

St. PETER'S UNIVERSITY

Chennai – 600 054.

B.E. BIOMEDICAL ENGINEERING

3 & 4 SEMESTERS CURRICULUM AND SYLLABI

Regulations – 2008

SEMESTER III

(Applicable to the students admitted from the Academic year 2008–2009 onwards)

Code No.	Course Title	Credit	L	T	P	Marks		
						CA	EA	Total
Theory								
308BMT01	Transforms and Partial Differential Equations	3	3	1	0	25	75	100
308BMT02	Medical Physics	2	3	0	0	25	75	100
308BMT03	Signals and Systems	3	3	1	0	25	75	100
308BMT04	Sensors and Measurements	2	3	1	0	25	75	100
308BMT05	Electronic Circuits	2	3	1	0	25	75	100
308BMT06	Biochemistry	2	3	0	0	25	75	100
308BMT07	Anatomy and Human Physiology	2	3	0	0	25	75	100
Practical								
308BMP01	Biochemistry and Human Physiology Lab	1	0	0	4	25	75	100
308BMP02	Electronic Circuits Lab	1	0	0	3	25	75	100
Total		18	21	4	7	225	675	900

SEMESTER IV

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

Code No.	Course Title	Credit	L	T	P	Marks		
						CA	EA	Total
Theory								
408BMT01	Probability and Random Processes	3	3	1	0	25	75	100
408BMT02	Biomedical Instrumentation	2	3	0	0	25	75	100
408BMT03	Basics of Electrical Engineering	2	3	0	0	25	75	100
408BMT04	Analog and Digital ICs	3	3	1	0	25	75	100
408BMT05	Pathology and Microbiology	2	3	0	0	25	75	100
408BMT06	Analog and Digital Communication	2	3	0	0	25	75	100
408BMT07	Environmental Science and Engineering	2	3	0	0	25	75	100
Practical								
408BMP01	Integrated Circuits Lab	1	0	0	3	25	75	100
408BMP02	Pathology and Microbiology Lab	1	0	0	4	25	75	100
Total		18	18	2	7	225	675	900

308BMT01 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4
(Common to all branches)

OBJECTIVES

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT I FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORMS 9 + 3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

Lectures : 45

Tutorials : 15

Total : 60

TEXT BOOKS

1. Grewal, B.S, "*Higher Engineering Mathematic*", 40th Edition, Khanna publishers, Delhi, (2007)

REFERENCES

1. Bali.N.P and Manish Goyal, "*A Textbook of Engineering Mathematic*", 7th Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V., "*Higher Engineering Mathematics*", Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, "*Advanced Modern Engineering Mathematics*", 3rd Edition, Pearson Education (2007).
4. Erwin Kreyszig, "*Advanced Engineering Mathematics*", 8th edition, Wiley India (2007).

AIM

To get the complete understanding of radioactivity and medical applications of various radio isotopes

OBJECTIVES

To Study the effects of sound and light in Human body

To study the effects of radiation in matter and how isotopes are clinically used.

UNIT I**10**

Electromagnetic spectrum and its medical application

Light - Physics of light, Intensity of light, limits of Vision and color vision **Sound** - Physics of sound , Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) – Interaction of Ultrasound with Materials-Reflection and Refraction – Absorption and Scattering **Non- ionizing Electromagnetic Radiation** Tissue as a leaky dielectric – Relaxation Processes – Overview of non – ionizing radiation effects -Low Frequency Effect – Higher frequency effect.

UNIT II**10**

Radioactive Decay – Spontaneous Emission – Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture **Principles of Nuclear Physics** – Natural radioactivity, Decay series,Half life period, type of radiation and their applications. **Production of radionuclides** – Cyclotron produced Radionuclide - Reactor produced Radionuclide – fission and electron Capture reaction, Radionuclide Generator – Milking Process - Linear accelerator , Radionuclide used in Medicine and technology.

UNIT III INTERACTION OF RADIATION WITH MATTER**8**

Interaction of charged particles_with matter – Specific ionization , linear energy Transfer Range, Bremsstrahlung , Annihilation Interaction of Gamma radiations_with matter – Photoelectric effect, Compton Scattering , pair Production, Attenuation of Gamma Radiation, Interaction of neutron with matter

UNIT IV PHYSICS OF CARDIOPULMONARY SYSTEM**9**

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relationships of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O₂ and CO₂ exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulent

UNIT V RADIATION EFFECTS**8**

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro-intestinal syndrome –Bone Marrow syndrome **Delayed Effects of Radiation** - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

TOTAL : 45 PERIODS

TEXT BOOKS

1. B.H Brown , PV Law ford, R H Small wood , D R Hose , D C Barber , “Medical Physics and Biomedical Engineering”, CRC Press, 1999.
2. Gopal B.Saha “Physics and Radiobiology of Nuclear Medicine” Springer, 3rd ed, 2006

REFERENCES

1. John R. Cameron and James G. Skofronick, “Medical Physics”, John–Wiley & Sons, 978.
2. RF Farr and PJ Allisy –Roberts, “Physics for Medical Imaging” Saunders, 1997.
3. P.Uma Devi, A. Nagarathnam, B S Satish Rao, “Introduction to Radiation Biology” B.I .Churchill Livingstone pvt ltd, 2000.
4. S.Webb, “The Physics of Medical Imaging”, Taylor and Francis, 1988.

AIM

To study and analyse characteristics of continuous, discrete signals and systems

OBJECTIVE

- To study the properties and representation of discrete and continuous signals
- To study the properties and representation of discrete and continuous systems
- To study the signals in time domain and frequency domain using Fourier
- To study the sampling process and analysis of signals and systems using Laplace and Z-transforms.
- To study the analysis and synthesis of systems.

1. Classification of Signals and Systems 9

Classification of signals – Continuous-time signal and discrete-time signals – periodic and aperiodic signals – even and odd signals – energy and power signals – deterministic and random signal. Basic operations on signals – arithmetic operations – reflections – time shifting – time scaling. Types of signals – exponential, sinusoidal, step, impulse and ramp. System - impulse response of the system. Classification of systems – stable – memory – invertible – time invariant – linear – causal. Convolution integrals and its properties. Sampling theorem.

2. Fourier Series and Fourier Transform 9

Continuous-time Fourier series (CTFS) – Exponential and trigonometric representation of CTFS. Dirichlet condition. Properties of CTFS – linearity, time-shifting, time-reversal, time-scaling, multiplication, Parseval's relation – differentiation – integration. Continuous-time Fourier transform (CTFT) – properties of CTFT – linearity, time shifting, time-reversal, time-scaling, multiplication, convolution, Parseval's relation – differentiation in time and frequency domains– integration. Application to systems - solution to differential equation using CTFT.

Discrete-time Fourier series (DTFS) and Discrete-time Fourier transform (DTFT) – properties – linearity, time-shifting, time-reversal, time-scaling, multiplication, Parseval's relation – difference – accumulation. Application to systems - solution to difference equation using DTFT.

3. Laplace Transform 9

Unilateral and bilateral Laplace transform (LT) – region of convergence (ROC) - properties of LT – linearity, time-shifting, time-reversal, time-scaling, multiplication, convolution, Parseval's relation – differentiation in time and frequency domain – integration – initial value and final value theorem – inversion of LT – solution to differential equation using LT – analysis of passive network using LT.

4. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) 9
Discrete Fourier transform – properties of DFT – linearity, circular-shifting in time and frequency domains, time-reversal, time-scaling, circular correlation, multiplication, convolution, parseval’s relation – circular convolution – circle method, matrix method – sectional convolution – overlap-add method and overlap-save method – radix-2 fast Fourier algorithm – decimation-in-time FFT – decimation-in-frequency FFT – inverse FFT.

5. Z-transform and state matrix 9
Z-transform (ZT) – region of convergence (ROC) - properties of ZT – linearity, time-shifting, time-reversal, time-scaling, multiplication, convolution, parseval’s relation – differentiation in time and frequency domain – integration – initial value and final value theorem – inversion of ZT – power series method, partial-fraction method, residual method - solution to difference equation using ZT.
State variable description for LTI system – determination of transfer function from state model – discrete-time model.

TEXT BOOK

1. Allan V. Oppenheim et al, “Signals and Systems”, Pearson Education, 2007

REFERENCE

1. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Willey, 1999
2. Roger E. Zeimer et al, “Signals and Systems”, McMillan, 2nd Edition, 1999.
3. Douglas K. Linder, ““Signals and Systems”, McGraw-Hill, 2nd Edition, 1999.

UNIT I SCIENCE OF MEASUREMENT 7

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II DISPLACEMENT , PRESSURE,TEMPERATURE SENSORS 11

Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gage, biomedical applications; strain gauge as displacement & pressure transducers: force summing devices, capacitive transducer, inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors. Active type: Thermocouple – characteristics,

UNIT III PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS 9

Phototube, Photo Multiplier Tube (PMT), photovoltaic, photoconductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectro-photometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

UNIT IV SIGNAL CONDITIONING & SIGNAL ANALYSER 9

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering -Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V DISPLAY AND RECORDING DEVICES 9

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, X–Y recorder, thermal recorder.

TOTAL : 45**TEXT BOOK**

1. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – John Wiley and sons.
2. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.

REFERENCES

1. Ernest o Doebelin and dhanesh N manik, Measuremet systems, Application and design ,5th edition ,McGraw-Hill, 2007.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2007.
3. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
4. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004

AIM

The aim of this course is to familiarize the student with analysis and design of basic transistor amplifier circuits, signal generator circuits and power supplies

OBJECTIVES:

On completion of this course, the student will understand

- The methods of biasing transistors,
- Design the simple amplifier circuits, and design of signal generation circuits,
- Advantages and analysis of feed back,
- Design of Power supplies.

UNIT I DIODE APPLICATIONS AND TRANSISTOR BIASING 9

Rectifiers – HWR, FWR, Bridge rectifier with and without capacitor and pie filter. Clipper- clampers – voltage multiplier circuits - Operating point of the bi-polar junction transistor – Fixed bias circuit – Transistor on saturation – Emitter stabilized Bias Circuit – Voltage divider bias – Transistors switching network – Trouble shooting the Transistor (In circuit testing)- practical applications. Biasing the FET transistors - CMOS devices – MOSFET handling.

UNIT II SMALL SIGNAL AMPLIFIERS 9

Two port network, h-parameter model – small signal analysis of BJT (CE and CC configurations only) — high frequency model of BJT – (CE configuration only) - small signal analysis of JFET (CS configuration only) - Frequency response of BJT and FET.

UNIT III FEEDBACK AMPLIFIER AND OSCILLATORS 9

Basic of feedback system (block diagram approach) – Types of feedback amplifier – Basic principles of oscillator. Audio oscillators – RC phase shift and wein bridge oscillator. RF oscillators – Hartly and Collpit oscillator – Crystal oscillator, Multivibrators.

UNIT IV POWER AMPLIFIERS 9

Definition – Types of power amplifiers – Class A (series fed – transformer coupled)- Class B amplifier – Class-B push-pull amplifier – Complimentary symmetry type - Class-C amplifier – Heat sinking .

UNIT V VOLTAGE REGULATIONS 9

Shunt voltage regulator – Series voltage regulator – current limiting – feedback technique – SMPS (Block diagram approach) – DC to DC converter - Three terminal IC regulators (78XX and 79XX).

TEXT BOOKS:

1. Robert L. Boylestad, Louis Nashelsky , Electronic Devices and circuit Theory , Prentice Hall of India , 2004.

REFERENCES

1. David A. Bell , Electronic Devices And Circuits 4 th Edition Prentice Hall of India, 2003.
2. Millman Haykins, Electronic Devices And Circuits, 2nd Edition Tata MC Graw Hill, 2007.

AIM

- To study the biochemical reactions and the various methods to analyze them.

Objective:

- To give a clear understanding of important biomolecules and their functions.
- To analyze the metabolic pathways in normal and diseased state.
- To help in devising analytical & diagnostic tools.

UNIT I**6**

Introduction to biochemistry – Biomolecules, structure of water & its importance – Important noncovalent forces – Hydrogen bonds, electrostatic, hydrophobic & vanderwaals forces – Acid, base & buffers – pH, Henderson Hasselbalch equation. Biological buffers and their significance – Principle of viscosity – surface tension, adsorption, diffusion, osmosis & their applications in biological systems.

UNIT II**9**

Classification, structure & properties of carbohydrates – mono, di, oligo & polysaccharides. Classification, structure & properties of amino acids & proteins. Classification, structure & properties of Lipids – Simple lipids, Phospholipids, glycolipids & steroids. Transport of lipids: Lipoproteins Structure & functions of nucleic acids – Nucleosides, nucleotides – Cyclic AMP, cyclic GMP, ATP, GTP – DNA & RNA

UNIT III**12**

Classification of Enzymes, Chemical nature, Active Site, Specificity of Enzyme catalyzed reactions, Regulation: Feedback, Allosteric, Covalent modification, Hormonal regulation, co-enzymes. Assay of enzymes, enzymes in clinical diagnosis of diseases. Introduction to Metabolism: Carbohydrate metabolism, Glycolysis
Lipid metabolism: fatty acid, beta oxidation, ketogenesis and cholesterol metabolism. TCA cycle: Structure of biological membranes, electron transport & Oxidative phosphorylation.

UNIT IV**9**

Liver function and liver function tests, Kidney function and kidney function tests, normal & abnormal constituents of urine and their clinical significance. General characteristics of hormones. Structure, functions & disorders of thyroid, parathyroid, pituitary, adrenal and pancreatic hormones. Hormones as chemical messengers: General assay of hormones – Bio assay, chemical assay & immuno assays.

UNIT V**9**

Analytical techniques: Principle and applications of electrophoresis – PAGE, SDS PAGE, Isoelectric focusing, Two Dimensional Electrophoresis. Chromatography: Principle of adsorption & partition chromatography, Size exclusion, Ion exchange & affinity chromatography. Spectro photometry, fluorimetry, flame photometry, manometry, microcalorimetry, electrochemical methods, biosensors, automation in clinical laboratory, use of radio isotopes in biochemistry.

TOTAL : 45**TEXT BOOKS**

1. Harper's review of biochemistry By David. W. Martin, Peter. A. Mayes, Victor. W. Rodwell. LANGE medical publications, 2003.
2. Practical Biochemistry – Principles & Techniques, Keith Wilson & John Walker. Oxford university press.

REFERENCE BOOKS

1. Understanding Enzymes By Trevor palmer. Published by Ellis Horwood LTD.
2. Biochemistry Lippincott's Illustrated Reviews By Pamela.C.Champe & Richard. A.Harvey. Lippincott-Raven publishers, 3rd edition, 2006.

AIM

To provide the students the exposure to the fundamentals in human anatomy and physiology.

UNIT I STUDY OF CELLULAR SYSTEM 8

Cell: Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane – origin of cell membrane potential (Nernst and Goldman and Katz equations) – Action potential.

UNIT II HEMATOLOGICAL SYSTEM 9

Blood composition - functions of blood – functions of RBC. WBC types and their functions. Blood groups –importance of blood groups –identification of blood groups. blood flow factors regulating blood flow such as viscosity, radius , density etc (Fahreus lindqvist effect, Poiseuille's Law)

UNIT III RENAL AND RESPIRATORY SYSTEM 9

Structure of Kidney and nephron. Mechanism of Urine formation and acid base regulation. Dialysis. Components in of respiratory system. Oxygen and carbon dioxide transport and acid base regulation.

UNIT IV CARDIAC SYSTEM 9

Structure of heart – Properties of Cardiac muscle – Cardiac muscle and pacemaker potential - Cardiac cycle – ECG - Heart sound - volume and pressure changes and regulation of heart rate.

UNIT V SENSORY SYSTEM 10

Structure of a Neuron. Synaptic conduction. Conduction of action potential in neuron Parts of brain cortical localization of functions.. EEG. Simple reflexes , withdrawal reflexes. Autonomic nervous system and its functions, Structure of eye ,ear and auditory and visual pathways.

TEXT BOOK

1. Essential of human Anatomy and Physiology, Elaine.N. Marieb Eight edition, Pearson Education New Delhi ,2007.

REFERENCE BOOKS

1. Review of Medical Physiology, 22nd edition, William F. Ganong Mc Graw Hill New Delhi,
2. Text book of Physiology, Prof. A.K. Jain, Third edition volume I and II Avichal Publishing company, New Delhi

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.
3. Estimation of blood glucose.
4. Estimation of serum cholesterol.
5. Assay of SGOT/SGPT.
6. Estimation of creatinine in urine.
7. Electrophoresis of serum proteins.
8. Separation of amino acids using thin layer chromatography.
9. ESR , PCV , MCH, MCV, MCHC, total count of RBCs and Hemoglobin estimation
10. Differential count of different WBCs and Blood group identification
11. Ishihara chart for color blindness and Snellen's chart for myopia and hyperopia – by letters reading and ophthalmoscope to view retina.
12. Weber's and Rinnee's test for auditory conduction.

TOTAL : 60 PERIODS

LAB EQUIPMENTS

- 1) Test tube, microscope (Binocular), colorimeter
- 2) Centrifuge, Test tubes, anticoagulant
- 3) Blood Glucose kit
- 4) Cholesterol kit
- 5) SGOT/SGPT kit
- 6) Creatinine kit
- 7) Electrophoresis apparatus
- 8) Glass tanks, thin layer chromatography
- 9) ESR glan tube wintrobe PCV tube(Haematocrit tube) , sahli's Haemo globinometer, Microscope, Haemocytometer(Mirror coated)
- 10)Differential count Leishman stain(readymade),Blood group antigen ,microscope slides.
- 11)Ishihara chart, Snellen's chart, Ophthalmoscope
- 12)Weber's and Rinnee's test.

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. Study of biasing circuits
 - a. i). Fixed bias, ii). Self bias, iii). collector to base bias
4. FET amplifier
5. Differential amp – CMRR and determination of Gain
6. Design of RC coupled amplifier
7. Design of Voltage series feedback amplifier
8. Design of Class A and Class B amplifier
9. Design of RC phase shift oscillator
10. Design of Hartely Oscillator
11. Design of Colpitts oscillator
12. Study of pulse shaping circuits
 - i). Astable Multivibrator
 - ii). Monostable Multivibrator

TOTAL : 45 PERIODS

(Common to Electronic and Communication Engineering & Bio Medical Engg.)

**LIST OF EQUIPMENTS AND COMPONENTS FOR A BATCH OF 30 STUDENTS
(3 per Batch)**

S.No	Name of the Equipments / Components	Quantity Required	Remarks
1	Variable DC Power Supply	10	(0-30V)
2	Fixed Power Supply	5	+ / - 12V
3	CRO	10	30MHz
4	Multimeter	10	Digital
5	Function Generator	5	1 MHz
6	Digital LCR Meter	1	
Consumables (Minimum of 25 Nos. each)			
7	BC107, BF195, 2N2222, BC147, BFW10, SL100		
8	IC 555, LEDs		
9	Resistors 1/4 Watt Assorted		
10	Capacitors		
11	Inductors		
12	Bread Boards		
13	Transformer Diodes, Zener Diodes		

AIM

This course aims at providing the necessary basic concepts in random processes. Knowledge of fundamentals and applications of random phenomena will greatly help in the understanding of topics such as signals & systems, pattern recognition, voice and image processing and filtering theory.

OBJECTIVES

At the end of the course, the students would

- Have a fundamental knowledge of the basic probability concepts.
- Have a well-founded knowledge of standard distributions which can describe real life phenomena.
- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Understand and characterize phenomena which evolve with respect to time in probabilistic manner.
- Be able to analyze the response of random inputs to linear time invariant systems.

UNIT I RANDOM VARIABLES**9 + 3**

Discrete and continuous random variables – Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and normal distributions – Function of Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES**9 + 3**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem (for iid random variables)

UNIT III CLASSIFICATION OF RANDOM PROCESSES**9 + 3**

Definition and examples - first order, second order, strictly stationary, wide-sense stationary and ergodic processes - Markov process - Binomial, Poisson and Normal processes - Sine wave process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES**9 + 3**

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS**9 + 3**

Linear time invariant system - System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output – white noise.

LECTURES : 45**TUTORIAL : 15****TOTAL : 60**

TEXT BOOKS

1. Oliver C. Ibe, "Fundamentals of Applied probability and Random processes", Elsevier, First Indian Reprint (2007) (For units 1 and 2)
2. Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2002. (For units 3, 4 and 5).

REFERENCES

1. Miller,S.L and Childers, S.L, "Probability and Random Processes with applications to Signal Processing and Communications", Elsevier Inc., First Indian Reprint 2007.
2. H. Stark and J.W. Woods, "Probability and Random Processes with Applications to Signal Processing", Pearson Education (Asia), 3rd Edition, 2002.
3. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw-Hill edition, New Delhi, 2004.
4. Leon-Garcia,A, "Probability and Random Processes for Electrical Engineering", Pearson Education Asia, Second Edition, 2007.
5. Yates and D.J. Goodman, "Probability and Stochastic Processes", John Wiley and Sons, Second edition, 2005.

1. BIO POTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

2. ELECTRODE CONFIGURATIONS 9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

3. BIO AMPLIFIER 8

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

4. MEASUREMENT OF NON-ELECTRICAL PARAMETER 10

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

5. BIO-CHEMICAL MEASUREMENT 9

Biochemical sensors - pH, pO₂ and pCO₂, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004

REFERENCE

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
3. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, 2003.

AIM

To make the students understand the basics of electricity generation and utilization.

OBJECTIVES

- To study the magnetic circuits
- To study the principle and application of transformers
- To study the principle of operation of DC motors
- To study the principle and operation of AC machines
- To study the principle of fractional-kW motors and their applications.

1. MAGNETIC CIRCUIT **9**

Magnetic effects of electric current, Magnetic circuits, Magnetic materials and B-H relationship, Electromagnetic induction and force, Hysteresis and eddy current losses.

2. DC MOTORS **9**

Parts of DC motors, types of motors, principle of operation of DC motors, Back EMF, circuit model, power balance, calculation of torque and speed, armature and field control, DC motor starting, calculation of efficiency.

3. TRANSFORMERS **9**

Methods of generation of AC voltages, role of transformers in the distribution of electricity, Construction and principle of operation of single phase transformers, Ideal transformer, voltage and current relationships, impedance transformation, definition of voltage regulation, Losses in the transformer, calculation of efficiency of transformer, construction and voltage ratio aspects of single phase autotransformer, construction and voltage ratio aspects three phase transformer.

4. AC MACHINES **9**

Synchronous machines, construction, principle of operation, phasor diagram, voltage equation, Open circuit and short circuit characteristics, voltage regulation, induction motor, construction, circuit model, torque slip characteristics, starting, speed control-slip control, frequency control

5. FRACTIONAL -KW MOTORS **9**

Single phase induction motor, principle of operation, torque-speed characteristics, two-phase motors, split phase motor, universal motor, two value capacitance motor, stepper motors - variable reluctance stepper motor-single stack and multistack-permanent magnet stepper motor- drive concepts-unipolar drive circuit, bipolar drive circuit-calculation

TOTAL : 45

TEXT BOOKS:

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", TMH, 2ed, 2007.
2. P. C Sen, "Principles of Electric machines and power electronics", John-Wiley & Sons, 2ed, 2007.

REFERENCE

1. Muhammad Rashid, "Power electronics circuit, devices and applications", Prentice-Hall of India, 3rd ed, 2004.

AIM

To understand the functions of various analog and digital IC and their applications

OBJECTIVES

To acquire the knowledge about the characteristics and operation of various analog ICs

To study the application of analog ICs in the designing circuit.

To study the applications of these Digital ICs.

To understand the basic of the Digital systems.

To study the design of the various functional circuits using these ICs.

1. OPERATIONAL AMPLIFIERS**9**

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth - equivalent circuit of an op-Amp – virtual ground concept – Linear applications of op-amp – inverting and noninverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Differential amplifiers – differentiator and integrator. Nonlinear applications – comparator - Schmitt Triggers – Precision Diode Half wave and full wave rectifiers – Average detectors – peak detector

2. ACTIVE FILTERS AND SIGNAL GENERATOR**9**

Active filters (first and second order) – Low pass, high pass, band pass filters, band reject filters (notch filters). Oscillators - RC Phase shift and Wein-bridge. Waveform generators - Square, triangular and saw tooth.

3. TIMER, PLL, A/D AND D/A CONVERTERS**9**

555 Timer (internal diagram) and its applications – monostable multivibrator, astable multivibrator. Phase locked Loop (565 - block diagram approach) and its applications - Frequency multiplication, Frequency translation, voltage to frequency and frequency to voltage converters. DAC – Binary weighted DAC and R-2R DAC. ADC – single slope and dual slope ADCs, successive approximation ADC

4. NUMBER SYSTEMS AND LOGIC GATES**9**

Decimal, Binary, Octal and Hexadecimal Numbers.-Conversion between these number systems.- Complements r's and (r-1)'s complements.- subtraction using complements – Encoding numbers and characters using Binary digits. –Binary coded Decimal –Gray code - Binary to Gray code conversion –ASCII Code. Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions, Truth Tables and Logic circuits – The Karnaugh Map – half adder, full adder, Multiplexers and Demultiplexers - Decoders and encoders. Coding of Combination Circuits in verilog.

5. REGISTERS AND COUNTERS**9**

Flip Flops – RS, D, T, JK Flip Flops – Characteristic equations, exciting tables – JK Master – Slave flip-flop – Universal shift register. Design of modulo-N counters – counter design using state diagram. sequential circuit design with verilog.

TOTAL = 45 HOURS

TEXT BOOKS

1. Ramakant A. Gayakwad , “Op-AMP and Linear Ics, Prince Hall, 1994
2. M. Morris Mano , “Digital Logic and Computer design “ Prentice Hall 1994.

REFERENCE:

1. Robert B.Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, CRC Press, 2004.
2. Sergio Franco, DESIGN with Operational Amplifiers and analog Integrated circuits, McGraw-Hills
3. Millman , J. Halkis.C.C “Integrated Electronics”.McGraw Hill , 1972.
4. John. F. Wakerly, “Digital design principles and practices”, Pearson Education,Fourth Edition, 2007 .
5. Charles H. Roth, Jr, “Fundamentals of Logic Design”, Fourth edition, Jaico Books, 2002

UNIT I: **9**
Cell Degeneration, repair and neoplasia-Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours.

UNIT II: **9**
Fluid and hemodynamic derangements, - edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock.
Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

UNIT III : **9**
General Structural Organisation of bacterial and viral cell- growth and identification of bacteria, observation of culture.
Microscopy: Light microscopy, dark field microscopy, phase contrast microscopy, fluorescence and electron microscopy.

UNIT IV: **9**
Genetic disorders, Infection and Immunity-Mutations, Autosomal and X linked disorders, Mendelian disorders, types of immune response, hypersensitivity disorders, Immune deficiency syndrome, Viral disease, Chlamydial ,Bacterial, Mycoplasma, Rickettsial, Fungal, protozoal and helminthic disease.

UNIT V: **9**
Identification of disease producing organisms, simple stain, Gram stain, AFB stain, Fluorescent techniques, antigen-antibody techniques.

TEXT BOOKS:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins: Pathologic Basis of diseases. WB Saunders Co. 7th edn-2005.
2. Harsh Mohan: Text book of Pathology. Jaypee publishers. 4th edn. 2000.

REFERENCE:

1. **Underwood JCE:** General and Systematic Pathology Churchill Livingstone 3edn.2000.

MICROBIOLOGY

TEXT BOOK

1. Ananthanarayanan R& Panicker CKJ:Textbook of Microbiology. Orient Longmans.7th ed.2006.
- 2..Dubey RC and Maheswari DK.A textbook of Microbiology. S Chand,2007.

REFERENCES:

1. Prescott,Harley,Klein.Microbiology.Mc Graw Hill 5th ed. 2002.
2. Manual of Microbiology tools and techniques. Kanika Sharma. Ane's student edition.2007.

1. ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

2. PULSE MODULATION 9

Low pass sampling theorem – Quantisation - PAM – Line coding - PCM, DPCM, DM, ADPCM and ADM, Channel Vocoder,– Time Division Multiplexing, frequency Division Multiplexing

3. DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK - Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding - Cosine filters – Eye pattern, equalizers

4. INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem - Shannon-Fano coding, Huffman Coding, LZ Coding– Channel capacity – Shannon-Hartley law – Shannon's limit- Error control Codes – Cyclic codes, Syndrome calculation – Convolutional Coding, Sequential and Viterbi decoding

5. SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence –DSSS –Processing gain, Jamming – FHSS –Synchronisation and tracking - Multiple Access – FDMA, TDMA, CDMA

Tutorial = 15
TOTAL 45+15 = 60

TEXT BOOK:

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH, 2007
2. S. Haykin "Digital Communications" John Wiley, 2005

REFERENCES:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3/e, Oxford University Press,2007
2. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
3. B.Sklar, "Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007

AIM

The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participates.

OBJECTIVE

At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, 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.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion

and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

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 – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, 2nd Edition, Pearson Education, 2004.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. R.K. Trivedi, “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, “Environmental Encyclopedia”, Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, “Environmental law”, Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press (2005).

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Active filter – first order LPF and HPF
4. Schmitt trigger using IC741
5. Instrumentation amplifier using IC741
6. Wein bridge oscillator
7. Multivibrator using IC555 Timer
8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to 7 segment decoder
10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flipflops
12. Design of mod-N counter

TOTAL : 45 PERIODS

LIST OF EQUIPMENTS AND COMPONENTS FOR A BATCH OF 30 STUDENTS (3 per Batch)

S.No	Name of the equipments / Components	Quantity Required	Remarks
1	Dual ,(0-30V) variable Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1 MHz
5	IC Tester (Analog/Digital)	2	
6	Bread board	10	
Consumables (Minimum of 25 Nos. each)			
1	IC 741	25	
2	IC NE555	25	
3	LED	25	
4	Potentiometer		
5	Seven Segment Display	25	
6	Capacitor		
7	Resistors 1/4 Watt Assorted	25	
8	Single Strand Wire	25	
9	Encoder and Decoder ICs (IC7445, IC 74147)	25	
10	Multiplexer and Demultiplexer ICs. (IC74150, IC74154)	25	
11	Shift register ICs, Counter ICs	25	
12	IC7400	25	
13	IC7404	25	
14	IC7402		
15	IC7408	25	
16	IC7411	25	
17	IC7432	25	

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Hematoxylin and eosin staining.
3. Study of parts of compound microscope
4. Histopathological slides of benign and malignant tumours.
5. Manual tissue processing and section cutting (demonstration)
6. Simple stain.
7. Gram stain.
8. AFB stain.
9. Slides of malarial parasites, micro filaria and leishmania donovani.
10. Haematology slides of anemia and leukemia
11. Bleeding time and clotting time.
12. Study of bone marrow charts

TOTAL : 60 PERIODS

(Lab Requirement for a both of Semester)

- 1) Test tubes, Test tube racks, Bunsen burner(gas),(Benedict's solution, Acetic acid, Sulphosalicylic acid), centrifuge, microscope.
- 2) Slides, cover slips,H & E stains
- 3) Microscope
- 4)Beakers,graded alcohols, acetone,Lmoulds(or maling bodies), paradigm wax, water bath, microtone for section cutting,slides,cover slips,hotair oven,refrigerator to store chemical and ice.
- 5)whanman filter paper for bleeding time Test tubes.
- 6) Simple Stain test
SIMPLE STAIN, Glass Slide
Reagents – Methylene blue, Crystal Violet, Cabal lushin
- 7) Gram Stain test
SIMPLE GRAM STAIN
Reagents – Crystal Violet, Gram's Iodine, 95% ethyl alcohol Safranin
Urine bacterial count/ml exceeding 100,000(10s) denotes urinary tract infection.
Normal : 0-100 ml
Glass Slide
- 8) AFB Strain test
ACID FAST STAIN (ZIEHL – NEELSON METHOD)
Reagent – Carbal lushin, Acid Alcohol, Methylene blue, Glass slide
- 9) Bone marrow charts