Category of Course	Course Title	Course Code	Credit-4C			Theory Paper (ES)
			L	T	P	
Departmental Core DC-15	Communication Engineering	EX601	3	1	-	***Max.Marks-100*** Min.Marks-35 Duration-3hrs.

Branch: Electrical & Electronics Engineering -VI Semester

COURSE: EX601 COMMUNICATION ENGINEERING

Unit-1. Fourier series, Fourier Transform and its properties, Probability, random variables & their moments, their significance, convolution, auto correlation, cross Correlation & power spectral density, Gaussian & Rayleigh probability density Function, mean, variance & standard deviation, central limit theorem, voltage & Power decibel scales. Signal Processing : Types of signal, deterministic & random, periodic & non Periodic, analog & discrete, energy & power signals, Representation of sinusoid in different forms & their conversion

Unit-2 Need of modulation in a communication system, block schematic of a typical Communication system. AM modulation system, modulation index, generation & detection of AM wave, side bands & power content in an AM wave, DSB-SC, SSB, their methods of generation & detection, vestigial side Band modulation, AM transmitter block diagram, comparison of various AM system, modulation & demodulation circuits. Relationship between phase & freq. modulation, FM wave & its spectrum, phasor diagram of a narrow band FM signal, wide band FM, methods of generation & detection of FM, discriminators, pre-emphasis & de-emphasis, Stereophonic FM broadcasting, FM transmitters.

Unit-3 TRF receiver & its limitations, necessity of heterodyning, super heterodyning Receivers, IF amplifiers, selection of intermediate frequency. RF amplifiers, detectors, AGC, AVC, FM receivers, AFC.

Unit-4 Nyquist sampling theorem, TDM, pulse modulations & PCM, quantization error, necessity of non linear quantizer, A-law, μ-law, FSK & PSK, QPSK, QAM. Source of noise, noise figure, noise bandwidth, effective noise temperature, performance of AM, FM & digital system in presence of noise.

Unit-5 Satellite system block diagram, satellite freq. bands, satellite multiple access Format like TDMA, FDMA, transponders, earth station & satellite eclipses, Link calculation

References:

1. Taub & shilling, Communication System, TMH
2. Singh & Sapre, Communication System, TMH
3. B.P. Lathi, Modern Digital and ana communication system,
4. Simon Haykins, Communication System. John Willy
5. Wayne Tomasi, Electronic Communication system.
6. Schaum outline Series, Analog and digital communication
7. Martin S. Roden, Analog & Digital Communication System., Discovery Press.
8. Frank R. Dungan, Electronic Communication System, Thomson/Vikas
9. John G. Prokis,Masoud Salehi, Gerhard Bauch, Contemporary communication sytems using MATLAB, Cengage learning 2004.

PROGRAMME: B.E. Electrical & Electronics Engg., VI Semester

Course: EX 602 Control Systems

CATEGORY OF COURSE	COURSE TITLE	COURSE CODE	CREDITS - 6C			THEORY PAPERS
Departmental Core DC-16	Control Systems	EX 602	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
		COMMON WITH	3	1	2	
		EE				

COURSE CONTENTS

Unit-I

Modeling of dynamic systems: Electrical, Mechanical and hydraulic systems, Concept of transfer function, Simulation of differential equations in analog computer, State space description of dynamic systems: Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros & Potentiometer), Servomotors (AC & DC), techo generators, power amplifier, steeper motors

Unit-II

Time – domain analysis of closed loop systems: Test signals, time response of first and second order systems, Time domain performance specifications, Steady state error & error constants Feedback control actions: Proportional, derivative and integral control.

Solution of state equation: Eigen values & eigenvectors digitalization state transitive matrix, stability Routh-Hurwit stability analysis.

Unit-II

Characteristics equation of closed loop system root loci, construction of loci, Effect of adding, poles and Zeros on the loci, Stability by root loci.

Unit-IV

Frequency, Domain analysis, Bode plots, Effect of adding, poles and Zeros, Polar plot, Nyquist stability analysis, Relative stability : Gain and phase margins.

Unit-V

Frequency- Domain compensation : lead lag, Lag-lead compensation, Design of compensating networks

List of Experiments:

- Time response of second order system.
- Characteristics of Synchros.
- Effect of feedback on servomotors.
- Determination of transfer function of A-C servomotor
- Determination of transfer function of D-C motor.
- Formulation of PI & PD controller and study of closed loop responses of 1^{st} and 2^{nd} order dynamic systems.

- State space model for classical transfer function using MATLAB.
- Simulation of transfer function using operational amplifier.
- Design problem: Compensating Networks of lead and lag.
- Temperature controller using PID.
- Transfer function of a DC generator.
- Characteristics of AC servomotor.
- Use of MATLAB for root loci and Bode plots of type-1, type-2 systems.
- Study of analog computer and simulation of 1^{st} order and 2^{nd} order dynamic equations.
- Formulation of proportional control on 1^{st} order and 2^{nd} order dynamic systems.
- Feed back control of 3^{rd} order dynamic Systems
- Study of lead and lag compensating networks.
- Effect of adding poles & zeros on root loci and bode plots of type-1, type-2 systems through MATLAB.

References:

- I.J. Nagrath and M. Gopal, Control system Engineering, New Age International.
- K. Ogata, Modern Control Engineering, PHI.
- B.C. Kuo, Automatic Control systems, PHI
- Gopal M., Control System : Principles & Design, TMH Third edition 2008.
- Stefani, Shahian, Savant, Hostetter, "Design of feed back control System's", Oxford.
- Krishna. K. Singh & Gayatri Agnihotri, System Design through MATLAB control tool & Simulink, Stringer Verlag, U.K.
- Rudra Pratap, Getting Started with MATLAB, Oxford.
- Modern Control Systems by Roy Chaudhary, PHI.
- Les Finical, Control Systems,Cengage learning,India Edition 2007.
- Stephen J.Chapman, MATLAB Programming for Engineers, Cengage learning,India Edition 2004.

PROGRAMME : B.E. Electrical & Electronics Engg., VI Semester

Course: EX 603 Switchgear & Protection

CATEGORY OF COURSE	COURSE TITLE	COURSE CODE	CREDITS - 6C			THEORY PAPERS
			L	T	P	
Departmental Core DC-17	Switchgear & Protection	EX 603	3	1	2	Max.Marks-100 Min.Marks-35 Duration-3hrs.

COURSE CONTENTS

UNIT-I

Fault Analysis

Fault Analysis per unit, representation and its advantages, faults in power systems (Symmetrical & Unsymmetrical), Single line and equivalent impendence diagram representation of power system components. Symmetrical components and its application to power systems, fault analysis, Sequence networks and their interconnection for different types of faults, Effect of fault impedance, Current limiting reactors, its location and application, Short circuit calculation.

Unit-II

Proactive Relays

Requirement of relays, Primary & backup protection, Desirable qualities of relays, Concept of Pickup, reset & drop-off, Drop off/ Pickup ratio, inverse time & definite time charters tics, Attracted armature, Balanced Beam, Induction disc, Induction cup, Moving coil & moving Iron, Rectifier , Thermal, Bimetal directional relay, Frequency, DC, all or nothing relays.

Pilot & negative sequence, Over current, Over Voltage, Directional, Differential and Distance relays, R-X diagram, Impedance mho & reactance relay.

Introduction of static analog & digital relays, Classification of static relays.

Unit-III

Circuit Breakers

Elementary principle of arc quenching, recovery & re-striking voltage, arc quenching devices, description and operation of Bulk oil, Minimum oil, Air break, Air blast, SF6, Vacuum circuit breakers and DC circuit breakers, their comparative merits, LT Switch gear, HRC fuses, current limiting reactor & influence of reactors in CB ratings, Testing of circuit breaker.

Unit-IV

System Protection

Protection of Generators - Earth Fault, percentage, differential, Loss of excitation, Prime mover failure, Over current, Turn to turn fault, Negative phase sequence, heating, Reverse power protection schemes

Protection of Transformers

Internal & external fault protection, Differential, Earth fault, Over Current, Over heating, Protection schemes, Protection of transmission lines, Over current, Distance and carrier current protection schemes.

Unit-V

Surge Protection & insulation co-ordination

Switching surges, Phenomena of Lightning, over voltage due to lightning, Protection against lightning, Lightning arrestors, selection of lightning arrestors, Surge absorbers and diverters, Rod gap, Horn gap expulsion type & valve type lightning arrestors, solid resistance and reactance earthing, Arc suppression coil, Earthing transformers, Earthwires, Earthing of appliances, insulation co-ordination, Definitions determination of line insulation, insulation level of substation equipment, co-ordination amongst items of substation equipment.

List of Experiments:

1. Determination of drop out factor of an instantaneous over current relay.
2. Determination of operating characteristic of IDMT relay.
3. Determination of operating characteristic of differential relay.
4. Study and operation of gas actuated protective relay.
5. Study and operation of static over current relay.
6. Determination of transmission line parameters using MATLAB.
7. Analysis of power system faults (Symmetrical & Asymmetrical) using MATLAB.
8. Study of SF6 circuit breaker
9. Protectional simulation study of generator, Transformer, Feeder & Motor protection.

References:

- B. Ravindran and M Chander, Power System protection and Switchgear, New Age International reprint 2006.
- Badrirka, Power System protection and switchgear, TMH.
- CL Wadhwa, Electrical Power systems, New age International.
- Haddi Saadet, Power System Analysis, TMH
- A.R. Bergen, Vijay Vittal, "Power System Analysis, Pearson Education, Asia.
- Switchgear & protection Sunil S. Rao. Khanna Publication.

PROGRAMME: B.E. Electrical and Electronics Engg., VI Semester
COURSE: EX 604 ELECTRONIC INSTRUMENTATION

CATEGORY OF COURSE	COURSE TITLE	COURSE CODE	CREDIT-6C			THEORY PAPER
			L	T	P	
Departmental Core DC-18	Electronic Instrumentation	EX 604	3	1	2	Max.Marks-100 Min.Marks-35 Duration-3hrs.

Course Contents

Unit-I

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

Unit-II

A.C. Bridge Measurement

Sources and detectors, Use of Bridges for measurement of inductance, Capacitance & Q factor Maxwells bridge, Maxwells inductance capacitance bridge, Hays bridge, Andersons bridge, Owen's Bridge, De-sauty's Bridge, Schering Bridge, High Voltage Schering bridge, Measurement of relative permittivity, Heaviside cambell's bridge, Weins bridge, Universal bridge, Sources of errors in Bridge circuit, Wagner's Earthing device, Q meter and its applications and measurement methods.

Unit-III

Transducers

Transducers definition and classification, mechanical devices as primary detectors, Characteristic & choice of Transducers, Resistive inductive and capacitive transducers, strain gauge and gauge factor, Thermistor, Thermo couples, LVDT, RVDT, Synchros, Piezo-Electric transducers, Magnet elastic and magnetostrictive Hall effect transducers, Opto-electronic transducers such as photo voltaic, Photo conductive, photo diode and photo conductive cells, Photo transistors, Photo optic transducers. Introduction to analog & Digital data acquisition systems-Instrumentation systems used, Interfacing transducers to electronic control & measuring systems Multiplexing - D/A multiplexing A-D Multiplexing, Special encoders. Digital control description

Unit-IV

Signal Generators

Fixed & variable frequency AF oscillators, Sine wave generators, Standard signal generator, AF Sine and Square wave generator Function generator, Square and pulse generator, Random noise generator, Sweep generator, TV Sweep generator, Marker generator, Sweep- Marker generator, Wobblyscope, Video pattern generator Vectroscope, Beat frequency oscillator

Wave analyser

Basic wave analyzer, Frequency selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion, analyzer, spectrum analyzer digital Fourier analyzer.

Unit-V

Digital Instruments

Advantages of Digital instruments over analog instruments, resolution and sensitivity of Digital meters., Digital Voltmeter - Ramp type, Dual slope integration type, Integrating type, Successive approximation type, Continuous balance DVM or Servo balancing potentiometer type φVM. , compression of Electronic & Digital Volt meter, Digital Multimeter, Digital frequency meter, Time period measurement, High frequency measurement, Electronic counter, Digital tachometer, Digital PH meter, Digital phase meter, Digital capacitance meter.

Digital display system and indicators like CRT, LED, LCD, Nixies, Electro luminescent, Incandescent, Electrophoretic image display, Liquid vapour display dot-matrix display, Analog recorders, X-Y recorders. Instruments used in computer-controlled instrumentation RS 232C and IEEE 488, GPIB electric interface.

List of Experiments:-

1. Measurement of inductance of a coil using Anderson Bridge.
2. Measurement of capacitance of a capacitor using schering bridge.
3. LVDT and capacitance transducers characteristics and calibration.
4. Resistance strain gauge- Strain Measurement and calibration.
5. Measurement of R,L,C & Q using LCR-Q meter.
6. Study & measurement of frequency using Lissajous patterns.
7. Measurement of pressure using pressure sensor.
8. Study of Piezo-electric Transducer and Measurement of impact using Piezo-electric Transducer
9. Measurement of Displacement using LVDT.
10. Measurement of speed of a Motor using photoelectric transducer.
11. Study & Measurement using ph meter.
12. Temperature measurement & Control using thermo couple & using thermistor.

References:

1. Albert. D. Helfrick, W.D. Cooper, Modern Electronic Instrumentation and measurement techniques, PHI.
2. Kalsi H.S., Electronic Instrumentation, TMH.
3. A.K. Sawhney, Electrical and Electronic measurements and Instrumentation, Dhanpat Rai and Co.
4. E.W. Golding, Electrical Measurement and Measuring Instruments Sir Isaac Pitman and Sons, Ltd. London 1940
5. C.S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems Tata McGraw-Hill Publishing
6. Company Ltd.
7. B.C. Nakra, K.K. Choudhry, Instrumentation, Measurement and Analysis Tata McGraw-Hill Publishing CompanyLtd.
8. Morris A.S., Principles of Measurement & Instrumentation, PHI
9. Murthy BVS, "Transducers and Instrumentation", PHI.
10. Doeblin D.O., Measurement Systems- Applications and Desig Albert D. Helfrick, William D.Cooper, Modern Electronic Instrumentation and Measurement Techniques Pearson Education.

PROGRAMME: B.E. Electrical & Electronics Engineering-VI Semester

Course: EX605 Energy Conservation & Management

CATEGORY OF COURSE	COURSE TITLE	COURSE CODE	CREDITS - 4C			THEORY PAPERS
Departmental Core DC-19	Energy Conservation & Management	EX605	L	T	P	Max.Marks-100 Min.Marks-35 Duration-3hrs.
			3	1	0	

COURSE CONTENTS

UNIT-I

General energy problem: Energy use patterns and scope for conservation.

Energy audit: Energy monitoring, Energy accounting and analysis, Auditing and targeting. Energy conservation policy, Energy management & audit, Energy audit, Types of energy audit, energy management (audit), qualities and function of energy managers, language of an energy manager, Questionnaire, Check list for top management, Loss of energy in material flow, energy performance, Maximizing system efficiency, Optimizing, input energy requirements, Energy auditing instruments, Material load energy balance diagram.

Unit-II

Thermodynamics of Energy Conservation. Basic principle. Irreversibility and second law efficiency analysis of systems. Primary energy sources, optimum use of prime-movers, energy efficient house keeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation. Thermal energy audit in heating, ventilation and air conditioning. Maintenance and Energy audit – friction, lubrication and tribo-logical innovations. Predictive and preventive maintenance.

Unit-III

Load curve analysis & load management DSM, Energy storage for power systems (Mechanical, Thermal, Electrical & Magnetic) Restructuring of electric tariff from energy conservation consideration, Economic analysis depreciation method, time value of money, Evaluation method of projects, replacement analysis, special problems inflation risk analysis. Pay back period, Energy economics, Cost Benefit Risk analysis, Pay back period.

UNIT-IV

Energy efficient electric drives, Energy efficient motors V.S.D. power factor improvement in power system. Energy Conservation in transportation system especially in electric vehicle. Energy flow networks, Simulation & modeling, formulation & Objective & constraints, alternative option, Matrix chart.

Unit-V

Energy conservation task before industry, Energy conservation equipments, Co-Generation, Energy conservation process, Industry Sugar, Textiles, Cement Industry etc Electrical Energy Conservation in building, heating and lighting. domestic gadgets

References:

1. Energy Management – W.R. Murphy & G. Mckey Butler worths.
2. Energy Management Head Book- W.C. Turner, John Wiley
3. Energy Management Principles- Craig B. Smith, Pergamon Press
4. Energy Conservation- Paul O Callagan- Pergamon Press
5. Design & Management of energy conservation. Callaghan,
6. Elect, Energy Utilization & Conservation. Dr. Tripathi S.C.,

PROGRAMME: BE Electrical & Electronics Engg., VI-Semester

Course: EX 606 Minor Project

CATEGORY OF COURSE	COURSE TITLE	COURSE CODE	CREDITS-4C			PRACTICAL EXAMN.
			L	T	P	
Departmental Core DC-20	Minor Project	EX 606	0	0	4	Max. Marks-50 Min. Marks-25 Duration-3 Hrs

COURSE GUIDELINES

The Minor Project Work provides students an opportunity to do something on their own and under the supervision of a guide. Each student shall work on an approved project, which may involve fabrication, design or investigation of a technical problem that may take design, experimental or analytical character or combine element of these areas. The project work involves sufficient work so that students get acquainted with different aspects of manufacture, design or analysis. The students also have to keep in mind that in final semester they would be required to implement whatever has been planned in the Major Project in this semester. It is possible that a work, which involves greater efforts and time may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and evaluated also at the end of the semester. At the end of semester, all students are required to submit a synopsis and be assessed by an external examiner.