$24 \times 6 = \underline{\underline{144}}$

Bio - Medical Engg

V & VI

Old - Course

24 X 5 = 120

A.C. Item No.4.11(10) dt. 13.06.2003

old

UNIVERSITY OF MUMBAI

Old Course

Revised Scheme

and

Syllabus for the

Biomedical Engineering

T. E. (Sem. V & VI)

(with effect from the academic year 2003-2004)

UNIVERSITY OF MUMBAI
SCHEME OF INSTRUCTIONS & EXAMINATION
B.E.(Biomedical Engineering)
(R-2001)

(Revised Scheme Considering 60 Minutes' Period Instead of 45 Minutes' Period as per AICTE Guide-lines)

SEMESTER -III

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	* Applied Mathematics- III	4	-	-	3	100	-	-	-	100
2.	# Electronic Circuit Analysis & Design – I	4	3	-	3	100	25	-	-	125
3.	# Electrical Network Analysis & Synthesis	3	2	-	3	100	25	-	-	125
4.	* * Numerical Techniques	3	2	-	3	100	25	-	-	125
5.	Human Anatomy and Physiology	4	3	-	3	100	25	-	-	125
6.	Bio-Engineering Materials and Components	3	-	1	3	100	25	-	-	125
Total		21	10	1	-	600	125	-	-	725

* Subject common with Electronics, Instrumentation, Electrical and Electronics &Telecommunication engineering branches.

Subject common with Electronics Engineering branch.

** Subject common with Electronics, Electrical and Electronics & Telecommunication Engineering branches.

SEMESTER -IV

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	* Applied Mathematics -IV	4	-	-	3	100	-	-	-	100
2.	# Electronic Circuit Analysis & Design - II	4	3	-	3	100	25	25	25	175
3.	Electronic Instruments	3	2	-	3	100	25	-	25	150
4.	Principles of Communication Engineering	3	3	-	3	100	25	-	-	125
5.	* * Logic Circuits	3	2	-	3	100	25	25	25	175
6.	Transducers in Biomedical Instrumentation	3	2	-	3	100	25	-	25	150
Total		20	12	-	-	600	125	50	100	875

* Subject common with Electronics, Instrumentation, Electrical and Electronics & Telecommunication Engineering branches.

Subject common with Electronics Engineering branch.

** Subject common with Instrumentation Engineering branch.

SEMESTER- V

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	* Applied Mathematics - V	4	-	-	3	100	-	-	-	100
2.	Microprocessors I	3	2	-	3	100	25	-	-	125
3.	# Engg. Electromagnetics	3	-	1	3	100	25	-	-	125
4.	Principles of Control Systems	3	2	-	3	100	25	-	-	125
5.	Biomedical Instrumentation - I	3	2	-	3	100	25	-	-	125
6.	Medical Imaging I	3	2	-	3	100	25	-	-	125
7.	* Presentation & Communication Techniques	2	2	-	-	-	25	--	25	50
Total		21	10	1	-	600	150	--	25	775

* Subject common with Electronics, Instrumentation, Electrical and Electronics & Telecommunication engineering branches.

\# Subject common with Electronics Engineering branch.

SEMESTER - VI

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	Microprocessors II	3	2	-	3	100	25	25	25	175
2.	# Analog Integrated Circuits & Applications	4	2	-	3	100	25	-	25	150
3.	Biomechanics	3	2	-	3	100	25	-	25	150
4.	Medical Imaging II	3	2	-	3	100	25	-	25	150
5.	Biomedical Instrumentation II	4	2	-	3	100	25	-	25	150
6.	Signal Processing for Biomedical Applications	3	2	-	3	100	25	-	25	150
Total		20	12	-	-	600	150	25	150	925

\# Subject common with Electronics Engineering branch.

(3)

SEMESTER-VII

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	$ Industrial Inplant Training Industry / Hospital (20 Weeks Duration)	-	6	-	-	-	100	-	100	200
Total			6				100		100	200

$ 20 Weeks Training.
$ Contact Period 1hour/Student/Week.

SEMESTER-VIII

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1.	Advanced Biomedical Instrumentation	4	2	-	3	100	25	-	25	150
2.	Biological Modeling & Simulation	4	2	-	3	100	25	-	25	150
3.	Principles of Image Processing	4	2	-	3	100	25	-	25	150
4.	Elective	4	2	-	3	100	25	-	25	150
5.	Project Work	-	8	-	-	-	50	-	50	100
Total		16	16	-	-	400	150	-	150	700

Elective

A. Nuclear Medicine
B. Hospital Management & Information Systems
C. Advanced Medical Imaging
D.Telemedicine

T.E.(ELECTRICAL/ELECTRONICS/INSTRUMENTATION/ BIOMEDICAL/ELECTRONICS & TELECOMMUNICATION)

SEMESTER V

APPLIED MATHEMATICS - V

Lecture: 4hrs per week 100 Marks(3hrs)

1. **Random Variables**
   Discrete and continuous Random Variables. Probability mass function and density function probability distribution for random variables. Expected value, Variance, Moments and Moments generating functions Relation between Raw moments and central moments.

2. **Probability Distributions**
   Binomial, Poisson and Normal Distribution for Detailed Study. Introduction to the distributions such as 't' and chi-square. Central limit theorem and problems based on this theorem.

3. **Sampling Theory**
   Sampling distribution. Test of Hypothesis Level of significance critical region. One Tailed and Two tailed tests. Internal estimation of population parameters.

   Large and small samples
   Test of significance for large samples
   (i) Test for significance of the difference between sample mean and population means
   (ii) Test of significance of the difference between the means of two samples.

   Test of significance for small samples
   (i) Test for significance of the difference between sample means and population mean
   (ii) Test of significance of the difference between the means of two samples
   (iii) Paired "t" test

   Application of X^2 distribution
   Test of the goodness of fit and independence of Attributes.

4. Fitting of curves
   Least square method. Fitting of the straight line and parabolic Trend Bivariate frequency distribution Covariance and correlation Karl Pearsons coefficient and spearman's Rank correlation co-efficient (non repeated and repeated ranks) lines of regression

5. Introduction to discrete Structure (5)

(A) Relations and functions Matrix of relation Partial order and equivalence relation Injective, Surjective and Bijective functions Pigeonhole principle and its application

(B) Posets and Hasse Diagram. Lattice, Bounded lattice, Complemented lattice and distributive lattice.

(C) Algebraic Structure: Groups, Rings, Integral domains, Fields, Boolean Algebra, Homomorphism and isomorphisms of Algebraic structures

BOOKS

1) "Fundamentals of Mathematicals Statistics "
S.C.Gupta & V.K.Kapoor Sultan Chand & Co. N.Delhi
2) "Probability Statistics and Random Processes"
T.V.Veerajan, Tata McGraw Hill Publications
3) "Probability & Statistics" Schaum Series
4) Discrete Mathematics – Second Edition
N. Biggs – Oxford University Press
5) Schaums Outlines – Discrete Mathematics – Tata McGraw Hill Publications
6) Discrete Mathematical Structures – Bernard Kolman, Robert C. Bushy, Sharon Rus, Prentice Hall of India Pvt. Ltd.
7) Function of Discrete Mathematics - K.D.Joshi,

T.E. (BIOMEDICAL ENGINEERING) SEM V

(6)

2-SUB:MICROPROCESSORS I

Lectures : 3 HRS./W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs. : 100 Marks.) T/W : 25 Marks.

1. Introduction to Microprocessors:
Features, Programmer's Model, External and Internal Organization.

2. 8085 Arcitecture:
8085 organization and architecture, Instruction Cycle, Machine Cycles and T-States, Address decoding techniques, Minimum system design, Memory Interfacing with timing consideration, Clock, Reset and buffering,circuits.

3. 8085 Instruction Set:
Instruction Format, Addressing Modes, Classification of instruction set.

4. 8085 Programming:
Assembly language,'programming :- Basic structure, Data transfer, Arithmatical, Logical, Transfer of control and miscellaneous instruction types.

5. Stack & Subroutines :
Stack operations, limitations , Subroutine concepts, parameter passing techniques,Subroutine design, Delay Subroutine-design and applications, Re-entrant & Recursive subroutines, concept of counters and timers.

6. I /O Data Transfer Tecniques:
I /O Interface concepts, speed consideration, program controlled I /O, asynchronous and synchronous I/O techniques, Interrupt driven program controlled I/O ,Direct Memory Access data transfer controlled techniques handshake signals, concepts of serial communications, Matrix keyboard and multiplexed display interfacing.

7. Interrupts:
Requirements, Single level interrupt, Multilevel interrupt and Vector interrupt system, 8085 interrupt structure and its operation, 8259A interrupt controller.

8. I /O Controllers:
Features , organization & operating modes of 8155 Multi function device, 8255 Programmable Peripheral interface, 8254 Programmable Timer ,8237 Programmable DMA Controller.

Term Work: Each student shall appear for atleast one written test during the term. Report on atleast 8 experiments based on tne above syllabus duly graded and graded answer- books for the test shall be submitted as term - work .

BOOKS.

1Microprocessor By R.S.Gaonkar.
2 Mioroprocessors and Programmable logic by By K.Short.
3.Microprocessor' By II.P.P.Tawade & P.Borole.
4.8085 Assembly level programming' By Leventhal.
5.Microprocessors' by Gilmore.

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T.E. (BIOMEDICAL ENGINEERING) SEMESTER V (8)

Engineering Electromagnetics

Lectures: 3 hours / week	**Theory Paper: 3 hours and 100 marks**
Tutorial: 1 hours / week	**Termwork: 25marks**

Rationale

After having studied circuit theory, this subject exposes the student to the more exact field theory. Electromagnetic field theory deals directly with electric and magnetic field vectors, where as circuit theory deals with voltages and currents that are the integrated effects of electric and magnetic fields. An understanding of Electromagnetics is a must to appreciate Wave propagation, Antenna theory, Microwave and Optical fiber systems

Electrostatics Coulomb's law , Electric field intensity , Field due to a continuous volume charge distribution, Field of a line charge, Field of a sheet of charge, Electric Flux density, Gauss's Law, Application of Gauss's law , Divergence theorem, Potential and Potential Difference, Potential gradient, Nature of dielectric materials, Boundary conditions, Capacitance, Electrostatic Energy, Poisson's and Laplace's equations, Uniqueness Theorem

The steady magnetic field Biot–Savart's law and its applications, Ampere's Circuital law and its applications, Stokes theorem, Magnetic flux and Magnetic flux density, The Scalar and Vector magnetic Potentials, Lorentz force equation, Self and Mutual Inductance, Energy stored in an inductor

Time–varying fields and Maxwell's Equations Faraday's law, Displacement current, Maxwell's equations in point form, Integral form.

The Uniform Plane Wave The wave equation and its solution in its simplest form, Concept of space and time variation and the direction of wave propagation, Sinusoidally time varying uniform plane waves in free space, Attenuation and Phase shift constant.

Transmission Lines Transmission Line equations, Transmission Line parameters, Transmission Line examples, Use of Smith Chart, Impedance matching.

Text Books

1. William H Hayt, John A Buck - Engineering Electromagnetics, Tata McGraw - Hill, sixth edition, 2002
2. John D Krauss - Electrmagnetics, McGraw - Hill, sixth edition, 2001

Additional Reading

1. Guru and Hizirogulu - Electromagnetic Field Theory Fundamentals, Thomson Learning, 2001
2. Edminister - Electromagnetics, Schaum Series, Tata McGraw - Hill, second edition, 1992
3. Jordan,Balmian - Electromagnetic Waves and Radiating Systems, PHI, second edition, 1988
4. Wali S S - Electromagnetic Engineering, Mahalaxmi Publishing House, second edition, 1999

Term work

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Term work shall consist of at least eight tutorials based on the above syllabus out of which one tutorial should cover transmission line problems using Smith Chart and one tutorial on magnetic materials and BH curve. At least one test which shall have a weightage of ten marks.

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T.E. (BIOMEDICAL ENGINEERING) SEM V

(10)

4-SUB:PRINCIPLES OF CONTROL SYSTEMS.

Lectures : 3 HRS./W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs. : 100 Marks.) T/W : 25 Marks.

1. Introduction to Concepts like.:
Open loop systems, closed loop systems, regulating Systems ,Servo mechanisms, Transfer function and impulse response of system.

2. Study of components:
Op -Amp as differential amplifier or error detector,Stepper motor, synchro control transformer, synchro control transmitter, potentiometer and two phase servo Motor

3. Modelling Of Systems:
RLC circuits, Armatureand field controlled dc motors. importance of a mathematical model.

4.Block Diagrams:
Various techniques of block diagram reduction, Mason's gain formula and its applicationto block diagram reduction.

5. Transient response of systems:
Importance of second order system models, time domain specifications of systems and the analysis of transient response using second order model.

6.. Steady state error analysis :
"Type" of systems, steady state error analysis of different ,typesof systems using step, Ramp and parabolic input signals.

7. Stability analysis:
Introduction to the concept of stability, stability analysisusing Routh-Hurwitz Criterion.

8. Freqency Domain analysis of Systems:
Frequency domain specification of systems. Resonance peak and peak resonating frequency regarding complex poles and zeros, Relationship between time and frequency domain specification of systems.

9. Stability Analysis of systems using Bode plots.

10. Stability analysis of systems using Root locus and the concept of dominant, closed Loop pole pair.

11.Introduction To polar Plots :

12.Principle of Argument and its application study of stability of systems. (11)

13.Constant gain and phase loci and their use in the stability study of systems.

Term Work.. Term work will consist of atleast Six laboratory Experiments based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal.

References

1. Analysis and design ofcontrol systems : D'A'zzo and Houpis.
2. Control Systems: Katsuhiko Ogata.
3. Control Systems :Bejamin C. Kuo.
4. Control Systems Engineering : Nagrath and M.Gopal.
5. Control Systems .N.K. Sinha (Wiley Eastern)

T.E. (BIOMEDICAL ENGINEERING) SEM V

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5-SUB:BIOMEDICAL INSTRUMENTATION I

Lectures : 3 HRS./W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs. : 100 Marks.) T/W : 25 Marks.

1. Basic principles, technical Specifications, working and applications of Analytical and Laboratory Instruments :

A. Spectrophotometer.
B. Colorimeter.
C. pH meter.
D. Electrolyte Analyser.
E. Autoanalyser.
F. Blood Cell Counter.
G. Electrophorosis
H. Chromatography.
I. ELISA reader & WASH.
J. Centrifuge.
K. Microscopes.
L Cell and Plasma Seperator.

2. Blood Gas Analyser :
Measurements of Blood pH, pCo_2, pO_2 and Complete Blood gas analyser.

3. Pulmonary Function Analyser:
Respiration measurement technique : Lung volume and capacities, Spirometry.
Pulmonary function measurement and analyser, Spirometer and respiratory function analyser.

4. Blood Flow Measurement :
Electromagnetic, Ultrasonic, NMR and Laser Doppler flowmetry, cardiac output measurement, Impedance plethysmography.

5. Oximetry and Anesthesia equipment.

6. Audiometers :
Basic audiometer, Pure tone and Speech Audiometer, Evoked response Audiometry.

Termwork : Term work will consist of atleast Six laboratory Experiments based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal.

Text :

1. Handbook of Analytical Instruments : R. S. Khandpur. (TMH Pub)
2. Handbook of Biomedical Instrumentation : R. S. Khandpur. (TMH Pub)
3. Medical Instrumentation, Application and Design : J. G. Webster.(John Willey)

References :

1. Encyclopedia of Medical Devices and Instrumentation : John G. Webster. Vol I, II, III, IV (John Willey)
2. Introduction to Biomedical Equipment Technology : Carr - Brown. (Pearson Education Pub)
3. Various Instruments Manuals.

T.E. (BIOMEDICAL ENGINEERING) SEM V

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6- SUB: MEDICAL IMAGING I

Lectures : 3 HRS./ W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs. : 100 Marks.) T/W : 25 Marks.

1. Ultrasound Imaging :
Ultrasound transducer, measurement of imaging system, application of A - scan, M - scan and B- scan, scattering and propogatioon of ultrasound in biological material with application to imaging and tissues, sector scan, mechanical sector transducer, linear scan using multi element linear array scanner, annular array system. Theory and construction of array transducer for imaging, doppler ultrasound systems and their application to the study of blood flow continuous wave and pulsed system, doppler imaging, practical inter pretation of ultrasound images.

2. X-rays :
Properties of x-rays , production of x-rays, x-ray tubes, x-ray apparatus, engineering principles of x-ray system : Image Intensifier, Angiography technique and system, Digital Radiography, Radiation protection, scattered radiation and its importance to radiographical image quality, safety specification of x-ray equipment. Film development technique. Planigraphy.

3. Medical thermography : Physics of thermography, thermographic equipment, applications of Thermography.

Termwork : Term work will consist of reports of visits arranged at hospitals and radiation centres and assignments / Seminars based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal.

Text:
1. Text book of Radiology --Christensens.(Lippimcott William and Willkins Pub)

References :
1. Medical Radiation Physics - edited by William Hendee. (Academic Press)
2. Instrumentation in Nuclear medicine - edited by G. Hine - Vol I and II. (Academic Press)
3. Clinical Scintigraphy - edited by P. M. Johnson and L. Freeman - Vol I, II and III. (Plennum Pub)

Presentation & communication Techniques

Class: **T. E. (Biomedical Engineering)**	Semester: **V**
Periods per week: Lectures: - 2 Practicals: - Tutorials: - 2	Evaluation System: Theory paper: - Term Work: - 25 Practical: - Oral: - 25 Total: **50**

Detailed Syllabus	
1	**Communication in a business organization** Internal (Upward, Downward, Horizontal, Grapevine, Problems, Solutions), External Communication, Strategies for conducting successful business meetings, documentation (notice, agenda, minutes) of meetings, Introduction to modern communication techniques (e-mail, internet, video-conferencing, etc.), Legal and ethical issues in communication (Intellectual and property rights, patents)
2	**Advanced technical writing** xiii. Report writing and presentation: Definition and importance of reports. Qualities of reports, language and style in reports, types of reports, formats (letter, memo, project-reports), methods of compiling data. A computer-aided presentation of a technical project report based on a survey-based, or reference based topic. Topics to be assigned to a group of 8-10 students. The written report should not exceed 20 printed pages. xiv. Technical paper-writing xv. Writing proposals
3	**Interpersonal skills** Introduction to emotional intelligence, Motivation, Negotiating and conflict-resolution, Assertiveness, Leadership, Team-building, Decision-making, Time-management.
4	**Interview techniques** Preparing for job interviews, verbal and non-verbal communication during interviews. Observation sessions and role-play techniques to be used to demonstrate interview strategies
5	**Group discussion** Dynamics of Group Behavior, Techniques for effective participation.

	Term Work: Assignments: 2 assignments on Communication topics 3 assignments on Report-writing 3 assignments on Interpersonal Skills 1 class test Distribution of term work marks will be as follows: Assignments: 15 marks. Written Test: 10 marks. Distribution of oral marks will be as follows: Project report presentation: 15 marks Group discussion: 10 marks
	Books recommended: 1. Fred Luthans, Organizational Behaviour, McGraw Hill 2. Lesikar and Petit, Report Writing for Business, Tata McGraw Hill 3. Huckin & Olsen, Technical Writing and Professional Communication, McGraw Hill 4. Wallace & Masters, Personal development for Life & Work, Thomson Learning 5. Heta Murphy, Effective Business Communication, McGraw Hill **Additional Readings:** 1.Lewicki, Saunders & Minton: Essentials of Negotiation, McGraw Hill 2. Hartman Lemay, Presentation Success, Thomason Learning 3. Kitty O.Locker, Stephen Kyo Kaczmarek: Business Communication; Building Critical Skills, McGraw Hill 4. Vikas Gupta: COMDEX Computer Course Kit, IDG Books Pvt Ltd. 5. Heller & Handle, The Essential Manager's Manual, Dorling Kindersley 6. The Sunday Times 'Creating Success Series': 1. Develop Your Assertiveness, 2. Make every minute Count, 3. Successful Presentation Skills, 4. How To Motivate People, 5. Team Building

1-SUB : MICROPROCESSORS II

Lectures : 3 HRS./ W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs :100 Marks.) T/W : 25 Marks. Practical : 25 Marks Oral: 25 Marks

1. Overview of microcomputer systems.Hardware and software principles

2. Introduction to Single chip microcomputer Intel 'MCS 51 family. Architectureal and Operational features .Its instruction set. CPU timing and machine cycles. Interrupt structure and priorities.Internal Timers / counters, serial interface.Connection of external Memory.Power saving modes.EPROM programming for EPROM versions.

3.Architecture and organisation of 8086 / 8088 microprocessor family. Study of its Instruction set. Assembly language programming, Introduction. to mixed language programming using C and Assembly. language. 8086 family minimum and maximum Mode operation.Timing diagram for 8086 family, detailed study of maximum mode connection . Study of 8288 bus controller. 8086 interrupt structure.

4.Memory system design for 8086 family including interface of dynamic Read / write memory, timing considerations for memory interfacing.Connections of I/O Controllers 8255 AII Programmable peripheral interface, Programmable Interrupt Controller 8259A, UAR'I' 8250, Programmable D.M.A. Controller 8237. Data Communications, E.IA RS 232C serial interface and IEEE ' 488 General purpose interface. Error detection and correction - parity and Cyclic redundancy check.

5. Study of architecture of 8087 floating point. co- processor. Data types supported by 8087. Host and co - processor interface, Assembly language programming for 8086 .8087 based systems.

6.Introduction to Multiprocessor systems. Multiprocessor configurations. Study of 8289 bus arbiter.Design of 8086 based multiprocessor systems (Without timing considerations).

Term Work: Each student shall appear for atleast one written test during the term. Report on atleast 8 experiments based on tne above syllabus duly graded and graded answer- books for the test shall be submitted as term - work .

Books:

1. 8086 / 8088 interfacing ,Programming and Design - John Uffenback (PHI)
2.Experimentation with the Intel SDK 51 By Boyet and others (Hayden Publishing)
3. Microprocessor interfacing and Programming - Douglas Hall (McGraw Hill)
4. Microcomputer systems 8086 / 8086 family - Liu & Gibson (PHI)
.5.Intel Microprocessors by Goody (Mc Graw Hill)
6.Data Manuals from Intel Corporation.
7.Intel Microprocessors - Tabak (Mc Graw)

Analog Integrated Circuits & Applications

Lectures: 4 hours / week	**Theory Paper: 3 hours and 100 marks**
Practicals: 2 hours / week	**Termwork: 25 marks, Oral: 25marks**

Rationale

Though digital electronics has its advantages and flexibility, the physical world is inherently analog indicating a need for analog circuitry to condition physical signals such as those associated with transducers, as well as convert information from analog to digital domain for processing, and from digital back to analog for reuse in the physical world. This subject is a study of integrated circuit operational amplifiers and other linear integrated circuits and their applications.

Operational Amplifier Fundamentals

Basic Op Amp Configurations, Ideal Op Amp Circuits Analysis, Negative Feedback, Feedback in Op Amp Circuits, the Loop Gain, Op Amp Powering.

Circuits with Resistive Feedback

Current-to-Voltage Converters, Voltage-to-Currents Converters, Current Amplifiers, Difference Amplifier, Instrumentation Amplifier, Instrumentation Applications, Transducer Bridge Amplifiers.

Active Filter

The Transfer function, First-Order Active Filters, Audio Filter Applications, Standard Second-Order Responses, KRC Filters, Multiple-Feedback Filters, State-Variable and Biquad Filters, Sensitivity, Filter approximations, cascade design, generalized impedance converters, direct design, Switched capacitor filters.

Static Op Amp Limitations

Simplified Op Amp Circuits Diagram, Input Bias and Offset Currents, Low-Input-Bias-Current Op Amps, Input Offset Voltage, Low-Input-Offset-Voltage Op Amps, Input Offset-Error Compensation, Maximum Ratings.

Dynamic Op Amp Limitations

Open-Loop Response, Closed-Loop Response, Input and Output Impedances, Transient Response, Effect of Finite GBP on Integrator Circuits, Effect of Finite GBP on Filters, Current-Feedback Amplifiers.

Noise

Noise Properties, Noise Dynamics, Sources of Noise, Op Amp Noise, Noise in Photodiode Amplifiers, Low-noise Op Amps.

Stability

The Stability Problem, Stability in Constant-GBP Op Amps Circuits, Internal Frequency Compensation, External Frequency Compensation, Stability in CFA Circuits, Composite Amplifiers.

Nonlinear Circuits
Voltage Comparators, Comparator Applications, Schmitt Triggers, Precision Rectifier, Analog Switches, Peak Detectors, Sample-and-Hold Amplifiers.

Waveform Generators
Sine Wave Generators using Op-Amps, Multivibrators using Op-Amps, Monolithic Timer – NE555, Triangular Wave Generator using Op-Amps, Saw tooth Wave Generator using Op-Amps, Monolithic Waveform Generator - ICL8038, V-F and F-V Converters.

Voltage References And Regulators
Performance Specifications, Voltage References, Voltage-Reference Applications, Linear Regulators, Linear- Regulator Applications, Switching Regulators, Monolithic Switching Regulators.

D-A and A-D Converters
Sample and Hold Circuits, D-A Conversion Techniques, Multiplying DAC Applications, A-D Conversion Techniques, Performance Specifications, over sampling Converters.

Nonlinear Amplifiers and Phase-Locked Loops
Log / Antilog Amplifiers, Analog Multipliers, Operational Trans-conductance amplifiers, Phase-Locked Loops, Monolithic PLLs.

Operational Amplifier Circuit Design
Introduction, Differential Amplifier, current mirror, output stage, General Op-Amp circuit design, Detailed circuit description and working of 741 Op-Amp, small signal analysis, frequency response.

Text Books:

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, Third edition, McGraw Hill International edition, 2002.
2. James M. Fiore, Op Amps and Linear Integrated circuits, First reprint, Thomson Asia Pte. Ltd., 2001.
3. Robert Coughlin and F Driscoll, Operational Amplifiers and Linear Integrated circuits, sixth edition, Pearson Education Asia, 2001

Additional Reading:

1. Donald A. Neamen, Electronic Circuit Analysis and Design, Second edition, McGraw Hill International edition 2001

Termwork:
The termwork shall consist of atleast six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as at least four computer simulations using EDA tools like PSPICE duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

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3- SUB : BIO MECHANICS

Lectures : 3 HRS./ W Practicals : 2 HRS. / W

Theory Exam : (3 Hrs.:100 Marks.) T/W : 25 Marks. Oral : 25 Marks.

1. Biomechanics :

1.1 General principles of Biomechanics, Analysis of biological sub system from biomechanical view and rise modelling. Instrumentation.

1.2 Tissue Biomechanics : Direct, shear, bending and torque actions and the corresponding stresses, strains in biological tissues. Stress relaxation and creep, stability and instability. Biomechanical characterisation of bone and the soft connective (Skin, Tendon, ligaments) covering structure, function and ph ysiological factors.

1.3 Movement Biomechanics : Gait Analysis, body and limb mass and motion characteristic actions, forces transmitted by joints. Joints forces results in the normal and disabled human body, normal and fast gait on the level. Strain and ramp ascent and discent. Joint replacement.

2. Prosthetics and Orthotics :

2.1 Principles in designing orthesis and prostheses : Principles of three point pressure, total contact, partial weight releaving.

2.2 Positions of anatomical axis and corresponding movements of the body part. International conventions with respect to above.

2.3 Purpose for providing Prostheses and Orthoses : Various aspects regarding diagnosis, prognosis, stature and socio-economic conditions.

2.4 Classification in Prosthetics and Orthetics : Lower Extremity orthesis and prostheses , Upper Extremity Ortheses and Prostheses, Spinal Orthoses.

2.5 Recent developments in prosthetics and Orthetics.

3. Material Technology in Prosthetics and Orthetics :

3.1 Indegenious metals and their alloys.
3.2 Different types of leather and leather tannling.
3.3 Types of rubber.
3.4 Thermoplastics and thermosetting resins, moulding / lamination techniques.
3.5 Wood and Binding materials.
3.6 Research and development in orthetics and prosthetics.

4. Artificial machines and Inplants : Introduction, basic transport theory.
Artificial Lungs / Respirator, Artificial Kidney, Intra Arotic Ballon pump.

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Termwork : Term work will consist of atleast Six laboratory Experiments based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal.

Text / References :

1. A textbook of Biomedicl Engineering - Edited by R. M. Kenedy. (Blackie Pub)
2. Handbook on Bioengineering - by Richard Skalak and Shu Chien.
3. Human limbs and their substitutes. - Atlas
4. American Atlas of Orthopedics - Lower Extremity Prosthetics.
   Upper Extremity Prosthetics.
   Orthitics.
5. Biomechanics - by Prof. Ghista. (Private Publication UAE)
6. Biomechanics - by White and Puyator. (Private Publication UAE)

T.E. (BIOMEDICAL ENGINEERING) SEM VI

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4-SUB: MEDICAL IMAGING II

Lectures : 3 HRS./ W Practicals : 2HRS./ W
Theory Exam : (3 Hrs. : 100 Marks.) T/W : 25 Marks. Oral : 25 Marks.

1. Basic Nuclear Physics : Radioactivity, properties of radiations. Radiation detectors, scintillation detectors, pulse height analysis, gamma ray spectrometry.

2. Nuclear Medicine Instrumentation :
   Collimators, functional parameters of various types of collimators.
   Functional block diagram of thyroid uptake systems.
   Rectilinear scanners and Scintillation cameras. (Gamma camera)

3. Tomography :
   Computer Tomography, its basic principle, generations and applications.
   Applied Potential Tomography, its basic principle and applications.
   Positron Emission Tomography.
   Single Photon Emission Computer Tomography.

4. Magnetic Resonanace Imaging :
   Basic principle and applications.

Termwork : Term work will consist of reports of visits arranged at hospitals and radiation centres and assignments / Seminars based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal

Text:
1.Text book of Radiology --Christensens.(Lippimcott William and Willkins Pub)

References :
1. Medical Radiation Physics - edited by William Hendee. (Academic Press)
2. Instrumentation in Nuclear medicine - edited by G. Hine - Vol I and II. (Academic Press)
3. Clinical Scintigraphy - edited by P. M. Johnson and L. Freeman-Vol I, II and III(Plennum Pub)

T.E. (BIOMEDICAL ENGINEERING) SEM VI

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5- SUB : BIOMEDICAL INSTRUMENTATION - II

Lectures : 4 HRS./ W Practicals : 2 HRS./ W

Theory Exam : (3 Hrs.:100 Marks.) T/W : 25 Marks. Oral : 25 Marks.

1.1 Generation of Bioelectric potentials :

1.2 Recording techniques of Bioelectric signals : ECG, EMG, EEG, EOG, ERG.

1.3 Biophysical Amplifiers and recorders (with technical specifications):
Basic recording system. General consideration for electronic recorder amplifier. Sources of noise in low level recording circuits. Recording systems for ECG, EMG, EEG and Phonocardiography. Measurment of skin resistance

1.4 Writing Systems :
Ink jet, Potentiometric, UV, Thermal, Light gate, Magnaetic, Laser optics and Instrumentation tape recorders.

2. Medical Display Systems :
Oscilloscope for Biomedical measurements, Single and Multichannel displays, Non-fade display system, LCD display system and Touch Screen display system.

3. Patient Monitoring system :
Measurement of Heart rate, Blood pressure, Temperature and Respiration rate. Apnoea Detector.

4. Arrhythmia and Ambulatory Monitoring Instruments :
Cardiac Arrhythmias. Ambulatory monitoring instruments.

5. Foetal Monitoring System :
Cardiotocograph. Methods of monitoring foetal heart rate and labour activity. Foetal scalp pH measurement.

6. Biotelemetry.

7. Biofeedback technique.

8. Electrical safety in biophysical measurments

Termwork : Term work will consist of atleast Six laboratory Experiments based on the above syllabus. Test and Assignments / Seminars be suitably graded by teacher and attached in the journal.

Text :

1. Handbook of Biomedical Instrumentation : R. S. Khandpur. (TMH Pub)
2. Medical Instrumentation, Application and Design : J. G. Webster.(John Willey Pub)

References :

1. Encyclopedia of Medical Devices and Instrumentation : John G. Webster. Vol I, II, .III, IV .(John Willey Pub)
2. Introduction to Biomedical Equipment Technology : Carr - Brown. (PH Pub)
3. Various Instruments Manuals.

T.E. (BIOMEDICAL ENGINEERING) SEM VI

6- SUB : SIGNAL PROCESSING FOR BIOMEDICAL APPLICATIONS

Lectures : 3 HRS./ W Practicals : 2 HRS./ W
Theory Exam : (3 Hrs.:100 Marks.) T/W : 25 Marks. Oral : 25 Marks.

1. Digital signals and Systems:Classification of systems :causal, timevarying, time Invarient, lumped. Introduction to Digital Signals Systems, Convolution, Auto-correlation and Cross-correlation.Sampling, aliasing. Nyquist criteria.

2 Z Transform : Introduction ,Defenition, Convergence, Inverse Z Transforms, Analysis of discrete time systems using Z transforms. Solutions of Differential equations, Transfer functions and Stability

3. Fourier Transform for continous signals, Energy spectrum, Properties (Without proof), Gibbs phenomena, Auto and cross correlation. Discrete Dourier transforms, Properties (without proof), Inverse DFT, FFT: Decimation in time and Decimatin in frequency

4. Digital Filter design: Introduction, Realisation of digital systems, Canonical form, Direct form and cascade realisation of IIR and FIR filters. Design of IIR anf FIR filters, Low pass, high pass,band pass filters using windows-Kaiser windows. FIR filter design using Frequency sampling.

5. Study of DSP hardware : DSP chips from Texas and Motorola, Implementation of digital filters using the above chips.

6. Adaptive Noise cancelling: Introduction, Principles,LMS,RLS adaptation algorithm Adaptive line enhancer (ALE):Introduction, Principles,LMS,GAL, algorithm.

Termwork : Term work will consist of atleast Six laboratory Experiments based on the above syllabus, A seminar presentation, Test and Assignments be suitably graded by teacher and attached in the journal.

Text :
1. Digital Signal processing : Proakis (PH Pub)
2. Digital Signal processing: Oppenhim and Schafer (PH Pub)
3. Biomedical signal processing : Metin Akay (Academic press)

References :
1. Biomedical signal processing : Tompkins (Academic press)
2. Theory and applications of Digital Signal processing :Rabiner and Gold (EEE Pub)