Solapur University, Solapur

Structure of S.E.(Bio-medical Engineering) Part I & II

w. e. f. Academic Year 2009-10

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	Th.	TW	POE	OE	Total
1	Engineering Mathematics - III	3	1	---	4	100	25	---	---	125
2	Human Anatomy and Physiology	4	--	2	6	100	25	50	---	175
3	BioMaterials	3	1	---	4	100	25	---	25	150
4	Electronic Circuits Analysis and Design – I	4	--	2	6	100	25*	50*	---	175
5	Electrical Network Analysis and Synthesis	4	--	2	6	100	---	---	---	100
6	Software Lab	2	--	2	4	---	25	---	---	25
	Total	**20**	**2**	**8**	**30**	**500**	**125**	**100**	**25**	**750**

7	Environmental Science	2	-	--	2	---	---	--	---	---

Note:-* Electrical Network Analysis and Synthesis Term Work and POE is combined in Electronic Circuits Analysis and Design - I

S.E. (Bio-Medical Engineering) – II

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	Th.	TW	POE	OE	Total
1	Transducers in Biomedical Instrumentation	4	--	2	6	100	25	50	---	175
2	Biomedical Prosthetic and Orthotics	4	1	--	5	100	25	--	25	150
3	Electronic Instrumentation	3	--	2	5	100	25	--	--	125
4	Digital Design	3	--	2	5	100	--	--	--	100
5	Electronic Circuits Analysis And Design – II	4	--	2	6	100	25*	50*	--	175
6	Electronic Work Shop	--	1	2	3	--	25	--	--	25
	Total	**18**	**2**	**10**	**30**	**500**	**125**	**100**	**25**	**750**

7	Environmental Science	2	-	--	2	---	---	--	---	---

Note:-* Digital Design Term Work and POE is combined in Electronic Circuits Analysis and Design - II

S.E. (Bio – Medical Engineering) Part – I

1. Engineering Mathematics - III

Lectures 3 Hrs/Week	Paper 100 Marks
Tutorial 1 Hrs/Week	Term Work 25 Marks

SECTION I

1. Laplace Transform **8 hrs**

Functions of bounded variations. Laplace Transforms of 1, t^n, e^{at}, sin at, cos at, sinh at, cosh at, erf(t) Linear property of L.T .First shifting theorem Second shifting theorem $L\{t^n f(t)\}$, $L\{f(t)/t\}$, $L\{\int f(u)du\}$, $L\{d^n/dt^n f(t)\}$.Change of scale property of L.T. Unit step function , Heavy-side, Dirac delta functions, Periodic functions and their Laplace Transforms.

2. Inverse Laplace Transforms **5 hrs**

Evaluation of inverse L.T., partial fractions method, convolution theorem. Applications to solve initial and boundary value problems involving ordinary diff. Equation with one dependant variable

3. Complex Variables 1 **7 hrs**

Functions of complex variables, continuity and derivability of a function, analytic functions, necessary condition for f(z) to be analytic, sufficient condition (without proof), Cauchy – Riemann conditions in polar forms. Analytical and Milne – Thomson method to find analytic functions f(z) = u + iv where (i) u is given (ii) v is given (iii) u+v (iv) u-v is given. Harmonic functions and orthogonal trajectories.

SECTION II

4. Complex Variables 2 **4 hrs**

a) Mapping

Conformal mapping, Bilinear mapping, fixed points and standard transformation, inversion, reflection, rotation and magnification.

5. Complex Variables 2 **7 hrs**

b)Line Integral of function of complex variable, Cauchy's theorem for analytical function (with proof), Cauchy's Goursat theorem (without proof), properties of line integral, Cauchy's Integral formula and deduction.

6. Fourier series **6 hrs**

Orthogonality & orthogonal functions, Expression for the function in a series of orthogonal functions, Dirichlet's conditions, Fourier series of periodic functions with period 2pi or 2l. (Derivation of Fourier coefficients a0, an, bn is not expected)

7. Dirichlet's theorem **3 hrs**

Dirichlet's theorem Even & Odd functions. Half range sine & cosine expressions Parsaval's identities (without proof)

Text Books:

1. Wartikar P.N. / Wartikar J. N., Textbook of Applied Mathematics, Pune Vidyarthi Griha Prakashan, 1981.
2. Kreyszig Erwin, Advanced Engineering Mathematics, 8th ed., Wiley Student Edition, New Delhi, 2006.

Reference Books:

1. Churchil, Coplex variables, Mc Graw Hill.
2. Shantinarayan, Theory of function Complex Variable, S. Chand & co.
3. Shastri S.S., Engineering Mathematics, Prentice Hall.
4. Glyn James, Advanced Modern Engineering Mathematics, 3rd ed., Pearson Education Ltd., 2004.
5. Potter Merle C., Goldberg J. L., Aboufadel Edward F., 3rd ed., Oxford University Press, New Delhi, 2005.

S.E. (Bio – Medical Engineering) Part – I

2. Human Anatomy and Physiology

Lectures 4 Hrs/Week	Paper 100 Marks
Practical 2 Hrs/Week	Term Work 25 Marks
	POE 50 Marks

SECTION 1

1. **Cell** **2 hrs**
   Structure and functions of cell. Polarization and depolarization of cell

2. **Body Structure** **8 hrs**
   Basic tissues and their functions in brief. Outline of structures of the following system. Cardiovascular System, Respiratory System, Alimentary System, Central Nervous System. Reproductive System, Urinary System, Skeletal System, Muscular System, Endocrine System, Special Organs – Eye and Ear, Integumentary system (Skin Study)

3. **Cardiovascular System** **8 hrs**
   Heart, Conductive tissues of heart, Cardiac cycle, Heart Valves, System and Pulmonary Circulation, Transmission of Cardiac Impulse, Blood Pressure, ECG (Einthoven's Triangle, Various leads and Waveforms).

4. **Respiratory System** **3 hrs**
   Respiration external (Ventilation) Exchange in gases in the alveoli, Artificial respiration. Spiro meter (Forced expiratory volumes) peak flow meter.

5. **Alimentary System** **3 hrs**
   All organs of the digestive system, other secretions and main Functions. Deglutition and defecation.

SECTION II

6. **Blood** **3 hrs**
   Composition of Blood – Blood cells and their functions. Cell counting, Hemoglobin, Blood groups, Coagulation, Blood transfusion

7. **Excretory System** **3 hrs**
   Structure of Nephron, formation of urine and function of Kidney, Urinary Bladder, urethra, internal / external sphincters

8. **Nervous System** **4 hrs**
   Different parts, their functions. Reflex actions and reflex arc, Function of Sympathetic and Parasympathetic nervous system. Nerve conduction and action potentials.

9. **Reproductive System** **3 hrs**
   (Male and Female) Different organs and their functions. Main actions of Androgens, Oestrogens and Progesterone

10. **Endocrine System** **3 hrs**
    All glands, their secretions and functions. Control of secretions.

11. **Eyes and Ears** **4 hrs**
    Eyes-Structure, Refractive Medias of the eye, formation of image on the Retina, Ophthalmoscope. Ear – Structure of Cochlea, Hearing mechanism, type of Deafness. Hearing aid.

12. Muscle physiology and aspects of skin resistance **4 hrs**

Term work

Term work consists of minimum ten practicals based on entire syllabus. It shall also include visit to a Hospital to study the human anatomy and physiology to acquire the knowledge about human body. During the visit the students are required to study

i) The human anatomy, skeletal system and body organs and the equipments used for measurement of physiological parameters.
ii) How to identify the different body parts and their activities.

The student should submit the detailed report depending on the observations made.
Oral examination will be based on the visit report and term work.

List of Experiments:

1. To measure Blood Pressure using sphygmomanometer using occlusive cuff method.
2 To determine hemoglobin count in the blood by Shali's method.
3. Invitro recognition of A, B, O blood groups by slide test.
4. To find the total Red Blood Cell count using Neubauer's haemocytometer.
5. To find the total White Blood Cell count using Neubauer's haemocytometer.
6. Defibrillator
7. External Pacemaker
8. ECG Machine
9. Any other experiments based on syllabus may be added

Text Books

1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Pub)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

References

1. Physiology of Human Body. : Guyton. (Prism Book)
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper Collin Pub.)

S.E. (Bio – Medical Engineering) Part – I

3. Biomaterials

Lectures 3 Hrs/Week	Paper 100 Marks
Tutorials 1 Hrs/Week	Term Work 25 Marks
	OE 25 Marks

SECTION I

1. Introduction **2 hrs**

Introduction of Biomaterials, Classification of Biomaterials

2. Properties and Applications of Metallic Biomaterials **4 hrs**

Stainless steel, Titanium, Titanium based alloys, Cobalt – Chromium alloys in fabrication of biodevices and implants

3. Properties and Applications of Polymeric Biomaterials **6 hrs**

Classification, polyurethanes, PTFE, Polyethylene, Polypropylene, Polyacrylates, PMMA, PHEMA, Hydrogel, Silicone rubber, Biopolymer in fabrication of biodevices and implants.

4. Properties and Applications of Ceramic Biomaterials **5 hrs**

Bioceramics – classifications, Alumina, Zirconia and types, Bioglass, Hydroxyapatite, Tricalcium phosphate in fabrication of biodevices and implants

5. Composite Biomaterials **3 hrs**

Properties and Applications of Composite Biomaterials in fabrication of biodevices and implants

SECTION II

6. Properties and Applications of Degradable Biomaterials **4 hrs**

Polymers & Ceramics in fabrication of biodevices and implants

7. Biomaterials for Soft Tissue Replacements **4 hrs**

Properties and Applications of biomaterials for Soft Tissue Replacements

8. Properties and Applications of Materials used in Prosthetics **4 hrs**

The Indigenous metals and their alloys, Different types of leather, Types of rubber, Thermoplastic and thermosetting resins, Wood and binding materials

9. Surface properties of Biomaterials **4 hrs**

Surface properties of Biomaterials and their testing with reference to biological safety

10. Testing of Biomaterials **4 hrs**

Biological Testing of Biomaterials, Biocompatibility of Materials, Biomaterials corrosion and wear

Term work

Term work consists of minimum ten practicals based on entire syllabus.

Text Books

1. Biomaterial Science and Engineering: J.V. Park (Plenum Press- New York)
2. Fundaments of Biomedical Engineering: G S. Sawhney (New Age International Publication)
3. Biomaterial Science: An Introduction to Materials in Medicine, Rotner & Hoffmann

Reference Books

1. Encyclopedia of Medical Devises and Instrumentation: John G. Webster. Vol. I, II, III, IV (Marcel Dekkar Pub).
2. Encyclopedia – Handbook of Biomaterials and Bioengineering: Part-A: Materials Vol I, II (Marcel Dekkar Pub) Part – B: Applications Vol. I, II.
3. Design Engineering on Biomaterials for medical devices: David Hill, John Willey Publication
4. Biological Performance of Materials, 2nd Edition – Jonathan Black, Marcel Dekker Inc. New York. Basel. Hong Kong.

S.E. (Bio – Medical Engineering) Part – I

4. Electronic Circuits Analysis and Design – I

Lectures 4 Hrs/Week	Paper	100 Marks
Practical 2 Hrs/Week	Term Work	25* Marks
	POE	50* Marks

SECTION-I

1. **Design of Power Supply** **7 hrs**
   Design of Half wave, full wave (center tap and Bridge) rectifier using PN-Junction diode. Zener diode voltage regulator, emitter follower regulator, series voltage regulator, shunt regulator Design of Zener diode voltage regulator

2. **Application of PN- Junction diode** **5 hrs**
   Positive clipper, Negative clipper and combination clipper circuit, positive clamper, negative clamper, voltage doublers and Tripler

3. **Bipolar Junction transistor** **6 hrs**
   Biasing of transistor – need of biasing, fixed bias, collector to base bias, emitter bias and voltage divider biasing, stability factor (Detailed analysis is expected),Common base, Common collector, Common emitter configuration, single stage common emitter amplifier
4. **Application of BJT** **6 hrs**
   h- Parameter model of common emitter configuration (voltage gain, current gain, input impedance and output admittance), Application of BJT as switch, Design of relay driver circuit, Design of common emitter amplifier

SECTION-II

5. **IC Regulator** **8 hrs**
   Fixed volt regulator using IC 78XX & 79XX series, variable volt regulation using IC LM317 & LM337. Dual regulated power supply, features of IC voltage regulation (Short circuit protection, thermal shut down, line regulation, load regulation & ripple rejection ratio),Current boosting in voltage regulator.
   Design of voltage regulators using above IC

6. **Waveform generator using IC 555** **8 hrs**
   Monostable, Astable & Bistable Multivibrator, Schmitt trigger, V/F converter (study includes circuit diagram. & Analysis).
   Power ON delay circuit using IC 555, pulse generator using IC 74121 & 74123.
   Design of Astable & Monostable Multivibrator.

7. **Field Effect Transistor** **8 hrs**
   JEET, V – I Characteristics, different configurations of JEET, parameters of JEET, and application as an amplifier. JEET as VVR, application of VVR.
   MOSFET – Types, V-I Characteristics, application as a switch.

Term Work

Term work consists of minimum ten practicals based on entire syllabus.

1. Full wave rectifier analysis
2. Performance parameters of filters
3. Clipper, clamper
4. Voltage multiplier
5. VI – characteristics of Zener diode and Zener regulator
6. Design and implementation of unregulated power supply
7. Frequency response of single stage CE amplifier
8. Fixed voltage regulators using 78xx/79xx
9. Variable voltage regulator using LM 317/ LM 337
10. Astable multivibrator using 555
11. Monostable multivibrator using 555
12. VI – characteristics of JFET
13. Any other experiments based on syllabus may be added

Note:-* Electrical Network Analysis and Synthesis Term Work and POE is combined in Electronic Circuits Analysis and Design - I

Text & Reference Books -

1. Electronic Devices and Circuits, Allen Mottershed, PHI publication
2. Electronic Devices, Floyd , Pearson Education
3. Electronics Devices and Circuit theory, Boylestad, Pearson Education
4. Electronic design from concepts to reality, Roden, Shroff Publication
5. Op- amp and linear integrated circuits, Ramakant Gaykwad ,PHI

S.E. (Bio – Medical Engineering) Part – I

5. Electrical Network Analysis & Synthesis

Lectures 4 Hrs/Week Paper 100 Marks
Practical 2 Hrs/Week

SECTION I

1. Review of Circuit Analysis **2 hrs**

D.C. & A.C. circuits. Circuit analysis basics.

2. Mesh & Node Analysis **5 hrs**

Mesh & Node Analysis of circuits with independent & dependent sources.

3. Linearity, Superposition & Source Transformation **5 hrs**

Linearity, Superposition, Current & Voltage Source Transformation.

4. Network Theorems **5 hrs**

Thevenin's & Norton's Theorem (with independent and dependent sources),Millman's Theorem, Maximum power transfer theorem.

5. Circuit Analysis **7 hrs**

Introduction to Graph Theory. Tree, link currents, branch voltages, cut set & tie set Mesh & Node Analysis, Gauss Elimination Technique, Duality.

SECTION II

6. Time and Frequency Response of Circuits **9 hrs**

First & second order Differential equations, initial conditions. Evaluation & Analysis of Transient Steady state responses using Classical Technique as well as by Laplace Transform (for simple circuits only). Transfer function, Concept of poles and zeros. Frequency response of a system (concepts only), stability criteria & Bode plot (concepts only)

7. Two-Port Networks **7 hrs**

Concept of two-port network. Driving point and Transfer Functions, Open Circuit impedance (Z) parameters, Short Circuit admittance (Y) parameters, Transmission (ABCD) parameters. Inverse Transmission (A'B'C'D') parameters. Hybrid (h) parameters. Inter Relationship of different parameters. Interconnections of two-port networks

8 Fundamentals of Network Synthesis **8 hrs**

Positive real functions, Driving Point functions, Brono's Positive real functions, Properties of positive real functions. Testing Positive real functions. Testing driving point functions, Maximum modulus theorem, Properties of Hurwitz polynomials, Residue computations, Even & odd functions, Sturm's theorem. Driving Point Synthesis with L-C, R-C, R-L and R-L-C networks.

Term work

Term work consists of minimum ten practicals based on entire syllabus.

List of experiments

1. Validation of Transfer functions
2. a) Validation of Y parameters of a two port network.
   b) Validation of Z parameters of a two port network.
3. Validation of Norton theorem
4. Validation of Thevenin's theorem
5. Validation of Superposition theorem
6. Validation of Maximum power theorem
7. Second order frequency response of an RLC circuit
8. Time Response of first order system
9. Any other experiments based on syllabus may be added

Minimum two of above experiments shall be performed on PC using any simulation software.

Note:-* Electrical Network Analysis and Synthesis Term Work and POE is combined in Electronic Circuits Analysis and Design - I

Text Books

1. Circuits and Networks Sudhakar & Shyammohan, , Tata McGraw Hill, thirteenth reprint, 2000.
2. Engineering Circuit Analysis,William H. Hayt, Jack e. Kemmerly & Steven M. Durbin, McGraw Hill International, sixth edition, 2002.
3. Introduction to Modern Network Synthesis M. E. Van Valkenburg, , Wiley Eastern Ltd.

Reference Books

1. Linear Circuit Analysis Artice M. Davis, , Thomson Asia Pte. Ltd, Singapore, first edition, 2001.
2. Network Analysis M.E. Van Valkenburg, , Prentice Hall of India, third edition.
3. Linear Circuit Analysis Raymond A. DeCarlo & Pen-Min Lin, , Oxford University Press, second edition, 2001.

6. Software Lab

Lectures: 2 Hrs/Week Term Work 25 Marks
Practical: 2 Hrs/Week

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1. **Review of C – 4 hrs**
   Loops, strings and arrays, pointers, user defined data types, functions

2. **Introduction to Object Oriented Programming 2 hrs**
   Comparison of object oriented programming and procedure oriented programming, Basic Data types, operators in C++, keywords, identifiers, constants, strings, input output functions, manipulators

3. **Classes and Objects 5 hrs**
   Class declaration, member variable, access modifiers, member functions, use of scope resolution operator, constructor and destructor, objects of class, array of objects, inline functions, new and delete operator

4. **Inheritance 5 hrs**
   Types of inheritance - single, multi level and hybrid, calling sequence of constructor and destructor, Derived objects, derived functions, friend functions, friend classes

5. **Polymorphism and Overloading 5 hrs**
   Concept of polymorphism, early and late binding, virtual functions, abstract base classes, virtual destructor and virtual base classes, interfaces, function overriding, copy constructor , function and operator overloading

6. **File handling 3 hrs**
   File reading, writing and appending of slandered text files

Term work
Term work consists of minimum ten programming assignments **focused on C++ features.**

Text & Reference Books -

1. Programming in C+ + , Dewhurst S.C., Stark K.T.
2. Programming with C+ + , Ravichandran D. (TMH)
3. Object oriented programming with C+ + , E. Balagurusamy. (TMH)
4. Let us C++ ,Yashwant Kanitkar (BPB)
5. Turbo C+ + Techniques and application, Scoot, Robert Ladd.
6. Turbo C+ + Users Guide and Ref. Guide- Borland.

S.E. (Bio – Medical Engineering) Part – II

1. Transducers in Biomedical Instrumentation

Lectures 4 Hrs/Week	Paper 100 Marks
Practical 2 Hrs/Week	Term Work 25 Marks
	POE 50 Marks

SECTION I

1. Introduction to Transducers & instrumentation 6 hrs

Generalized Instrumentation System, General Properties of Transducer Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance.

Dynamic Characteristics: First Order and Second Order Characteristics, Time Delay, Error Free Instrument, Transfer Functions. Design Criteria, Generalized Instrument Specifications.

2. Displacement and Pressure Measurement 6 hrs

Resistive: Potentiometers, Strain Gauges and Bridge Circuits. Inductive: Variable Inductance and LVDT. Capacitive type, Piezoelectric Transducers. Types of Diaphragms, Bellows, Bourdon Tubes, Applications

3. Temperature Measurement 4 hrs

Thermistor, Thermocouple, Resistive Temperature Detector, IC based Temperature Measurement, Applications

4. Electro chemistry and Biopotential Electrodes 8 hrs

Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non Polarizable, Electrodes, Calomel Electrode, Electrode Circuit Model, Electrode Skin-Interface and Motion Artifact. Body Surface Electrodes. Internal Electrodes: Needle and Wire Electrodes (Different Types). Microelectrodes: Metal, Supported Metal Micropipette (Metal Filled Glass And Glass Micropipette Electrodes)

SECTION II

5. Chemical Sensors 9 hrs

Blood gas and Acid- Base Physiology Potentiometric Sensors, Ion Selective Electrodes, ISFETS. Amperometric Sensors, Clark Electrode with examples- pH, pO2, pCO2 Electrodes, Transcutaneous Arterial Oxygen Tension, Carbon Dioxide measurements: capnostat, electrolyte sensors, O2 cell.

6. Biosensor **8 hrs**

Classifications: Biological phenomenon, transduction phenomenon i.e. Enzyme sensor and Electrode based: affinity sensors (Catalytic Biosensors), Two examples of each biosensors and Immunosensors.

7. Fiber optic sensor **4 hrs**

Design Principles in fabrication of fiber optic sensors - Temperature, Chemical, Pressure.

8. Radiation Sensors and Applications. **3 hrs**

Term work

Term work consists of minimum ten practicals based on entire syllabus.

List of Experiments

1. Validation of characteristics of thermistor.
2. Validation of thermistor linearization.
3. Validation of dynamic behavior of thermometer system.
4. Validation of characteristics of light dependent resister.
5. Validation of characteristics of LVDT.
6. Validation of characteristics of thermocouple.
7. Validation of characteristics of Capacitive Transducer
8. Validation of characteristics of Inductive Transducer
9. Validation of characteristics of electrodes.
10. Validation of Non polarizable characteristics of electrodes.
11. Any other experiments based on syllabus may be added

Text Books

1. Medical Instrumentation-Application and Design , John G. Webster.
2. Transducers for Biomedical Measurements: Principles and Applications, Richard S.C. Cobbold, John Wiley & Sons, 1974
3. Instrument Transducer – An Intro to their performance and design, Hermann K P. Neubert
4. Biomedical sensors – fundamentals and application ,Harry N, Norton

Reference Books

1. Principles of applied Biomedical Instrumentation, La Geddes and L.E. Baker
2. Biomedical instrumentation and measurement, Leslie Cromwell, Fred. J. Weibell and Pfeiffer.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merril Publishing Co., Columbus, 1990.
4. Measurement Systems, Application and Design, Ernest O. Doeblin, McGraw-Hill, 1985
5. Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, AIP press.

S.E. (Bio – Medical Engineering) Part – II

2. Biomedical Prosthetic & Orthotics

Lectures 4 Hrs/Week	Paper 100 Marks
Tutorial 1 Hrs/Week	Term Work 25 Marks
	OE 25 Marks

SECTION I

1. Force system **2 hrs**

Classification of force system. Equilibrium of force system.

2. General principles of Biomechanics **3 hrs**

Analysis of biological sub system from the biomechanical view and rise modeling. Instrumentation.

3. Tissue Biomechanics **7 hrs**

Direct shear, bending and torque actions and the corresponding stresses and strains in biological tissues. Stress relaxation and creep, stability and instability. Biomechanical characterization of bone and the soft connective (skin, tendon, ligaments, etc.) covering structure function, and physiological factors.

4. Movement Biomechanics **6 hrs**

Force analyses in the joints, Gait Analysis, body and limb mass and motion characteristic actions. Forces transmitted by joints. Joint forces results in the normal and disabled human body. Normal and fast gait on the level. Strain and ramp ascent and descent. Joint replacements.

5. Joint analysis **6 hrs**

Instrumentation for gait analysis: Measurement devices-footswitches, instrumented walkway, Motion analysis- interrupted light photography, film/video, VICON, Selspot, Goniometers.

SECTION I

6. Principles in designing orthoses and prostheses **5 hrs**

Principles of three points pressure, total contact, partial weight relieving.

7. Positions of anatomical axis **5 hrs**

Positioning and corresponding movements of the body part international conventions with respect to above.

8. Diagnosis Aspects **4 hrs**

Purpose for providing prostheses and orthoses, variation aspects regarding diagnosis, prognosis, stature and socio-economic conditions etc.

9. Classification in Prosthetics and Orthotics **10 hrs**

Lower and Upper Extremity orthoses and prostheses, Spinal orthoses. Recent development in prosthesis and orthotics. Transducers in Prosthetics & Orthotics.

Term work

Term work consists of minimum ten practicals based on entire syllabus.

List of Experiments

1. Coplanar force system.
2. Different types of joints in human body and joint movements
3. Simulation of elbow joint using bell crank lever.
4. Human gait cycle and instruments used for gait analysis.
5. Validation of Stress – Strain relation of Mild steel.
6. Fabrication of PTB/socket.
7. Fabrication of PSI.
8. Fabrication of Cervical collar.
9. Different types of alignment techniques
10. Below elbow prosthetic device.
11. Splints.
12. Any other experiments based on syllabus may be added

Text Books

1. Basic Biomechanics- Susan J. Hall, MC Graw Hill.
2. Human Limbs and their substitutes – Atlas, C. V. Mosby
3. American Atlas of Orthopedics: Prosthetics, C. V. Mosby.
4. American Atlas of Orthopedics: Orthotics, C. V. Mosby

Reference Books

1. Biomechanics - Prof Ghista (Private Publication UAE)
2. Biomechanics – By White and Puyator (Private Publication UAE)

3. Electronic Instrumentation

Lectures 3 Hrs/Week	Paper 100 Marks
Practical 2 Hrs/Week	Term Work 25 Marks

SECTION I

1. Introduction to Instrumentation and Measurement **6 hrs**

System Configuration-Block Diagram of a generalized measurement system, Zero Order System, First Order System- Response of a system to Step, Ramp, Impulse Inputs & Frequency Response. Second Order System- Response of a system to Step, Ramp & Frequency Response. Dead Time Element, Dynamic Response of a Measurement system.

2. Electronic meter **6 hrs**

Principle of Operation, ammeter, ohmmeter, voltmeter, Advantages over Conventional type Analog Voltmeter, Factors involved in selection of Voltmeter, FET Voltmeter, Peak Responding, Average Responding, and True RMS responding voltmeter, Multimeter

3. Digital Voltmeter **5 hrs**

Methods of Analog to Digital and Digital to Analog Conversion. Principle of working of Ramp Type, Dual Slope Type, Successive Approximation Type Digital Voltmeter. Resolution & Sensitivity of digital voltmeter

4. Frequency Meter And Phase meter **3 hrs**

Analog and Digital frequency meter. Analog and Digital Phase meter

SECTION II

5. Oscilloscopes **6 hrs**

Block Diagram study of C.R.O. Description of Panel Layout & Implementation of controls, Requirements of Time base, Delayed Time Base, Lissajous Patterns, Intensity modulation, Velocity modulation, use of these in phase & frequency measurements, Dual trace. Double beam, Sampling, Storage, Digital readout oscilloscope, Use of CRO in tracing Diode & transistor characteristics.

6. Signal Generator **4 hrs**

Requirement of a good laboratory type Signal Generator, A.F. Signal Generator, Function Generator.

7. Data Acquisition **4 hrs**

Data Acquisition System- Generalized DAS, Multi channel DAS, PC based DAS.

8. Writing System **3 hrs**

Ink jet, Potentiometric, UV, Thermal, Light gate, Magnetic, Laser optics and Instrumentation tape recorders.

9. Medical Display System **3 hrs**

Oscilloscope for biomedical measurements, Single & multichannel Display, Non-fade Display System, LCD Display System & Touch Screen Display System

Term work

Term work consists of minimum ten practicals based on entire syllabus.

List of Experiments

1. Peak and average Responding Voltmeter
2. FET voltmeter.
3. Analog ammeter.
4. Multimeter – Analog and Digital.
5. Frequency Meter: Analog and Digital
6. CRO
7. Phase meter
8. Function Generator.
9. Data Acquisition System
10. Instrumentation tape recorder
11. Medical Display systems.
12. Any other experiments based on syllabus may be added

Text Books

1. Electronic Instrumentation & Measurement Techniques, Cooper W. D. & Helfrick A.D.- Kalasi H.S
2. Electronic Instrumentation, Carr and Brown, Pearson Publication

Reference Books

1. Electrical & Electronic Measurement & Instrumentation., A.K. Sawhney
2. Insrtumentation devices and system , Rangan, Sharma and Mani-

4.Digital Design

Lectures 3 Hrs/Week Paper 100 Marks
Practical 2 Hrs/Week

SECTION-I

1. Digital logic gates characteristics and interfacing 6 hrs

Analog verses Digital, Binary code, Basic logic gates – AND, OR, INVERTER, NAND, NOR, XOR, XNOR, Logic family characteristics – TTL,TTL NAND gate, schottky TTL, ECL, CMOS, Tri – state logic, interfacing logic families to one another, Design Interfacing of logic gates to LED display and relays

2. Combinational logic Design, multiplexers and codes 8 hrs

Combinational logic gates, Boolean algebra, K – map, Minterm, Maxterm SOP and POS Implementation, Multiplexer, Demultiplexers, Decoders, Encoders, Binary based codes – octal, hexadecimal, BCD, Gray code, seven segment display code, Hamming Codes, ASCII, PLAs, PALs

3. Flip-Flops, Counters and Registers 6 hrs

Latch and flip flops – NAND, RS, D Latch, JK flip - flop, Asynchronous or ripple counter, Up/Down Counter, Design of divide by N counter, Synchronous counter, Register and shift register – SISO, SIPO, PISO, PIPO

SECTION-II

4. Read / Write Memories 6 hrs

The basic cell IC bipolar RAM, ROM, EPROM, E^2PRM, FLASH memories, read and write cycles, programming technique of EPROM

5. D/A and A/D Converters 7 hrs

Digital to analog converter – binary weighted resistor, R/2R ladder, analog to digital converter – FLASH, single slope, dual slope, successive approximation, ADC0808 and DAC0808 IC specifications

6. Digital Arithmetic 7 hrs

Addition- binary, BCD and excess -3 BCD, octal and hexadecimal, Subtraction – binary, 1's complement, 2's complement, realization of half and full adder, Magnitude Comparators, Arithmetic and logical unit, Binary multiplication and division, fixed point number, floating point numbers

Term work

Term work consists of minimum ten practicals based on entire syllabus.

List of Experiments

1. Verification of truth table of logic gates and.
2. Validation of NAND and NOR gates as Universal gates
3. Realization of a given function:
    i) Using all types of gate ICs
    ii) Using NAND gates only
    iii) Using NOR gates only
4. Verification of NAND Gate IC characteristics
5. Realization of half adder, full adder and subtracter
6. Verification of truth tables for flip flops using IC.
7. 16 to 1 decoder using 8 to 1 decoder ICs
8. To design & implement mod N synchronous up/down counter.
9. To design & implement a ring counter using D Flip-Flop.
10. Design & implementation of full adder using gates and decoder.
11. Design & implementation of ladder network & R -2R network DAC
12. Any other experiments based on syllabus may be added

Note:-* Digital Design Term Work and POE is combined in Electronic Circuits Analysis and Design - II

Text Books

1. Modern Digital Electronics , R.P.Jain,, Tata McGraw Hill, Latest reprint
2. Digital Design, M Morris Mono, Prentice Hall International- Latest reprint.
3. Digital Principal and Applications, Malvino & Leach, Tata McGraw Hill, 1991.

Reference Books

1. Digital Electronics, Malvino, Tata McGraw Hill, 1997.
2. Digital Electronics, James Bignell & Robert Donovan, Delmar, Thomas Learning,
3. 2001.
4. Introduction to Logic Design , Alan b. Marcovitz, McGraw Hill International 2002.
5. Microprocessors and digital System, Douglas Hall, TMH

5. Electronic Circuits Analysis and Design – II

Lectures 4 Hrs/Week	Paper 100 Marks
Practical 2 Hrs/Week	Term Work 25* Marks
	POE 50* Marks

SECTION-I

1. Multistage Transistor Amplifier **6 hr**

RC coupled & Direct Coupled amplifier, Frequency response, Analysis using h parameters. Design of two stages RC coupled amplifier

2. Two stage and Feed Back Amplifier **6 hr**

Theory of –ve feed back, types of -ve feed back, its effects on stability BW, noise distortion, i/p resistance & o/p resistance. Design of RC coupled amplifier involving voltage series feedback.

3. Sinusoidal Oscillators **5 hr**

Barkhausen criteria.

Types of oscillators – RC oscillators- phase shift, Wein bridge oscillators.
LC oscillators – Hartley Colppits & Crystal oscillator (Analysis of all), Design of RC oscillator.

4. Power amplifiers **7 hr**

Classifications, class A, B, C & AB (Analysis of A, B, & AB), cross over distortion, Harmonic distortion, Complementary symmetry power amplifier, Design of complementary system power Amplifier.

SECTION-II

5. Operational Amplifier **6 hr**

Introduction, Ideal operational amplifier, Block diagram representation of Op-amp, input offset voltage, input offset current, input bias current, CMRR, SVRR, output voltage swing, slew rate, Ideal voltage transfer curve, Open loop operational amplifiers configurations

6. Practical Operational Amplifier (µA741) **6 hr**

Input offset voltage, input bias current, input offset current, Total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Change in input offset voltage and Change in input offset current with time, Common mode configuration and common mode rejection ratio

7. Application of operational amplifier **7 hr**

Inverting and non-inverting amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, Integrator, differentiator, comparator, zero crossing detector, Schmitt trigger, Window detector and peak detector
Design of Inverting and non-inverting amplifier

8. **Filters and oscillators** **5 hr**
   Design of first and Second order low pass and high pass Butterworth filter, Phase shift oscillator, Wein bridge oscillator, Square wave and triangular wave generator, Voltage controlled oscillator

Term Work

Term work consists of minimum ten practicals based on entire syllabus.

List of Experiments

1. Design and implementation of two stage amplifier
2. Voltage series feedback amplifier
3. RC phase shift oscillator
4. Wein bridge oscillator
5. Complementary symmetry amplifier
6. Op-amp as inverting and non-inverting amplifier
7. Op-amp as adder and subtractors
8. Op-amp as Schmitt trigger
9. Op-amp as peak detector
10. Op-amp as waveform generators
11. Design of first and Second order low pass and high pass Butterworth filter
12. Phase shift oscillator
13. Any other experiments based on syllabus may be added

Note:-* Digital Design Term Work and POE is combined in Electronic Circuits Analysis and Design - II

Text and Reference Books

1. Electonic Devices and Circuits, Allen Mottershed, PHI publication
2. Electronic Devices, Floyd , Pearson Education
3. Electronics Devices and Circuit theory ,Boylestad, Pearson Education
4. Electronic design from concepts to reality, Roden, Shroff Publication
5. Op- amp and linear integrated circuits, Ramakant Gaykwad PHI

S.E. (Bio – Medical Engineering) Part – II

6. Electronic Work Shop

Tutorial 1 Hr/Week Term Work 25 Mark
Practicals 2 Hrs/Week

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1. **Introduction**
   MATLAB basics, MATLAB window, input output, file types, general commands

2. **Interactive computation**
   Matrices and vectors, Matrix and array operation

3. **Scripts and functions**
   Script file, function file, variables, global variables, loops, branches and control flow, interactive input, recursion, input/output

4. **Applications**
   Introduction to signal processing and image processing tool box

5. **Graphics**
   2-D/3-D plots

Term Work
Term work consists of minimum ten programming practicals based focused on various features of MATLAB.

Text and Reference Books

1. Getting started with MATLAB 7, Rudra Pratap, Oxford university press
2. MATLAB for engineers and scientist, Chapman