KANNUR UNIVERSITY

FACULTY OF ENGINEERING

Curricula, Scheme of Examinations & Syllabus for Semesters V & VI of B.Tech. Degree Programme in Electrical & Electronics Engineering with effect from 2007 Admissions

FIFTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
2K6 EE 501	Engineering Mathematics IV	3	1	-	50	3	100
2K6 EE 502	Environmental Engg: & Disaster Management	3	1	-	50	3	100
2K6 EE 503	Field Theory	3	1	-	50	3	100
2K6 EE 504	Electrical Machines II	3	1	-	50	3	100
2K6 EE 505	Modern Communication Systems	3	1	-	50	3	100
2K6 EE 506	Power systems – I	3	1	-	50	3	100
2K6 EE 507(P)	Linear Integrated circuits Lab	-	-	3	50	3	100
2K6 EE 508(P)	Electrical Machines Lab- I	-	-	3	50	3	100
TOTAL		**18**	**6**	**6**	**400**	**-**	**800**

SIXTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/ D		Hrs	Marks
2K6 EE 601	Economics & Business Management	3	1	-	50	3	100
2K6 EE 602	Power Electronics	3	1	-	50	3	100
2K6 EE 603	Power Systems-II	3	1	-	50	3	100
2K6 EE 604	Control Systems-I	3	1	-	50	3	100
2K6 EE 605	Electrical Engg. Drawing	1	-	3	50	3	100
2K6 EE 606	Elective - I	3	1	-	50	3	100
2K6 EE 607(P)	Electrical Machines Lab-II	-	-	3	50	3	100
2K6 EE 608(P)	Power Electronics Lab	-	-	3	50	3	100
TOTAL		**16**	**5**	**9**	**400**	**-**	**800**

Elective I

2K6 EE 606 (A) - Electrical System Design & Estimation
2K6 EE 606 (B) - Energy Conservation
2K6 EE 606 (C) - Linear System analysis
2K6 EE 606 (D) - Cellular & Mobile Communication Systems
2K6 EE 606 (E) - Industrial Psychology
2K6 EE 606 (F) - Operations research

2K6 EE 501 ENGINEERING MATHEMATICS IV

3 hours lecture and 1 hour tutorial per week

Module I Probability distributions (13 hours)

Random variables-Probability distributions - binomial distribution –Poisson distribution-normal distribution –Mean, variance and Moment generating function -Poisson process - Chebyshev's theorem- Geometric Distribution-Uniform Distribution, Gamma distribution, Beta Distribution, Exponential Distribution and Hyper-Geometric Distributions.

Module II Statistical inference (13hours)

Population and Sample-Sampling Distributions of Mean and Variance-Point Estimation-Interval Estimation -Null Hypotheses and Significance tests-Hypotheses concerning one mean- Confidence Intervals of mean and variance - Estimation of Variances-Hypotheses concerning one variance-Hypotheses concerning two variance- Chi square test as test of goodness of fit.

Module III (Series solutions of differential equations (13hours)

Power series method of solving ordinary differential equations - series solution of Bessel's equation – Recurrence formula for Jn(x)-expansions for J_0 and J_1 – value of $J_{1/2}$- generating function for Jn(x)- Orthogonality of Bessel functions - Legendre's equation – series solution of Legendre's differential equation -Rodrigues formula-Legendre Polynomials – Generating function for Pn(x)- Recurrence formulae for Pn(x) -Orthogonality of Legendre polynomials

Module IV Quadratic forms and Fourier Transforms (13 hours)

Quadratic forms - Matrix associated with a quadratic form - Technique of Diagonalization using row and column transformations on the matrix - Definite, Semidefinite and Indefinite forms - their identification using the Eigen values of the matrix of the quadratic form.

Fourier Transform-Properties of Fourier Transforms-Linearity property-Change of scale property-shifting properties –Modulation property-Transform of the Derivative-simple problems- Fourier Cosine transform-Fourier Sine Transform.

Text book

Johnson RA, Miller & Freund's Probability and Statistics for Engineers, Prentice Hall of India
(For Module I and II only)

Reference Books

1. Wylie C R & Barrett L. C., Advanced Engineering Mathematics, Mc Graw Hill
2. Kreyszig E., Advanced Engineering Mathematics, John Wiley.
3. Bali N. P. & Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications
4. Grewal B. S, Higher Engineering Mathematics, Khanna Publishers

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total marks	= 50

University Examination Pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module.
Q II - 2 questions of 15 marks each from module I with choice to answer any one.
Q III - 2 questions of 15 marks each from module II with choice to answer any one.
Q IV - 2 questions of 15 marks each from module III with choice to answer any one.
Q V - 2 questions of 15 marks each from module IV with choice to answer any one.

2K6 EE 502 ENVIRONMENTAL ENGG: & DISASTER MANAGEMENT

3 hours lecture and 1 hour tutorial per week

MODULE I (12 HOURS)

Multidisciplinary nature of Environmental studies – Definition – scope and importance – need for public awareness Natural resources – renewable and non-renewable resources – natural resources – forest resources - water resources Mineral resources – food resources – energy resources – Land resources – use, overuse and misuse of these resources with appropriate case studies to substantiate – effect on the environment – role of individual in conservation of natural resources – equitable use of resources for sustainable lifestyle.

MODULE II (12 HOURS)

Ecosystem – concept – structure and function – producers, consumers & decomposers – energy flow in the ecosystem- Ecological successive food chains - food webs (all in brief)

Ecological pyramids – introduction, types and characteristic features, structure and function of forest, grassland, desert and acquatic ecosystems (ponds, lakes, streams, rivers, oceans and estuaries) Biodiversity and its conservation – Introduction – definition : genetic species and ecosystem diversity – Biogeographical classification of India – value of biodiversity – consumptive and productive use, social, ethical, aesthetic and option values – biodiversity at global, national and local levels –India as a mega-diversity nation – hot spots of biodiversity – threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

MODULE III (13 HOURS)

Environmental Pollution – Definition – causes - effects and control measures of : Air Pollution – water Pollution – soil Pollution – marine Pollution – noise Pollution – thermal Pollution – Nuclear hazards .

Solid waste management – causes, effects and control measures of urban and industrial wastes – Role of an individual in preventing Pollution – Environmental Protection Act – Prevention and control of air and water Pollution – Wildlife Protection Act – Forest Conservation Act – Issues involved in Enforcement of Environmental Legislation – Public awareness.

Disaster Management – Principles of disaster management – nature and extent of disasters – natural disasters , hazards, risks and vulnerabilities – man-made disasters – chemical, industrial, nuclear and fire. – preparedness and mitigation measures for various hazards – financing relief expenditure – legal aspects - post disaster relief – voluntary agencies and community participation at various stages of disaster management – rehabilitation programmes.

MODULE IV (10 HOURS)

Social Issues and the Environment – From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting , watershed management – resettlement and rehabilitation of people ; its problems and concerns, case studies – environmental ethics : Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies – waste land reclamation – consumerism and waste products.

Human population and the environment – Population growth, variations among nations – population explosion – Family welfare programmes – Environment and human health – Pollution hazards, sanitation and health – Human rights for a clean environment – value education – HIV/AIDS – social concern – Women and Child welfare – role of Information Technology in environment and human health – Case studies.

FIELD WORK (5 HOURS)

- Visit to a local area to document environmental assets – river / forest / grassland / hill / mountain
- Visit to local polluted site – urban / rural / industrial / agricultural
- Study of common plants, insects , birds
- Study of simple ecosystems – pond, river, hill slopes, etc.

Text book

1. Clarke. R.S. Marine Pollution. Clanderson Oress Oxford.`
2. Mhaskar A.K. Matter Hazardous. Techno-Science Publications.
3. Townsend. C., Harper. J. and Michael Begon, Essential of Ecology. Blackwell Science.
4. S. Deswal & A . Deswal, A Basic Course in Environmental Studies, Dhanpat Rai & Co
5. Environmental Studies – Dr. B . S. Chauhan, University Science Press.
6. Kurien Joseph & R. Nagendran, Essentials of Environmental Studies, Pearson Education.
7. Trivedi. R.K. and Goel. P.K. Introduction to air pollution. Techno-Science Publications.

Reference Books

1. Agarwal.K.C. Environmental biology. Nidi Publ.Ltd. Bikaner.
2. Bharucha erach, Biodiversity of India, Mapin Publishing Pvt.Ltd.,.
3. Brunner,R.C.. Hazardous Waste Incineration. McGraw Hill Inc..
4. Cunningham W.P. , Cooper T.H., Gorhani E. & Hepworth M.T. Environmental Encyclopedia ,Jaico Publ.House ,.
5. De A.K. Environmental Chemistry.Wiley Eastern Ltd.
6. Hawkins R.E. Encyclopediaof Indian Natural History, Bombay Natural History Society ,.
7. Heywood V.H. & Watson R.T.. Global Biodiversity Assessment. Cambridge Univ. Press.
8. Jadhav H. & Bhosale V.M.. Environmental Protection and Laws. Himalaya Pub. House,
9. Odum E.P. Fundamentals of Ecology W.B. Saunders Co..
10. Rao M.N. & Datta A.K. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd..
11. Sharma B.K.. Environmental Chemistry Goel Publ. House, Meerut
12. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol.I & II.Enviro Media.
13. Wagner K.D. Environmental Management. W.B. Saunders Co.

Sessional work assessment

Two Tests	2 × 15	= 30 marks
Two Assignment	2 × 10	= 20 marks
Total		= 50 marks

University Examination Pattern

Q I – 8 short answer type questions of 5 marks, 2 from each module.
Q II- 2 questions of 15 marks each from module I with choice to answer any one.
Q III- 2 questions of 15 marks each from module II with choice to answer any one.
Q IV- 2 questions of 15 marks each from module III with choice to answer any one.
Q V- 2 questions of 15 marks each from module IV with choice to answer any one.

2K6 EE 503: FIELD THEORY

3 hours lecture and 1 hour tutorial per week

Module I: (16 hours)

Electric field : Co-ordinate System and transformations – Cartesian co-ordinates – circular cylindrical co-ordinates – spherical co-ordinates – relation between Cartesian, cylindrical and spherical co-ordinates

Vector calculus – Del operator – Gradient of a scalar – Divergence of a vector – Curl of a vector – Laplacian of a vector – Divergence theorem – Stoke's theorem.

Electrostatics – Electric field concept – Electric field intensity – Electric field due to continuous charge distributions – Electric flux – Gauss's law – Applications – Electric scalar potential – Electric dipole moment – Electric field polarization – Condition at boundary between dielectrics – Capacitance of an isolated sphere –Spherical capacitor – Capacitance between co-axial cylinder- Capacitance between parallel wires.

Module II: (16 hours)

Magnetic field: Magnetic circuit and electric circuit – Magnetic field intensity – Magnetic flux density – mmf – Flux – reluctance – Comparative study with electric and magnetic circuit – Lorentz force – Biot –Savart's law and Ampere's circuital law – H due to a long wire – H due to a long solenoid – H due to an infinite current sheet – H due to a circular wire loop – Skin effect – Faraday's laws of Electromagnetic induction – inductance and mutual inductance – Self inductance of toroid and toroidal solenoid – Lifting power of an electromagnet – Force and torque in terms of stored energy – Torque on a closed circuit

Magnetic vector potential and magnetic scalar potential – Helmholt's theorem – Magnetic dipole – Magnetic force on a charged particle – Force on a current element – Magnetic boundary conditions.

Module III: (10 hours)

Maxwell's equations: Faraday's law – Displacement current – Maxwell's equations in point form – Maxwell's equations in integral form and differential form – Boundary conditions.

The uniform plane wave – Propagation in free space – Plane wave propagation in loss less dielectrics – Plane wave in good conductor – Poynting theorem and wave power – Complex pointing theorem – Poynting vector.

Module IV: (10 hours)

Waves and transmission lines: Polarization of electromagnetic waves - Wave polarization - Elliptically and circularly polarized waves – Reflection and refraction of plane electromagnetic wave oblique – Law of refraction (Snell's law) - Brewster's law .

Transmission line parameters – Standing wave ratio – Impedance matching - Stub matching – Phase velocity and group velocity – Characteristic impedance – Reflection co-efficient – Reflection and transmission of plane wave at boundaries.

Text books

1. Hayt W.H., Engineering Electromagnetics, McGraw Hill
2. Premlet B., Electromagnetic Theory with Applications, Phasor Books
3. K A Gangadhar, Field Theory, Khanna Publishers
4. V V Sawate, Electromagnetic Fields and Waves, New Age international

Reference books

1. Guru & Hiziroglu, Electromagnetic Field Theory, *Fundamentals*
2. John D. Kraus, Electromagnetics, McGraw Hill
3. S P Seth, Elements of Electromagnetic Fields, Danapath Rai & Co
4. R Meenakumari & Subasri, Electromagnetic fields, New Age International
5. David K. Cheng, Field and Wave Electromagnetics, Addison Wesley

Sessional work assessment

Two tests	2 x 15	= 30
Two assignments	2 x 10	= 20
Total marks		= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 504 : ELECTRICAL MACHINES II

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Synchronous generators: Construction - principle of operation - type and selection- EMF developed in a winding - Distribution factor- Chording factor - armature reaction - voltage regulation - automatic voltage regulator - predetermination of voltage regulation - EMF method - MMF method - Potier method – ASA method - phasor diagrams - short circuit ratio- two reaction theory - modified phasor diagram - analysis by two reaction theory - slip test - sudden short circuit - current waveforms - transient and subtransient reactances - DC excitation - static excitation - brush less excitation .

Module II (14 hours)

Analysis of synchronous machines - Power angle characteristics of cylindrical rotor and salient pole machines - active and reactive power control - alternator connected to infinite bus -synchronizing power and torque- effect of armature reactance- load sharing upon parallel operation - power frequency characteristics - locus of generated voltage for constant real power and variable excitation - V curves - inverted V curves

Synchronous motor - Principle of operation - different starting methods -equivalent circuit - phasor diagram- effect of load changes on synchronous motor - mechanical load diagram - torque and power relations- synchronous condenser- hunting - periodicity of hunting – suppression- applications.

Module III (14 hours)

Theory of induction machines: 3 phase induction motors - construction - principle of operation - rotor MMF and production of torque - slip and frequency of rotor current - phasor diagram - equivalent circuit - mechanical power developed - maximum torque - torque slip characteristics - losses and power flow - single phasing - no-load and blocked rotor tests - the circle diagram - double cage rotors - effects of air gap flux harmonics - cogging and crawling - line excited and self excited induction generators - applications of induction motors.

Module IV (12 hours)

Starting and speed control of induction motors: starting methods for three phase induction motors - direct on line starting - auto transformer starting - star delta starting - rotor resistance starting - speed control - basic methods - voltage control - frequency control - rotor resistance control - pole changing - slip power recovery scheme

Single phase induction motor - double field revolving theory - equivalent circuit- starting methods-capacitor based starting and running.

Text book and References

1. Langsdorf A.S., Theory of A.C Machinery, McGraw Hill.
2. Dr PS Bimbhra, Electrical Machinery, Khanna Publishers
3. Nagrath I.J. & Kothari D.P., Electric Machines, Tata McGraw Hill
4. Fitzgerald A.E. & Kingsley, Electrical Machinery, McGraw Hill
5. Say M.G., Performance and Design of AC Machines, Pitman, ELBS.
6. Stephen J Chapman, Electric Machinery Fundamentals, McGraw Hill.
7. Vincent Del Toro, Electrical Machines and Power Systems, Prentice Hall
8. Ashfaq Hussain, Electric machines, Dhanpat Rai & co.
9. Theodore Wildi, Electrical Machines, Drives and Power systems, Pearson
10. Smarajit Ghosh, Electrical Machines, Pearson
11 JB Gupta, Theory and Performance of Electrical Machines, SK Kataria & Sons

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module.
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one.
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one.
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one.
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

2K6 EE 505 : MODERN COMMUNICATION SYSTEMS

3 hours lecture and 1 hour tutorial per week

Module I (16 hours)

Analog modulation schemes: Super heterodyne receivers-receiver parameters-AM receivers-IF and its selection-AGC, AM demodulator circuits-SSB receivers-demodulation of SSB, receiver types-FM receiver-FM demodulators, FM noise suppression- Pulse modulation, principle of PAM, PWM,PPM modulation and demodulation-circuits.

Digital modulation schemes: Coherent binary schemes: ASK,FSK,PSK,MSK, coherent M-ray schemes, calculation of average probability of error for different modulation schemes, Power spectra of digital modulated signals, performance comparison of different modulation schemes-PCM, DPCM, Delta modulation, generation and demodulation- Multiplexing- TDM, FDM, WDM.

Module II (12 hours)

Principle of TV communication: Theory of interlaced scanning- composite video waveforms-synchronising signal standards as per PAL625 line system-bandwidth-Block diagram of monochrome transmitter and receiver.

Colour TV signal standards-principle of NTSC, PAL and SECAM encoders/ decoders-Block diagram of transmitters and receivers.

Principles of Radar: Radar frequencies-Radar equation-Transmitter and receiver(Block diagram approach), Pulsed, CW, FMCW, MTI, and tracking radars.

Module III (12 hours)

Principles of optical communication system: LED and LASER diode- Principle of operation- optical detectors-pin detector-APD- optical fibres- step index- graded index- single mode and multimode

Principles of mobile communication systems: operation of cellular system- improving capacity in cellular systems-frequency re usage- hand off strategies- cell splitting- sectoring channel assignment strategies- call blocking in cellular networks.

Module IV (12 hours)

Satellite communication: Orbit of communication satellite-satellite constellation- orbital parameters- orbital perturbations- geostationary orbits-low earth and medium orbits- frequency selection- RF links- propagation characteristics- modulation methods- coding- multiple access spacecraft- antennas-transponders-inter satellite link-link power budget- earth station interference- special spectrum communication general concepts- frequency hopping- frequency hopping transmitter- frequency hopping receiver- time hopping- antijam consideration-CDMA.

Text books & References

1. Principles of Communication systems, George Kennedy, TMH.
2 Dennis Roody and john Coolen, Electronic communication, Prentice Hall..
3. Bernard sklar, Digital communications Fundamentals and applications, Pearson
4. Dennis Roddy, Satellite Communication, PHI.
5. TS Rappaport, Wireless digital communications, Principles and Practice, Pearson
6. R. R. Gulati, Monochrome and colour Television, John Wiley.
7. Skolnik, Introduction to Radar Systems
8. John Senior, Optical Fiber Communications, PHI
9. RE Ziemer , WH Tranter, Principles of Communication, 5th edition, John Wiley.
10. BP Lathi, Modern Digital and Analog Communication system, 3rd edition, Oxford.
11. Wayne Tomasi, Modern Electronic Communication system, Pearson
12. Simon, Hindey, Lindsey, Digital Communication Techniques, PHI
13. John G Proakis, Digital Communication, MGH
14. WL Prichard, Satellite Communication system engineering, Pearson

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total	= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module.
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one.
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one.
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one.
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

2K6 EE 506 : POWER SYSTEMS- I

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Economic considerations in power generation: Classification of generation costs-interest and depreciation-methods of providing depreciation-load curves-terms associated with generation-significance of load and diversity factors-base load and peak load plants. Tariff-types, Power factor-causes of low power factor-disadvantages-methods of power factor improvement-most economical power factor-economical comparison of the two methods of increasing power supplied.

Module II (15 hours)

Design of transmission lines: Main components of overhead lines- Conductors-materials-configuration-spacing and clearances-supports-span length-calculation of sag and tension- effect of wind and ice-supports at unequal heights - sag template-equivalent span -vibration and dampers-Insulators-materials-types-causes of failure of insulators-distribution of potential over a string of insulators-string efficiency-methods of improving string efficiency-formation of corona-disruptive and visual critical voltages-factors affecting corona-advantages and disadvantages-corona power loss-methods of reducing corona effects-underground cables-general construction-classification-insulation resistance-capacitance of 1-core cable-dielectric stress-grading methods-capacitance of 3-core cables-laying of cables-heating of cables.

Module III (13 hours)

Characteristics and performance of transmission lines: Constants of transmission lines-resistance-inductance and capacitance of 1-Φ,2 wire lines-composite conductors-GMD and GMR-inductance and capacitance of 3-Φ lines-transposition-double circuit lines-bundled conductors-classification of lines-short lines-voltage regulation and efficiency-medium lines-nominal T and Π configurations-ABCD constants- long lines- rigorous solution-interpretation of long line equation-Ferranti effect- tuned power lines-power flow through lines-methods of voltage control.

Module IV (12 hours)

Power distribution: -Feeders, distributors and service mains- types of distribution systems -design of feeders-Kelvin's law-current distribution and voltage drop calculations in DC distributors with concentrated loading and uniform loading-AC distributors with concentrated loading-radial and ring systems-AC interconnected systems, Improvement of existing distribution system-LT capacitor installation-size, connection and specifications.

Text books

1. Nagarth J & Kothari D P, Power system Engineering, TMH
2 J B Gupta, A course in electrical power, S K Kataria & Sons

Reference books

1. Stevenson Jr, Elements of power system analysis, TMH
2. Pabla A S, Electric power distribution systems, TMH
3. Wadhwa C L, Electric power systems, Wiley eastern LTD
4. Gupta B R power system analysis and design, Wheeler publishing & co.

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total	= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module.
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one.
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one.
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one.
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

2K6 EE 507(P) LINEAR INTEGRATED CIRCUITS LAB

3 hours practical per week

1) Study of OP AMPs: Measurement of OP AMP parameters-CMRR, slew rate ,open loop gain ,input and output impedances.
2) Design and set up of inverting and non inverting amplifier, summer, subtractor, scale changer, integrator and differentiator circuits.
3) Inverting and non inverting comparator, Level detector and zero crossing detector circuits using OP AMP.
4) Phase shift and Wein bridge oscillator with amplitude stabilization using OP AMPs.
5) OPAMP comparator –design and set up Schmitt trigger-window comparator.
6) Square, Triangular and Ramp generation using OP AMPS
7) Astable and Monostable Multivibrators using OP AMP s.
8) Precision rectification –absolute value and averaging circuit using OP AMPS.
9) Second order Low pass, High pass and Band pass filters using single OP AMPS.
10) Active notch filter realization using OP AMPs.
11) Experiments on precision OP AMPS.
12) Voltage regulation using IC723or 78xxor 79xx.
13) Design of PLL for given Lock and capture ranges and Frequency Multiplication.
14) Resistance-Temperature characteristics of Thermistors.
15) Characteristics of Optocoupler.
16) Audio Amplifiers- Input impedance. Output impedance, frequency response etc.

A minimum of 12 experiments to be conducted from the above list.

Sessional work assessment	
Laboratory Practicals and Record	= 35
Test	= 15
Total marks	= 50

2K6 EE 508(P) : ELECTRICAL MACHINES LAB I

3 hours practical per week

DC Machines

1. Open circuit characteristics of DC shunt generator at rated speed
   (a) Predetermine the OCC at different speeds and determine resistance required in the field circuit for generating different voltages on no load.
   (b) Find the critical resistance and the critical speed for a given field circuit resistance
2. Load test on DC shunt generator
   (a) Plot the external and internal characteristics by conducting load test
   (b) Deduce the armature reaction curve
3. Brake test on DC shunt and series motor
   Plot the following characteristics
   i) Output Vs Efficiency ii) Output Vs Line current iii) Output Vs Speed
   iv) Speed Vs Torque v) Line current Vs Torque
4. Swinburne's test on a DC shunt motor

   Predetermine the armature current and percentage efficiency when the machine operates as a motor and as a generator delivering 1/4, 1/2, 3/4 and full rated output and plot the characteristics
5. Hopkinson's Test on a pair of DC machines

   Predetermination of the efficiency of the machine working as a motor and as a generator under various load conditions on the generator
6. Retardation test on a DC machine

   i). Separate the losses ii) Find the moment of inertia of the rotating system
7. Separation of losses in a DC machine at rated speed

   By conducting no load test at different excitations, separate the losses in the DC shunt motor

Transformers

8. O.C and S.C test on the single-phase transformer - pre-determination of the following
   i). Equivalent circuit referred to HV and LV sides
   ii). Efficiency at 1/4, 1/2, 3/4 and full loads at 0.5, 0.86 and u p f.
   iii). Plot the regulation curve for full load and half load conditions
   iv). Upf load at which efficiency is maximum
   v). Performance of the transformer when a load of 30+j40 Ω is connected to the secondary.
9. Separation of losses in a transformer

   At normal voltage and frequency separate the hysterisis and eddy current losses of a single phase transformer
10. Sumpner's test
    Predetermination of efficiency and regulation at various loads and p.f.
11. Scott connection of the single phase transformers

    To determine the performance under various load conditions at upf and plotting the efficiency curves with
    (a) Main transformer secondary alone loaded, (b)Teaser transformer secondary alone loaded
    (c) Balanced loading

Sessional work assessment	
Laboratory Practicals and Rrecord	= 35
Test	= 15
Total marks	= 50

2K6 EE 601 ECONOMICS & BUSINESS MANAGEMENT

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Definition of economics-nature and scope f economic science-nature and scope of managerial economics-central problems of an economy-scarcity and choice-opportunity cost-objectives of business firms-forms of business-proprietorship-partnership-joint stock company-co-operative organization-state enterprise

Module II (14hours)

Consumption – wants –characteristics of wants- law of diminishing marginal utility- demand – law of demand-elasticity of demand- types of elasticity-factors determining elasticity-measurement- its significance in business-demand forecasting-methods of demand forecasting- supply – law of supply- elasticity of supply

Module III (14hours)

Production – factors of production – features of production – features of factors of production- division of labour – production function- Cobb-Douglas production function-production possibility curve-isoquants-marginal rate of technical substitution- properties of isoquants -law of variable proportions- returns to scale-isocost line-least cost combination of factors-expansion path-technical and economical efficiency-linear programming –graphical method-economics of large scale production.

Module IV (12hours)

Market structures and price determination – perfect competition-monopoly -monopolistic competition-oligopoly-kinked demand curve-money and banking-nature and functions of money-money market and capital market-commercial banks –functions-central banking functions-methods of credit control.

Text books and References

1 Varshney R.L & Maheshwari K.L , Managerial economics, S Chand & Co. Ltd..
2 Dwiivedi D.N, Managerial Economics, Vikas Publishing House Pvt Ltd
3. Dewett K.K, Modern Economic theory, S Chand & company Ltd.
4. Barthwal A.R ,Industrial Economics, New Age International Publishers
5. Benga T.R & Sharma S.C, Industrial Organization and Engineering Economics , Khanna Publishers
6. Ahuja H.L Modern Micro Economics –Theory and Applications , S Chand & Co. Ltd
7. Koutsoyiannis A , Modern Microeconomics, Macmillan Press Ltd.
8. Joel Dean, managerial Economics Prentice-Hall of India Pvt Ltd.
9. Dewett .K.K& Verma J.D,Elementary Economic Theory , S Chand & Co. Ltd.
10. Jhingan M.L., Macro Economic theory , Vrinda Publications Pvt.Ltd.

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total	= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module.
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one.
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one.
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one.
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

2K6 EE 602 POWER ELECTRONICS

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)
Power diodes-basic structure and V-I characteristics-various types –power transistors-BJT, MOSFET and IGBT-basic structure and V-I characteristics –Thyristors –basic structure-static and dynamic characteristics-device specifications and ratings-methods of turning on-gate triggering circuits using UJT-methods of turning off-commutation circuits-TRIAC,DIAC

Module II (13 hours)
Line frequency phase controlled rectifiers using SCR- single phase rectifiers with R and RL loads-half controlled and fully controlled converters with continuous and constant currents.-SCR invertors –circuits for single phase invertors –series, parallel and bridge invertors- pulse width modulated invertors- basic circuit operation.

Module III (12 hours)
AC regulator – single phase ac regulator with R and RL load - sequence control of ac regulators- cycloconverters – basic principle of operation- single phase cycloconverters- choppers – principle of operation- types of choppers.

Module IV (14 hours)
Switching regulators- buck regulators-boost regulators-buck-boost regulators-cuk regulators-switched mode power supply- principle of operation and analysis- comparison with linear power supply- uninterruptible power supply-basic circuit operation- different configurations- characteristics and applications.

Text books and References

1. Dr.PS Bimbra , Power Electronics, KhannaPublishers - Delhi
2. Sen P.C, Power electronics, Tata McGraw Hill
3. Rashid , Power Electronics, Pearson Education
4. Joseph Vidayathil , Power Electronics, McGraw Hill
5. Singh M.D & Khanchandani K.B, Power Electronics, Tata McGraw Hill
6. Ned Mohan et.al, Power Electronics, John Wiley & Sons
7. Sen P C , Modern Power Electronics, Wheeler publishers

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total	= 50

University examination pattern
Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 603 : POWER SYSTEMS II

3 hours lecture and 1 hour tutorial per week

Module I (13hours)

Representation of power systems– one line diagram-per unit quantities–impedance and reactance diagrams – formation of Y bus by direct inspection and singular transformation – effect of off nominal transformers on Y_{bus} - load flow studies - formulation – solution using Gauss-Siedel ,Newton Raphson and fast decoupled methods – line loss computation.

Module I1 13hours)

Short circuit studies– symmetric faults in power systems –short circuit MVA–current limiting reactors, Symmetrical components– sequence impedances and networks of generators, transformers and transmission lines – unsymmetrical faults– single line to ground, line to line & double line to ground faults at the terminals of an unloaded alternator – faults on power systems– consideration of pre fault currents – Z- bus building algorithm –fault analysis using Z-bus

Module III (13hours)

Economic dispatch of thermal plants – system constraints - economic dispatch neglecting losses- optimum load dispatch including transmission losses – derivation of transmission loss formula using B-coefficients – automatic load dispatching – optimal load flow solution – load frequency control of single area case – turbine speed governing system –model – block diagram representation – steady state analysis – control area concept – two area load frequency control - Automatic voltage regulation.

Module IV (13 hours)

Power system stability studies-–dynamics of synchronous machine – swing equation – machine connected to infinite bus – two machine system – steady state stability –transient state stability –equal area criterion - applications –effect of clearing time on stability– critical clearing angle and time – multi machine stability – swing curves using modified Eulers method – factors affecting stability –Voltage stability problem – causes and improvement methods - introduction to HVDC transmission.

Text books and References

1. Stevenson JV, William D, Elements of Power System Analysis, McGraw Hill, 1988
2. I.J Nagrath& D.P Kothari, Modern Power System Analysis. Tata McGraw Hill, 1989
3. A.K.Mahalanabis, Computer Aided Power System Analysis& Control, Tata McGraw Hill, 1991
4. Arthur R Bergen, Vijay Vittal, Power System Analysis, Pearson Education(Singapore)Pte.Ltd,2004
5. Hadi Sadat, Power System Analysis, Tata McGraw Hill, 2003
6. J.Arrilaga, C.P Arnold ,B.J Harker, Computer modeling of Power System
7. Elgerd ollei, Electric Energy System Theory-An Introduction, Tata McGraw Hill,2ed.1995
8. Wadhwa C.L, Electric Power System, New Age Publication,3ed.2002

to answer any one

Sessional work assessment

Two tests	2 x 15 = 30
Two assignments	2 x 10 = 20
Total	= 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 604 CONTROL SYSTEMS I

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

System concepts and Modeling of Systems: Systems –elements – classification of systems-principle of automatic control-open and closed loop systems-practical examples-modeling of translational and rotational systems-force voltage and force current analogue-transfer function approach-transfer function of simple electrical and mechanical systems-block diagram reduction-signal flow graphs-Mason's gain formula.

Module II (13 hours)

Control system components : Principle of operation and transfer function of Synchros, magnetic amplifier, armature controlled DC machine

Time domain analysis : Test signals –response of systems to standard test signals-first and second order systems-time domain specifications of second order systems-higher order systems – steady state error-static and dynamic error coefficients- Routh stability criterion-Root locus method-construction of root locus-effect of poles and zeros-and their location on the root locus

Module III (12 hours)

Frequency Domain Analysis: Frequency response representation- -Bode plots- minimum and non minimum phase systems -Polar plots- Frequency domain specification-gain margin and phase margin –stability from Bode and Polar plots- Bode plot system with transportation lag- Nyquist stability criterion-M and N circles

Module IV (13 hours)

Sampled Data Control System: Sampled data control system-sampling-process-mathematical analysis of sampling process-ideal sampling-data construction and hold circuits-zero and first order hold circuits-Z transform- inverse Z transform-solution of difference equation-pulse transfer function-system response-stability in the Z plane-bilinear transformation- Jury's stability test

Text books and Reference

1. Ogata K, Modern control Engineering, Prentice Hall.
2. Chatterjee, Control System components, Khanna Publishers.
3. Nagrath and Gopal, Control System Engineering, Wiley Eastern
4. Ogata K, Discrete Time Control Systems, Prentice Hall
5. Kuo, Analysis and Synthesis of Sampled Data Control Systems, Prentice Hall
6. Nagoorkani, Advanced control Theory, R B A Publications
7. Nagoor kani, control System, R B A Publications

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 605 : ELECTRICAL ENGINEERING DRAWING

1 hour lecture and 3 hours drawing per week

Module I (12 hours)

Winding diagrams

1. Simplex lap and wave dc armature windings
2. Simplex lap and wave, integral and fractional slot, double layer three phase ac armature windings
3. Mush and concentric type single layer three phase ac armature windings

Substation layouts

1. Layout and single line diagrams of outdoor and indoor substations
2. Layout of a 220KV substation
3. Single line diagram of a distribution centre

Module II (16 hours)

Transformer

1. Sectional plan and elevation of a transformer limb with windings
2. Sectional plan and elevation of the core assembly of a power transformer
3. Sectional plan and elevation of a distribution transformer tank with its accessories

DC Machines

1. Sectional front and side elevation of the yoke and pole assembly with field winding of a dc machine.
2. Sectional front and side elevation of armature with commutator of a dc machine.
3. Sectional front and side elevation of an assembled dc Machine.

Module III (18 hours)

Alternators:

1. Sectional front and side elevation of a water wheel rotor assembly with winding
2. Sectional front and side elevation of a salient pole alternator
3. Sectional front and side elevation of a turbo alternator

Induction motors:

1. Sectional front and side elevation of a slip ring induction motor
2. Sectional front and side elevation of a squirrel cage induction motor

Module IV (6 hours)

Developed winding diagrams using AUTOCAD (Not included for University examination)

1. Simplex lap and wave dc armature windings
2. Simplex lap and wave, integral and fractional slot, double layer three phase ac armature windings
3. Mush and concentric type single layer three phase ac armature windings

Reference Books

1. Bhattacharya S.K., Electrical Engineering Drawing, Wiley Eastern.
2. Narang K.L., A Text Book of Electrical Engineering Drawing, Tech India Publications.
3. Sawhney AK, Electrical Machine Design, Dhanpath Rai &Sons.
4. Clayton & Hancock, Performance and Design of DC Machines, ELBS
5. Say M.G., Performance and Design of AC machines, Pitman, ELBS.

Sessional work assessment

Assignments (class work)	= 30
Tests	= 20
Total marks	= 50

University examination pattern

Q I - 2 questions A and B of 30 marks from module I with choice to answer any one.
Q II - 2 questions A and B of 35 marks from module II with choice to answer any one.
Q III - 2 questions A and B of 35 marks from module III with choice to answer any one.

2K6 EE 606 (A) ELECTRICAL SYSTEM DESIGN AND ESTIMATION

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

Role of National Electric code and IE rules- types of wires and cables – selection of ratings of copper and aluminum wires and underground cables as per IS code – Criteria of selection of power cables – Grading of wires and power cables – protective devices such as fuses, relays, MCB's and ELCB's - Selection of fuses for motors- Types of fuses.

General rules for wiring – determination of number of points – determination of total load – determination of number of sub circuits-determination of ratings of main switch/isolator – DB – Distribution Board – Design and selection of bus bars and bus bar chambers in power circuits – Design – single line diagram using standard electrical signs and symbols of single phase/three phase circuits.

Module II (14 hours)

Wiring estimation for single phase/three phase residential consumers – schematic layout and diagram – single phase /three phase wiring estimation for small scale industries/offices/commercial building – Electrical Design and Estimation for High rise building.

Module III (12 hours)

Illumination systems – various types of lamps and luminaries – efficiency and applications – different types of lighting arrangement – energy efficiency in lamps and illumination – LED lighting. Design consideration for street lighting and factory lighting, flood lighting. Lightning protection – Design of lightning protection of residential buildings.

Module IV (12 hours)

Substation equipments – outdoor – indoor substations – layouts – components – selection of HV and EHV power and distribution transformers and switchgears – layout & schematic diagram for (a) 16MVA, 110/11KV outdoor substation (b) 11KV/415V, 63KVA outdoor / indoor substations.
Earthing – Pipe earthing, Plate earthing, earthmat design - test procedure.

Energy conservation – basics in domestic and industrial sector – instruments (Power Analyser single phase and three phase, clamp on meters, lux meter) – Electrical Energy Audit.

Text books and References

1. Gupta J.B Kataria & Sons -Electrical installation, Estimation & Costing
2. Raina & Battacharys, Electrical System Design, Estimation & Costing, Wiley Eastern
3. National Electric Code, Bureau of Indian Standard Publications
4. S.L Uppal & Garg - Khanna publishers. Electrical wiring estimating and costing

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q II - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 606 (B) ENERGY CONSERVATION

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Energy and its various forms-units and energy content of various fuels-electrical systems –supply and demand sides, economic operation, Input-output curves, load profiling-energy auditing-instruments for energy auditing-specify energy consumption-reactive power, power factor improvement-automated control-case study.

Module II (14 hours)

Energy efficiency, energy accounting, monitoring and control, transformer loading/efficiency analysis, feeder loss evaluation, diesel generator efficiency analysis, case study.
Lighting: energy efficiency in light sources, domestic/commercial/ industrial lighting, schemes and controls, LEDs , energy conservation in lighting schemes, luminaries, case study.

Module III (14 hours)

Electric motors: energy efficient starting and control, load matching, selection of motors, efficiency and load analysis, energy efficient motors-case study
Industrial drives: Variable speed drives and energy conservation schemes, pumps and fans-efficient control strategies-over sizing.

Module IV (12 hours)

Electric loads of air conditioning and refrigeration, energy conservation, electric heating-furnace operation and scheduling-Co generation.
Energy economics: Financial evaluation of energy projects; cash flow model; time value of money; evaluation proposals-payback period, average rate of return method, Internal rate of return method, present value method.

Text books and References

1. IEEE Bronze Book, Recommended practice for energy conservation and cost effective planning in industrial facilities., IEEE inc,USA,1995
2. Albert Thumann, P.W, Plant Engineers and Managers Guide to Energy Conservation-7th Edition-TWI Press Inc, Terre Haute, 1997
3. Donald R.W., Energy Efficiency Manual, Energy institute press
4. Partab H., Art & science of utilization of electrical energy , Dhanpat Rai and Sons, New Delhi, Second Edition.
5. Tripathi S C, Electrical Energy Utilization and Conservation., Tata Mc Graw Hill.,1993
6. Efficient use of electrical energy in industries-ECQ Series, Devaki R&D Engineers, Vadodara,2001
7. Turner , Wayne C., Energy Management Handbook, 2nd edition Lilburn, GA: The Fairmount press Inc,.1993
8.UNESCAP, Guide Book on Promotion of Sustainable Energy Consumption. (www.unescap.org/enrd/energy)
9. Industrial energy conservation, Charles M Gottschalk, - John Wiley & Sons,1996
10.Energy management principles, Craig B Smith, Pergamon Press
11. Optimizing energy efficiencies in industry, G G Rajan,- TMH, Pub. Co., 2001
12. Energy management, Paul O'Callaghan, McGraw Hill Book Co

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 606 (C) LINEAR SYSTEM ANALYSIS

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

System Concepts: System-classification of systems- static and dynamic systems-linear and nonlinear systems-distributed and lumped systems-time invariant and time varying systems-stochastic and deterministic system-continuous time and discrete time systems.
Modeling of Electrical and Non-electrical Systems: Modeling of electrical systems-dynamic equations of RL,RC and RLC circuits using Kirchhoff's current and voltage laws-modeling of translational and rotational mechanical systems- D'Alembert's principle-force voltage and force current analogy-gear train-dynamic equation of simple pneumatic, hydraulic, thermal and liquid level systems.

Module II (13 hours)

Transfer function: Review of Laplace transforms-concepts of transfer function-transfer function of different systems discussed in module I-block diagrams-signal flow graphs-Mason's gain formula.
Fourier series and Fourier transforms: Fourier series representation of periodic functions -symmetry conditions-exponential form of Fourier series-Fourier transform-properties of Fourier transforms-analysis by Fourier methods-relation between Laplace transform and Fourier transform

Module III (12 hours)

Time-domain analysis and stability of systems: Standard test signals-first and second order systems-steady state and transient response-time response specifications-steady state errors and error constants-effect of poles and zeros-dominant poles-higher order systems-concept of stability-bounded input, bounded output stability- Routh Hurwitz stability criterion for transfer function models.

Module IV (13 hours)

State space analysis: Concept of state space and state variables-advantage over transfer function approach-state models for typical electrical, mechanical and electromechanical systems-state space representation for continuous time, linear, single input single output systems-transfer function from state model-state transition matrix-properties-solution of state transition matrix-properties-solution of state equation-zero input zero state response. controllability and observability of linear systems-general concepts-relationship among controllability, observability and transfer functions.

Text books and Ref

1. Cheng DK, Linear System Analysis, Addison Wiley.
2. Tripati JN, Linear System Analysis, New Age International.
3. Ogatta K, Moden Control Engineering, Prentice Hall.
4. Nagrath & Gopal , Control System Engineering , Wiley Eatsern

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 606 (D) CELLULAR AND MOBILE COMMUNICATION SYSTEMS

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Introduction to cellular mobile system-performance-criteria-uniqueness of mobile radio environment-operation of cellular system-hexagonal shaped cells-analogue and digital cellular systems
Cellular concepts-frequency reuse – channel assignment-hand off- interference and system capacity- tracking and grade of service- improving coverage and capacity in cellular systems.

Module II (13 hours)

Free space propagation model-reflection-diffraction –scattering-link budget design-outdoor propagation model-indoor propagation model-small scale multipath propagation-impulse model-small multipath measurements-parameters of mobile multipath channels-types of small scale fading-statistical models for multipath fading channels.

Module III (13 hours)

Modulation techniques-minimum shift keying-Gaussian MSK, M-ary QAM, M-ary FSK-orthogonal frequency division multiplexing-performance of digital modulation in Slow-Flat fading channels and frequency selective mobile channels-equalization-linear equalization-non linear equalization-algorithm for adaptive equalization-diversity techniques-RAKE receiver

Module IV (13 hours)

Multiple access techniques –FDMA-TDMA-CDMA-SDMA-capacity of cellular CDMA and SDMA
Second generation and third generation wireless network standards-WLI-blue tooth-GSM-IS 95 and DECT

Text books and References

1. R.Blak, Mobile , Wireless Communication Technology, Thomson Delmar, 2003
2. W.C.Y.Lee, Communication Engineering: Theory and Applications, II Edition, MGH International, 1998
3. T.SS.Rappaport, Wireless Communications: Principles and Practices, Second Edition Pearson Education/Prentice Hall of India, Third Indian reprint.
4. Steele R., Hanzo L., Mobile Radio Communica5tion, second edition Wiley 1999

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 606 (E) INDUSTRIAL PSYCHOLOGY

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

The role of the psychologists in industry- occupational psychology- study of behavior in work situations and applications of psychological principles to problems of selection, placement, counseling and training-design of work environment. Human engineering and physical environment techniques of job analysis. Social environment-group dynamics in industry- personal psychology. Selection, training, placement, promotion, counseling, job motivations and job satisfactions.

Module II (13 hours)

The nature and scope of engineering psychology. Application of engineering psychology to industries. problem fatigue, boredom and accidents. Consumer behavior; study of consumer preference, effects of advertising. Industrial morale. case studies

Module III (12 hours)

Efficiency at work: the concept of efficiency, he work curve, its characteristics. The work methods, hours of work, nature of work, fatigue and boredom and rest pauses
The personal factors, age, abilities, interest and job satisfaction. The work environment, noise, illumination and atmospheric conditions. Increasing efficiency at work; improving the work methods. Time and motion study, its contribution and failure. resistance to time and motion studies, need for allowances in time and motion study. Case studies.

Module IV (13 hours)

Work and equipment design: Criteria in evaluation of job- related factor, job design, human factors, engineering information, input processes , mediation processes., action processes, methods deign, work space and its arrangement, human factors in job design. Accident and safety: The human economics costs of accidents, accident records and statistics, the causes of accidents. Situational and individual factors related to accident reduction. case studies

Text books and References

1. Tiffin J. and McCormic E J., Industrial Psychology,(Prentice Hall), 6 th Edn. 1975
2. McCormic E.J.:Human Factors Engineering and Design(McGraw Hill), 4th Edn.,19763 .Mair, N.R.F., Principles of Human Relations
4. Gilmer, Industrial Psychology
5. Ghiselli& Brown, Personnel and Industrial Psychology
6. Myer, Industrial psychology
7. Dunnete MD, Handbook of Industrial and Organizational Psychology
8. Blum&Taylor, Industrial Psychology

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 606 (F) OPERATIONS RESEARCH

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Overview: Definition, Characteristics and phases of operation research, Type of operations research models. General methods for solving operations research models.
Linear programming: Introduction to linear programming. Formulation, graphical solution, Simplex method, Artificial variable technique, Duality theory.
Transportation Problem: Formulation optimal solution. Variations in transportation problems. Degeneracy. (separate, bold) Assignment problem, Formulation. optimal solution, variation in assignment problems.

Module II (13 hours)
Sequencing : introduction ,Terminology, notations and assumptions. Problem with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines, problem with n-jobs and m-machines, graphical solutions. Travelling salesman problem.
Queueing Theory: Introduction, Terminologies of queueing system, Single channel Poisson arrivals, Exponential service times, Unrestricted queue with infinite population and finite population models, single channel poisson arrivals, Exponential service times with infinite population and restricted queue.

Module III (12 hours)

Replacement: Introduction, replacement of items that deteriorate with time-value of money unchanging and changing, Replacement of items that fail completely.
Theory of games: Introduction, Two-person zero-sum games, The maximin and minimax principles , Games without saddle points-Mixed strategies,2xn and mx2 Games-Graphical solutions, Dominance property, Use of L.P. to solve games, Algebraic solutions to rectangular games.

Module IV (14 hours)

Inventory Control: Introduction, inventory costs, Independent demand systems. Deterministic models-Fixed order size systems-Economic order quantity (EOQ)-Single item, Back ordering, Quantity discounts. Batch-type production systems: Economic production quantity. Fixed order interval systems: Economic order interval (EOI)-Single item, selective inventory control, ABC,VED,FSN Analysis.
Network analysis: Network definitions, Minimum spanning tree algorithm, Shortest root problem, Maximum flow model. Elements of project scheduling by CPM and PERT. Crashing of networks.

Text books and References

1.Operation Research, by TAHA (PHI)
2.Operations Research Methods and Problems, by M.Sasiene, A.Yespal and L.Friedman. (John Wiely)
3.Operation Research by S.D.Sharma. (Kedarnadh Ramnadh & Co.,)
4.Operation Research by R. Pannerselvam (PHI)

Sessional work assessment

Two tests	2 x 15	: 30
Two assignments	2 x 10	: 20
Total marks		: 50

University examination pattern

Q I - 8 short answer type questions of 5 marks, 2 from each module
Q II - 2 questions of 15marks from module I with choice to answer any one
Q III - 2 questions of 15marks from module II with choice to answer any one
Q IV - 2 questions of 15marks from module III with choice to answer any one
Q V - 2 questions of 15marks from module IV with choice to answer any one

2K6 EE 607(P) : ELECTRICAL MACHINES LAB II

3 hours practical per week

3 Phase Induction Motors

1. No load and blocked rotor tests on a 3 Φ squirrel cage Induction motor.
   (i). Conduct no load blocked rotor tests on 3 Φ squirrel cage Induction motor
   (ii). Determine the equivalent circuit parameters and draw the equivalent circuit and predetermine Torque-slip characteristics for 100% and 50% applied voltage.
   (iii). Draw the circle diagram and there from predetermine the performance characteristics
2. Load tests on 3 Φ squirrel cage and slip ring Induction motors
   (i). Conduct the brake test on both types of machines
   (ii). Plot the various performance characteristics
   (iii). Find the KVAr required to improve the power factor to 0.95 at various loads.
3. Performance of Induction machine as a generator and motor
   To operate the given 3 Φ Induction machine coupled with a DC machine as
   (i). An Induction motor
   (ii). An Induction generator working on supply mains and determine the capacitance required for self excitation
   (iii). To conduct load test in both generating and motoring modes and plot the following characteristics on the same graph - efficiency, line current, power factor and slip as a function of output power
   (iv). Plot output Vs slip characteristicsand obtain hysteresis power and corresponding torque
4. Pole changing as a method of speed control and load test on pole changing induction motor
   (i). To study the different modes of operation of a 3 Φ pole changing Induction motor
   (ii). Obtain the performance characteristics and compare the results obtained for different pole combinations at different load conditions.
5. Speed control of 3 Φ Induction motor by variable frequency method
   Plot speed vs frequency characteristics of a 3 Φ cage Induction motor under variable frequency method of speed control, under no load and constant load conditions

Single Phase Induction Motor

6. Single Phase Induction Motor
   (i). Study the different type of single phase Induction motors.
   (ii). Perform no load and blocked rotor tests on a single phase Induction motor and determine the equivalent circuit parameters and there from Pre-determine the performance characteristics.
   (iii). Conduct speed control of a Single Phase Induction motor by variable voltage method and plot the characteristics.

3 Phase Alternators

7. Voltage regulation of a 3 Φ alternator
   (i). Conduct open circuit and short circuit test on a 3 Φ alternator and plot OCC , SCC and ZPF characteristics
   (ii). Predetermine the voltage regulation curve for half and full load by EMF, MMF,ZPF and ASA methods
   (iii). Plot the power Vs power angle diagram
8. Slip test on Salient pole alternator
   (i). Conduct the slip test on 3 Φ salient pole alternator to obtain direct axis and quadrature axis reactances
   (ii). Predetermine the regulation at different loads and power factors and plot the power Vs power angle diagram
9. V curves of a 3 Φ synchronous machine
   (i). Synchronise a 3 phase alternator to the supply mains using dark and bright lamp methods.
   (ii). Plot the V curves and inverted V curves as a generator and motor under constant power condition.

Sessional work assessment	
Laboratory practicals and record	= 35
Test	= 15
Total marks	= 50

2K6 EE 608(P) : POWER ELECTRONICS LAB

3 hours practical per week

1. Study of Power devices – SCR, TRIAC, DIAC, Power transistor. Power MOSFET, IGBT, etc.
2. Characteristics of SCR & TRIAC
3. Phase control circuit using R & RC Triggering
4. UJT Trigger circuit for single phase controlled rectifier.
5. Experiments on Zero voltage switching circuits.
6. Single phase fully controlled SCR circuit.
7. Experiments on buck converter.
8. Experiments on boost converter.
9. Experiments on different types of commutation.
10. Three phase half controlled and fully controlled converter.
11. Experiments on Switched mode Power supply.
12. Experiments on Single phase dual converter.
13. Experiments on Single phase Cycloconverter.
14. Experiments on Power MOSFET chopper.
15. Study of DC motor control using converter.
16. Experiments on Single phase induction motor control – PWM

A minimum of 12 experiments to be done according to the facility available in the laboratory.

Sessional work assessment	
Laboratory practicals and record	= 35
Test	= 15
Total marks	= 50