler published by I.K. International Publishing housePvt. Ltd., New Delhi, India, 2011.

EE-604: Electric Drives

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Introduction, concept of electric drives, classification, components and characteristics of electric drives, starting, speed control and braking of DC electric motors, starting, speed control and braking of AC electric motors, Elecro-mechanical transients, time –energy calculations, load equilization

UNIT-II
line commutated converters, choppers, Inverters, cycloconverters, AC voltage controllers.

UNIT-III
Review of speed control of induction motors, Voltage injection in rotor circuit, Scherbius and Kramer schemes, Vector and sensorless control

UNIT-IV
self controlled, permanent magnet motor drive systems, number of phases, radial and axial field, sinusoidal and rectangular fed systems, closed loop control, sensor reduction and elimination

UNIT-V
Switched reluctance motor drive system-construction, principle of operation, merits and demerits, characteristics, closed loop control and applications.
Design problems

TEXT/REFFERENCE BOOKS

1. G K Dubey, Power Semiconductor Controlled Drives, Printice Hall Englewood Cliffs, NJ-1989
2. S.K. Pillai, A First Course in Electric Drives, Wiley Easterns, New Delhi 1989
3. W. Leonard, Control of Electric Drives, Springer-Verelag, Berlin, 1985
4. G..K. Dubey, Fundamentals of Electric Drives, Narosa Publishers Delhi, 1995
5. T.J.E. Miller, Switched Reluctance Motor and Their Control, Magna Physia and Clanderon Press Oxford 1998
6. T. Kenjo and S. Nagamori, Permanent Magnet Brushless DC Motors, Clanderson Press Oxford, 1985

EE- 607 DIGITAL COMMUNICATION

Credit	L	T	P
3	2	1	-

UNIT-I
Elements of information theory, Source coding theorem, Huffman coding, channel coding theorem, channel capacity theorem.

UNIT-II
Sampling process, Baseband and bandpass sampling theorems, reconstruction from samples, practical aspects of sampling and signal recovery, TDM.

UNIT-III
Waveform coding techniques, PCM, Channel noise and error probability, DPCM and DM, coding speech at low bit-rates, Prediction and adaptive filters, baseband shaping for data transmission, PAM signals and their power spectra, Nyquist criterion, ISI and eye pattern, equalization,

UNIT-IV
Digital modulation techniques: Binary and M-ary modulation techniques, coherent and non-coherent detection, bit v/s symbol error probability and bandwidth efficiency.
Error control coding: Rationale for coding, linear block codes, cyclic codes and convolutional codes, Viterbi codes decoding algorithm and trellis codes.
Spread spectrum codes: Pseudonoise sequences, Direct-sequence and frequency-Hop spread spectrum, signal-space dimensionality and processing gain.

UNIT-V
Data Networks: Communication networks, circuit switching, store-and-forward switching, layered architecture, packet switching, multiple access communication.

TEXT/REFFERENCE BOOKS

1. Data communication and networking: B.A. Forouzan: Tata Mc Graw Hill
2. Digital communication and design for the real world : Andy batenas (addi son)
3. Digital communication and design for the real world: S.K.LAR.
4. Digital communication systems: Kolinbiris.
5. Analog &digital communication: Roden
6. Digital communication: Proakis
7. Telecommunication by : Crane
8. Telecommunication systems &technology :Michael khalid
9. Digital &analog communication systems :William E. barre
10. Electronic communication modulation & Tech: Robert J.schoenbeck.

EE – 608: Programmable Logic Controller

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
The PLC: A look inside, General PLC programming Procedure, Devices to which PLC Input and Output Modules are connected: Input On/Off Switching Devices, Input Analog Devices, Output On/Off Devices, Output Analog Devices.

UNIT-II
Programming On/Off inputs to Procedure on-off outputs, Relation of Digital Gate to Contact/Coil logic, Creating Ladder Diagrams from Process Control Descriptions: Introduction, Ladder diagrams and sequence listings, Large Process Ladder diagram construction, Flowcharting as a programming Method.

UNIT-III
Register Basics: Introduction, General characteristics of Registers, Module addressing, Holding Registers, Input registers and Output Registers. PLC Timer Functions: Introduction, examples of Timer Function Industrial Applications, Industrial Process Timing Application. PLC Counter Functions: Introduction, PLC Counters with examples.

UNIT-IV
PLC Arithmetic Functions: Introduction, PLC addition and subtraction, repetitive clock, PLC multiplication, division and square root, Trigonometric and Log function. PLC Number Comparison: Introduction, Basic comparison Function, its application. Numbering System: Intro to Decimal, Binary, BCD, Octal and Hexadecimal number system.

UNIT-V
The PLC SKIP and Master Control Relay Functions, JUMP Functions, PLC data move system, PLC FIFO function, One Shot(ONS) and Clear (CLR). Controlling Robot: Intro, basic two axis robot with PLC sequencer control, Industrial three-axis Robot with PLC control.

TEXT/REFFERENCE BOOKS

1. Programmable Logic Controllers: Principles and Applications, Fifth Edition, Prentice Hall, 2006
2. PLC Programming For Industrial Automation by Kevin Collins

EE-609: Data Structure

Credit	L	T	P
3	**2**	**1**	**-**

UNIT-I
Introduction, Types and characteristics of Data structures, Abstract Data Type (ADT), Algorithm Concepts, Definition of Algorithm, Objectives of algorithms, Space complexity and Time complexity of algorithm, Arrays: Characteristics of an array, Implementation of 1-D arrays, Row and Column Major Implementations of 2-D, 3-D and n-D arrays.

UNIT II
Stacks: Basic concepts, operations on stack, Stack implementation using array, Applications of Stack: Polish and reverse Polish notations, Evaluating a Postfix expression, conversion of an expression from Infix to Postfix, Recursion, Queue: Introduction, Operations on queue, and types of queues: Linear Queue, Circular Queue, Priority Queue, and Double Ended Queue, Queue implementation.

UNIT III
Linked Lists: Concept of a Linked List, Inserting and removing nodes from the list, Linked implementation of stack and queues. Array implementation of lists, Linear, Single and Double lists, Circular Single and Double List, Generalized Linked List, Header Linked list.

UNIT IV
Trees: Concepts of a Tree, Binary trees, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree, Weight of a tree, Level of a node, Height/Depth of a Tree. Operations on tree, Tree Search Algorithms, Binary Search Tree, Tree traversal Algorithms, AVL Trees - Balance of a node, Weight Balanced Trees. Tree implementation.

UNIT V
Graphs: vertex and edge, Types of graphs – directed/undirected, connected/disconnected, cyclic/acyclic, Representation of graphs: Adjacency matrix, linked list implementation. Searching and sorting techniques: Linear Search, Binary Search. Bubble Sort, Sequential Sort, Shell Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort techniques.

Note: Implementation can be done using C/C++.

TEXT/REFFERENCE BOOKS

1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, “Data Structures Using C & C++”, PHI, Second Edition.
2. D. Samanta, “Classic Data Structures”, PHI.
3. S. Lipshutz, “ Data Structures” , Schaum outline series, Tata Mc-graw Hill.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Cliff Stein “Introduction to Algorithms”, McGraw Hill, Second Edition.

EES-701:Advanced Power Systems

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I

System constraints, Economic dispatch neglecting losses, Optimal load dispatch including transmission losses, Exact transmission loss formula, Coordination equation, Automatic load dispatching

UNIT-II

Methods of voltage control, VAR compensation, Reactive power injection and Control by transformers, Power flow through transmission line, Receiving-end and Sending-end power circle diagrams, Universal power circle diagram.

UNIT-III

Introduction to automatic generation and voltage control, Speed governor, Turbine and Power system modeling, Load Frequency Control (LFC), Single area case, Automatic voltage control.

UNIT-IV

Introduction, Rotor dynamics, Swing equation, Power angle curve, Steady state stability, Transient stability, Equal area criterion (Sudden change in mechanical input, sudden loss of one of the parallel lines, sudden short-circuit on one of the parallel lines), Point-by-point solution of the swing equation, Multi-machine stability studies, Factors affecting transient stability, Effect of grounding on stability, Prevention of steady-state pullout.

UNIT-V

Flexible AC transmission, Series and Shunt Compensation schemes, HVDC transmission, Limitation and advantages, Classification of DC links, Back – to – back and bulk power supply systems.

TEXT/REFFERENCE BOOKS

1. William D. Stevenson Jr, ‘Elements of Power System Analysis’, Tata McGraw Hill Publishing Co., New Delhi.
2. C. L. Wadhwa, ’Electrical Power System’, New Age International, New Delhi.
3. J. Nagrath and D. P. Kothari, ‘Modern Power System Analysis’, Tata McGraw Hill Publishing Co., New Delhi.
4. N. G. Hingorani and L. Gyugyi, ‘Understanding FACTS’, IEEE Press, USA.

EES-702: HVDC Transmission

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
Introduction of DC Power transmission technology – Comparison of AC and DCtransmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in DC transmission

UNIT–II
Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit– Converter bridge characteristics – Characteristics of a twelve pulse converter –Detailed analysis of converters.

UNIT-III
General – Required regulation – Inverter compounding – Uncompounded inverter –Rectifier compounding – Transmission characteristics with the rectifier and inverter compounding – Communication link – Current regulation from the inverter side –Transformer tap changing.

UNIT-IV
Introduction – Generation of harmonics – Design of AC filters and DC filters –Interference with neighboring communication lines.

UNIT–V
Introduction of DC cables – Basic physical phenomenon arising in DC insulation –Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables. Introduction to system simulation – Philosophy and tools –HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation.

Additional topics:
Matlab (Simulink) based problem solving procedures.

TEXT/REFFERENCE BOOKS
1. Padiyar, K. R., “HVDC power transmission system”, Wiley Eastern Limited, New
2. Delhi 1990. First edition.
3. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience,
4. New York, London, Sydney, 1971.
5. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power
6. Transmission”, Garraway Limited, London, 1960.
7. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London,
8. 1983.
9. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New
10. Age Interantional (P) Ltd., New Delhi, 1990.

Websites:
www.nptel.ac.in

EES-703: Micro Controllers and Its Application

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I

Introduction to PIC microcontrollers, factors to be considered in selecting a micro controller. Architecture of 8051: internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial port, interrupt structure, SFRs and their addresses, watch dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory. Program memory organization, Data memory organization. Power management.

UNIT-II

Assembly /C language programming: study of instruction set of 8051, Addressing modes supported by 8051, Data transfer instructions, Arithmetic instructions, Logical instructions, Boolean instructions and Program control transfer instructions. Long Jump and short jump, call instructions. Delay programs, subroutines. Programming examples.

UNIT-III

Introduction to interrupts. External and internal interrupts 8051 micro controller, hardware and software interrupts. SFRs related to control of interrupts. Design of ISR (Interrupt Service Routine) for interrupts. Introduction to Timers and counters. Intel 8051/8052 Timers, SFRs related to timer's control: TCON, TMOD, IE,IP. Operating modes of timers, timer control and operations. Design of ISR (Interrupt Service Routine) for timers. Delay design using timers. Programming examples.

UNIT-IV

Overview of the serial communications: synchronous and asynchronous communications; simplex, full duplex and half duplex communications. Serial communication SFRs: SBUF, SCON, PCON. Modes of serial communications; Mode0, Mode1, Mode2, Mode3. Serial data format, Baud rate and Baud rate generation using Timer. Programming for serial communication; initialization steps, serial communication interrupt service subroutine. Programming examples for serial communication in various modes.

UNIT-V

Interfacing external memory, RAM and ROM, with MC-8051. Interfacing signals. Program memory interfacing, data memory interfacing. Interfacing with 8255,Interfacing Key board. Interfacing ADC and DAC. Interfacing dc motor; direction control, speed control. Interfacing stepper motor; full step rotation, step angle control, direction control, speed control. Interfacing servo motor; features of servo motor, direction control, speed control. Some programming examples of each.

TEXT/REFFERENCE BOOKS

1. Mohammad Ali Mazidi, the 8051 Microcontroller and embedded systems, Pearson Education
2. Kenneth Ayala, the 8051 Microcontroller Architecture, Programming and Applications, 2nd Ed. Penram International.
3. Ajay Deshmukh, Microcontrollers [Theory and Applications], Tata McGraw Hill.

EES-705 Soft Computing

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
Hard Computing: Features of Hard Computing, Soft Computing: features of soft computing, Hybrid Computing, Fuzzy Set Theory: fuzzy versus crisp sets, basic fuzzy set operations, linguistic variables, membership functions, fuzzy Cartesian product, fuzzy relations, fuzzy rules.

UNIT-II
Approximate reasoning, fuzzy modelling, fuzzification, inferencing and defuzzification, fuzzymodeling and control schemes for nonlinear systems, applications in power system.

UNIT-III
Biological neural networks, models of an artificial neuron, neural network architectures, characteristics of neural networks, McCulloch-Pitts neuron, learning methods, Hebbian learningrules, Hebb nets.

UNIT-V
Architecture of backpropagation networks, perceptron model, single layer and multi-layer perceptron models, backpropagation learning, tuning parameters of backpropagation networks,neuro-fuzzy models, adaptive neuro-fuzzy inference system (ANFIS), applications.

UNIT-V
Basic concepts, creation of offsprings, working principle, encoding, fitness function, reproduction, Genetic Modelling; inheritance operators, cross over, inversion and deletion, mutation operator, bit-wise operator, generational cycle, convergence of genetic algorithm, multi-level optimization, real life problems

TEXT/REFFERENCE BOOKS

1. Soft Computing and Intelligent System Design: Theory, Tools and Applications,
1. Fakhreddine O. Karray and Clarence De Silva, Pearson Education Ltd., India.
2. Soft Computing: Techniques and its Applications in Electrical engineering, D. K.
3. Chaturvedi, Springer-Verlag, Germany.
4. Soft Computing and its Applications, R. A. Aliev and R. R. Aliev, World Scientific
5. Publishing Co. Pte. Ltd., Singapore.
4. Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine
6. Intelligence, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Pearson Education Ltd., India.
5. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, S.
7. Rajasekaran and G. A. VijayalakshmiPai, Prentice Hall of India, New Delhi.

EES-708 SELECTED TOPICS IN POWER ELECTRONICS

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
Review of Basics of Power electronics. Advance power electronics converter: Integrated boost inverter, H5, H6, Heric Topology. Type of faults & Protection schemes.

UNIT-II
Operation of DC-DC converter, inverter used in solar application, grid connection of solar inverter, MPPT.

UNIT-III
Modelling of DC-DC converter, Solar Inverter, Grid connected inverter, Stability Analysis. IEEE Standars, IEC standard, LVRT, HVRT, Anti Islanding.

UNIT-IV
Introduction to Power Management and Voltage Regulators Need of power management, power management applications, classification of power management, power delivery of a VLSI system, power conversion, discrete vs. integrated power management, types of voltage regulators (switching Vs linear regulators) and applications, converter's performance parameters (voltage accuracy, power conversion efficiency, load regulation, line regulation, line and load transient response, settling time, voltage tracking), local Vs remote feedback, kelvin sensing, Point-of-Load (POL) regulators.

UNIT-V
Introduction to Advanced Topics in Power Management Digitally controlled dc-dc converters, digitally controlled LDOs, adaptive compensation, dynamic voltage scaling (DVS), Single-Inductor Multiple-Outputs (SIMO) Converters, dc-dc converters for LED lighting, Li-ion battery charging circuits, Multiphase converters.

Additional topics:

Analysis of Converters for different applications
Simulation using PSIM

TEXT/REFFERENCE BOOKS

1. Ned Mohan, Undeland, Robin, "Power Electronics, Converters, Application and Design", John Wiley and Sons. Inc, New York, 2011.
2. P. C. Sen, "Power Electronics" Tata McGraw Hill Book Co., New Delhi.
3. G. K. Dubey, S.R. Doradla, A.Joshi and R.M.K. Sinha, "Thyristorised Power Controllers" Wiley Eastern Ltd., New Delhi.
4. M. H. Rashid, "Introduction to Power Electronics", Pearson Education India, New Delhi

Websites

www.nptel.ac.in

EES-709: BIOMEDICAL INSTRUMENTATION

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
The cell, body fluids, body as a control system, biomedical signals and electrodes, biomedical amplifiers, general block diagram of biomedical instrumentation.

UNIT-II
Active versus passive sensors, Sensor error sources, sensor terminology, electrochemical sensors, electrodes for biophysical sensing, transducer and transduction principles, active and passive transducers, transducers for biomedical applications, transducer care.

UNIT-III
Heart is a potential source, ECG waveform, Frontal plane ECG measurements, Lead systems for ECG recording, determination of heart rate, electrocardiograph, ECG faults and troubleshooting, Introduction of EEG based instruments.

UNIT-IV
Stimulators; types of stimulators, electro-diagnostic/ therapeutic stimulator, peripheral nerve stimulator, AC and DC defibrillators, pacemakers, diathermy, respirators, blood pumps, Myoelectric control of paralyzed muscles.

UNIT-V
Electrical impedance plethysmography, Audiometry, X-rays and radiography, X-ray computed tomography, diagnostic ultrasound, electromagnetic flow meter, Magnetic resonance imaging, electrical impedance tomography.

ADDITIONAL TOPICS:

- NeuroSciences
- Recent Trends in Neurotechnology

TEXT/REFFERENCE BOOKS

1. Raja Rao, C; Guha, S.K. Principles of Medical Electronics and Biomedical Instrumentation. Universities Press (India) Limited 2013.
2. Barbara Christe. Introduction to Biomedical Instrumentation: The Technology of Patient Care. Cambridge University Press, 2012.
3. John G. Webster. Medical Instrumentation Application and Design. 4th Edition, John wiley & sons, 2009.
4. Joseph J. Carr and John M. Brown. Introduction of Biomedical Equipment Technology. 4th Edition, Pearson Education Asia, 2001.
5. John E, Susan B, Joseph B. Introduction to Biomedical Engineering. 2nd Edition, Academic Press, Indian Reprint 2009.

EES-801: Industrial Management

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
Management and its functions: Purpose and Objectives of Planning; Organizing: Nature and Purpose of Organizing;, Authority and Responsibility; Staffing, Supply of Human Resources; Performance Appraisal: Controlling; System and Process of Controlling; Control Techniques. Social and Ethical Issues in Management: Ethics in Management, Social Factors; Unfair and Restrictive Trade Practices. Strategic and Technology Management: Need, Nature, Scope and Strategy SWOT analysis.

UNIT-II
Quality definition, dimensions and basic concepts, Cost of Quality, Quality control through control charts. Sampling plans. Statistical Quality Control, Total Quality Management and ISO Certification

UNIT-III
Project Management, Different phases of Project Management, CPM and PERT. Marketing Environment, Consumer Markets and Buyer Behavior; Marketing Mix, Advertising and Sales Promotion; Channels of Distribution.

UNIT-IV
Inventory and Inventory Control, EOQ model. Basics of Supply Chain Management and value chain, Maintenance Management, Production planning and control, Planning and Design of Production and Operations Systems; Facilities Planning, Location, Layout and Movement of materials.

UNIT-V
Financial Management and Accounting Concepts, Basics of Financial Statements Analysis; Financial Ratios; Capital Budgeting; Break-even Analysis.

Additional Topics:

Just in Time(JIT) Manufacturing
Lean Manufacturing

TEXT/REFFERENCE BOOKS

1. Kotler Philip, “Marketing Management”, Prentice Hall of India.
2. Robbins Stephen, P. “Organizational Behaviour Concepts, Controversies and Application”, Prentice Hall, Englewood Cliffs, New Jersey.
3. Khan, M.Y. and Jain, P.K. “Financial Management”, Tata McGraw Hill
4. Montgomery. Statistical Quality Control

Websites:

www.ocw.mit.edu
www.edx.org
www.nptel.ac.in

EES-802: Control System-II

Credit	L	T	P
4	**3**	**1**	**-**

UNIT I
Fundamentals of compensator design in time and frequency domain. Cascade and Feedback Compensation – Design of Lag, Lead, Lag-Lead Compensator using Bode Diagram and Root Locus Plot. Intersection method.

Unit II
Introduction to Proportional(P) action , Integral action, PI controller for first order system, Proportional derivative integral Controllers (PID),P, PI, PD and PID controller design methodology, PID controller tuning methods, Ziegler Nichols tuning methods.

UNIT III
Introduction, Sampling theorem, Spectrum analysis of sampling process, Signal reconstruction, Pulse transformation, z- transform analysis of sampled data system, Block diagram reduction. State variable representation of digital control system, State transition equation, Solution of state equation by z- transform technique, Digital controllers, Stability of digital control system.

UNIT IV
State regulator design, output regulator design, pole placement technique, Gain matrix by Ackerman's formula, Design example. Discrete data system Pole placement design by state feedback of digital systems. Pole placement by incomplete state feedback or output feedback Design of digital control systems with state feedback. Observer design, full order observer, reduced order observer

UNIT V
Non-linear systems, Non-linear state equation, Phase plane and describing function techniques of analysis, Lyapunov's stability criteria, Methods of construction of Lyapunov's function.

TEXT/REFFERENCE BOOKS

1. M. Gopal, "Control Systems (Principles and Design)", McGraw Hill Education, 4th edition, June 2012.
2. M. Gopal, "Digital control and State Variables methods", Tata McGraw-Hill Education, 4th edition, Publication, 2012.
3. Nagrath and Gopal, "Control System Engineering", 5th Edition, New Age International Publishers, June 2009.
4. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited, 5 edition 2010
5. B. C. Kuo, "Digital Control System", Oxford University Press 2nd edition, February 2012.
6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall Publisher, 2008.

EES-806: Utilization of Electrical Energy

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I

Introduction, general features, track specification, arrangement of locomotive drives, transmission of power from motor to driving wheel. Mechanics of train movement, speed-time curves, tractive effort for acceleration and propulsion, power and energy output from driving axis.

UNIT-II

Train resistance, adhesive weight, and coefficient of adhesion, Feeding and distributing system for tramways and railways, Track arrangements, collector gears and auxiliary equipments, Diesel-electric equipments, characteristics, transmission of drive, electric transmission. Review of traction motors and their control, comparative features of ac and dc traction. Recent trends in electric traction, Magnetic Levitation Systems.

UNIT-III

Nature of light, definitions, units, basics laws of illumination, determination of luminous flux, Light sources and their characteristics, light production by excitation and ionization, incandescence and fluorescence, sources of light- filament lam, halogen lamp, discharge lamp, fluorescent lamp, incandescent lamp, arc lamp and their applications, Direct lighting and mixed reflection, reflection factor, transmission factor, refractors, lighting fitting, street lighting, exterior and interior lighting.

UNIT-IV

Advantages of electric heating, resistance heating, types of furnaces, types of heating materials, temperature control of furnaces, variable voltage supply, design of heating element, arc furnace, induction heating, dielectric heating, microwave oven.

UNIT-V

Welding- classification, electric supply, for arc welding, welding transformer, welding techniques, Electrolytic Process- Basic principles, electrodeposition, electrolysis, electric supply for electrolysis.

TEXT/REFFERENCE BOOKS

1. H. Partab, Art and science of utilization of electrical energy, Pritam, Surat and brothers, New Delhi.
2. N. N. Hancock, Electric power utilization, Wheeler Publications, Allahabad.
3. Soni, Gupta and Bhatnagar, Electric power utilization, Dhanpat Rai and sons, New Delhi.
4. E. Openshaw Taylor, Utilization of electrical energy, Orient Longman Publishers.
5. C. L. Wadhwa, Generation, distribution and utilization of electric energy, New Age Publications, New Delhi.

EES-807: Data Communication and Computer Networks

Credit	L	T	P
4	3	1	-

UNIT –I

Data Communication System: Introduction, Purpose, Components; Concepts of Frequency, Spectrum, and Bandwidth; Bit Rate and Baud Rate, Bandwidth of a Transmission System, Channel Capacity, Nyquist and Shannon Theorems, Throughput, Latency, Jitter, Transmission Impairments - Attenuation, Distortion, Noise: Modes of Digital Data Transmission,

UNIT -II

Transmission Media: Guided Media - Twisted Pair, Co-Axial Cables, Optical Fiber, Wireless Transmission – Antennas, Use of Frequency Spectrum, Terrestrial Microwaves, Satellite Microwaves, Wireless Propagation- Line-of-sight Transmission, Communication Satellites.
Error Detection and Correction: Types of Errors: Single-Bit Error, Burst Error; Block Coding, Process of Error Detection and Error Correction in Block Coding, Parameters of a Coding Scheme, Minimum Hamming Distance for Error Detection and Error Correction, Linear Block Codes, Simple parity Check Code.

UNIT -III

Computer Networks: Network Topologies, IEEE LAN standards, Metropolitan Area networks, Wide Area Networks, Internetworks, Overview of OSI Reference Model, TCP/IP Protocol Suite, Comparison OSI and TCP/IP models, Addressing Schemes, Dotted Decimal Notation, Classful and Classless Addressing, IPv4 and IPv6 addressing.

UNIT -IV

Medium Access Control: Multiple Access Protocols at Data Link Layer, Random Access: ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA), CSMA/CD, CSMA/CA; Controlled Access: Reservation, Polling, Token Passing; Channelization: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA).

UNIT -V

Data and Network Security: Symmetric Key Cryptography, Traditional Cyphers, Substitution Cypher, Shift Cypher, Transposition Cypher, Simple Modern Cyphers, XOR Cypher, Rotation Cypher, Substitution Cyphers, S-box and P-box Cyphers, Modern Round Cyphers; Asymmetric Key Cryptography, RSA and Diffie-Hellman Algorithms; Network Security Services: Message Confidentiality, Message Integrity, message Authentication, Digital Signature.

TEXT/REFFERENCE BOOKS

1. Andrew S. Tanenbaum, David J. Wetherall,“Computer Networks,” 5th Edition, Pearson Education, India, 2012.
2. Behrouz A. Forouzan, “Data Communication and Networking,” 5th Edition, Mc Graw Hill, India, 2013.
3. William Stallings, “Data and Computer Communications,” 10th Edition, Pearson Education, Inc., NJ.

EES-810: SCADA &Smart Grid

Credit	L	T	P
4	**3**	**1**	**-**

UNIT-I
Evolution of Smart Grid, Components of Smart Grid, Distributed Energy Resources-Challenges & Opportunity, Smart Grid benefits, Status of Indian Electricity Systems Markets and Regulations, Grid Modernization Initiatives-Case Studies.

UNIT-II
Smart meters, Smart Appliances, Multiagent System Technology; multiagentspecifications-Control agent, DER agent, User agent, Database agent. Challenges to load flow in Smart grid and weaknesses of the present Load Flow Methods, Load flow for smart grid design, Dynamic Stochastic Optimal Power Flow (DSOPF) application to the Smart Grid.

UNIT-III
Distribution System Automation Requirement of the Power Grid-Voltage/VAr Control, Power Quality, Network Reconfiguration, Demand side management, Distribution Generation Control. Interoperability, Benefits and Challenges of Interoperability, Smart Grid Network Interoperability, Review of standards for Smart Grid.

UNIT-IV
ISO's OSI 7 layers Reference Model, TCP/IP Model, SCADA communication requirements, SCADA communication systems topologies, data communication techniques-Master-Slave, peer-to-peer, broadcast and multicast, Introduction to SCADA and Smart Grid communication protocols- Modbus, IEC61850-5-101/103/194, DNP.

UNIT-V
Intelligent Electronic Devices (IEDs), Substation Automation, Deregulation of Power Systems and Substation Automation, Substation LAN, Substation Communication Architecture, Ethernet in Substation, Wide area monitoring systems (WAMS), Phasor Measurement Unit (PMU),

TEXT/REFFERENCE BOOKS

1. Mini S. Thomas and John Douglas McDonald, "Power System SCADA and Smart Grids" CRC Press-2015.
2. James Momoh, "SMART GRID Fundamentals of Design and Analysis", IEEE Press, John Wiley & Sons, 2012.
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, 2012.
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press-2009.