SOLAPURUNIVERSITY,SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

BIOMEDICAL ENGINEERING

Syllabus for

S.E. (Biomedical Engineering) w.e.f. Academic Year 2017-18

Choice Based Credit System

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Biomedical Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To make students competent for professional career in Biomedical& allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Biomedical& other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineeringproblems.
2. **Problem analysis**: Identify, formulate, review research literature, andanalyze complexengineering problems reaching substantiated conclusions using first principles ofmathematics,natural sciences, and engineeringsciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and designsystemcomponentsorprocessesthatmeetthespecifiedneedswithappropriateconsideration for the public health and safety, and the cultural, societal, andenvironmentalconsiderations.
4. **Conductinvestigationsofcomplexproblems**:Useresearch-basedknowledgeandresearchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,andsynthesisoftheinformation to provide validconclusions.

5. **Moderntoolusage**:Create,select,andapplyappropriatetechniques,resources,andmodernengineering and IT tools including prediction and modeling to complex engineering activities withanunderstanding of thelimitations.

Theengineerandsociety:Applyreasoninginformedbythecontextualknowledgetoassesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to theprofessional engineeringpractice.

1. **Environment and sustainability**: Understand the impact of the professional engineeringsolutionsin societal and environmental contexts, and demonstrate the knowledge of, and need forsustainabledevelopment.
2. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineeringpractice.
3. **Individualandteamwork**:Functioneffectivelyasanindividual,andasamemberorleaderindiverse teams, and in multidisciplinarysettings.
4. **Communication**: Communicate effectively on complex engineering activities with theengineeringcommunity and with society at large, such as, being able to comprehend and write effectivereportsand design documentation, make effective presentations, and give and receive clearinstructions.
5. **Project management and finance**: Demonstrate knowledge and understanding of t h e engineeringandmanagementprinciplesandapplythesetoone'sownwork,asamemberandleader in a team, to manage projects and in multidisciplinaryenvironments.
12. **Life-longlearning**:Recognizetheneedfor,andhavethepreparationandabilitytoengageinindependent and life-long learning in the broadest context of technologicalchange.

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2017-18)

Credit System structure of S.E. Biomedical Engineering W.E.F. 2017-18 *Semester I*

Course Code	*Theory Course Name*	*Hrs./week*			*Credits*	*Examination Scheme*			
		L	*T*	*P*		*ISE*	*ESE*	*ICA*	*Total*
	Engineering Mathematics – III	3	1	_	4	30	70	25	125
	Human Anatomy and physiology	4	_	_	4	30	70	-	100
	Biomaterials	3	-	_	3	30	70	-	100
	Electronics Circuit Analysis and Design-I	4	_	_	4	30	70	-	100
	Linear circuit Analysis	4	_	_	4	30	70	-	100
Sub Total		18	1	_	19	150	350	25	525
	Environmental Studies	1	-	-	-	-	-	-	1
Course Code	*Laboratory Course Name*								
							ESE		
							POE	*OE*	
	Human Anatomy and physiology	_	_	2	1	_	50	--	25	75
	Biomaterials	-	1	-	1	-		25	25	50
	Electronics Circuit Analysis and Design-I	_	_	2	1	_	50*	_	25	75
	Linear circuit Analysis	--	--	2	1	--		--	25	25
	Software lab	2	-	2	2	_	_	_	50	50
Sub Total		--	1	08	6	_	125		150	275
Grand Total		**20**	**2**	**08**	**25**	**150**	**475**		**175**	**800**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, ICA- Internal Continuous Assessment ESE - University Examination (Theory &/ POE &/Oral examination)

- **Note:**

1. *- Practical and Oral Examination of Electronics Circuit Analysis and Design – I includes some of the practical from Linear Circuit Analysis
2. Student is required to study and pass Environmental Science subject in Second Year of Engineering to become eligible for award of degree.
3. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining students exceeds 9, then a new batch shall be formed.
4. Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I
5. Student shall select one Self Learning Module at T.E. Part I and T.E. Part II each from Technical and Humanities and Social Sciences Group with at least one Self Learning Module from the Humanities and Social Sciences Group
6. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology
7. ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2017-18)

Credit System structure of S.E. Biomedical Engineering W.E.F. 2017-18 *Semester II*

Course Code	*Theory Course Name*	*Hrs./week*			*Credits*	*Examination Scheme*			
		L	*T*	*P*		*ISE*	*ESE*	*ICA*	*Total*
	Transducers In Biomedical Instrumentation	4	_	_	4	30	70	-	100
	Biomedical Prosthetics and Orthotics	3	-	_	3	30	70	-	100
	Electronics Instrumentations	3	1	_	4	30	70	25	100
	Digital Design	4	_	_	4	30	70	-	100
	Electronic Circuit Analysis and Design - II	4	_	_	4	30	70	-	125
Sub Total		18	2	_	19	150	350	25	525
		-	-	-	-	-	-	-	-
Course Code	*Laboratory Course Name*								
							ESE		
							POE	*OE*	
	Transducers In Biomedical Instrumentation	_	_	2	1	_	50	--	25	75
	Biomedical Prosthetics and Orthotics	_	1	-	1	_	_	25	25	50
	Digital Design	_	_	2	1	_	50*	_	25	75
	Electronic Circuit Analysis and Design - II	_	_	2	1	_	_	_	25	25
	Electronic workshop	_	1	2	2	_	_	_	50	50
Sub Total		--	_	08	6	_	125		150	275
Grand Total		**18**	**3**	**08**	**25**	**150**	**475**		**175**	**800**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, ICA- Internal Continuous Assessment ESE - University Examination (Theory &/ POE &/Oral examination)

- **Note:**

1. * Practical and Oral Examination of Electronics Circuit Analysis and Design – II includes some of the practical from Digital design.
2. Student is required to study and pass Environmental Science subject in Second Year of Engineering to become eligible for award of degree.
3. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining students exceeds 9, then a new batch shall be formed.
4. Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I
5. Student shall select one Self Learning Module at T.E. Part I and T.E. Part II each from Technical and Humanities and Social Sciences Group with at least one Self Learning Module from the Humanities and Social Sciences Group
6. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology
7. ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-I
ENGINEERING MATHEMATICS-III

Teaching Scheme:
Lectures- 3 Hours / week, 3 Credits
Tutorial - 1 Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

SECTION I

UNIT -1. Laplace Transform **8hrs**

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.

UNIT-2. Inverse Laplace Transforms **7hrs**

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

UNIT-3. Complex Variables 1 **3hrs**

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

UNIT-4. Complex Variables 2 **5hrs**

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

UNIT-5. Complex Variables 2 **7hrs**

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.

UNIT-6. Fourier series 1 **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)

UNIT-7. Fourier series 2 **4 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.

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-I
2. Human Anatomy and Physiology

Teaching Scheme:	Examination Scheme
Lectures- 4 Hours / week, 4 Credits	ESE- 70 Marks
Practical -2 Hours / week, 1 Credit	ISE - 30 Marks
	ICA- 25 Marks
	POE- 50 Marks

Course Objectives

1) Human Anatomy and Physiology is an advanced course that is an elective designed for those students wanting a deeper understanding of the structure and function of the human body.
2) The body will be viewed as a whole using anatomical terminology necessary to describe location.
3) Focus will be at both micro and macro levels reviewing cellular functions, biochemical processes, tissue interactions, organ systems and the interaction of those systems as it relates to the human organism. Systems covered include integumentary, skeletal, muscular, respiratory, circulatory, digestive, excretory, reproductive immunological, nervous and endocrine.

Course Outcome

1) This course will develop 21st century skills and be appropriate for college bound students as well as those choosing a health services career cluster.
2) Students will engage in active inquiries, investigation, and hands-on activities for a minimum of 50% of the instructional time to develop conceptual understanding and research/laboratory skills as they evaluate the academic requirements and prepare for occupational opportunities in health and medical fields.
3) Safety instruction is integrated into all activities.

SECTION 1

UNIT - 1. Anatomy –Cell, Body Structure and blood **7 hrs**

Cell: Structure and functions of cell. Polarization and depolarization of cell.

Body Structure: Basic tissues and their functions in brief.

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

Outline of structures of the following system. Skeletal System, Muscular System, Integumentary system (Skin Study)

UNIT - 2. Cardiovascular System **8 hrs**

Introduction, 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)

UNIT - 3. Respiratory System **5 hrs**

Introduction, Respiration external (Ventilation) Exchange in gases in the alveoli, Artificial respiration. Spiro meter (Forced expiratory volumes) peak flow meter.

UNIT - 4. Alimentary System **5 hrs**

Introduction, All organs of the digestive system, other secretions and main Functions. Deglutition and defecation.

SECTION II

UNIT - 5. Excretory System & Reproductive System **6 hrs**

Introduction, Structure of Nephron, formation of urine and function of Kidney, Urinary Bladder, urethra, internal / external sphincters.

Introduction, (Male and Female) Different organs and their functions. Main actions of Androgens, Oestrogens and Progesterone

UNIT - 6. Central Nervous System **5 hrs**

Introduction, Different parts, their functions. Reflex actions and reflex arc, Function of Sympathetic and Parasympathetic nervous system. Nerve conduction and action potentials.

UNIT - 7. Endocrine System **3 hrs**

Introduction, All glands, their secretions and functions. Control of secretions.

UNIT - 8. Eyes and Ears **6 hrs**

Introduction, 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.

Practical & Oral Examination

Oral exam will be based on entire subject.

*Oral Examination Based on Hospital Visit

Visit to Hospitals 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. The concerned teachers of subject HAP will co-ordinate the visit. Oral examination will be based on the visit report.

Term work

Term work consists of minimum eight assignments

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. To study the Defibrillator

7. To study external Pacemaker

8. To study ECG Machine

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.)

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-I
3. Biomaterials

Teaching Scheme:	**Examination Scheme**
Lectures- 3 Hours / week, 3 Credits	**ESE- 70 Marks**
Tutorial - 1 Hours / week, 1 Credit	**ISE - 30 Marks**
	ICA- 25 Marks
	OE- 25Marks

Course Objectives

1) Biomaterials, recognized as a new class of materials in the Materials Science community, are being developed in last few decades for human health care.
2) The design and development of biomaterials requires the integration of the concepts and expertise from two widely different disciplines, i.e. Materials Science & Engineering and Biological Science.
3) While such integration is not an easy task by any means, the researchers have put their extensive efforts in this direction.

Course Outcome

1) After studying the students should be able to understand New trends in biomaterials, such as electrically conductive polymers, piezoelectric biomaterials, and sol-gel processing are discussed, and the recent merging of cell biology and biochemistry with materials is examined.
2) Case studies and in-class scenarios are frequently used to highlight the current opportunities and challenges of using biomaterials in medicine.
3) The importance of the field of biomaterials is increasingly being noticed in the Materials community with the compulsory course on this subject is being taught at undergraduate and graduate level in most of the top universities around the world.

SECTION I

UNIT - 1. Introduction, Properties and Applications of Metallic Biomaterials 7 hrs

Introduction of Biomaterials, Classification of Biomaterials

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

UNIT - 2.Properties and Applications of Polymeric Biomaterials 7 hrs

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

UNIT - 3.Properties and Applications of Ceramic Biomaterials **7 hrs**

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

UNIT - 4.Composite Biomaterials **5 hrs**

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

SECTION II

UNIT - 5. Properties and Applications of Degradable Biomaterials **4 hrs**

Polymers & Ceramics in fabrication of biodevices and implants

UNIT - 6. Biomaterials for Soft Tissue Replacements **5 hrs**

Properties and Applications of biomaterials for Soft Tissue Replacements

UNIT - 7. 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

UNIT - 8.Surface properties of Biomaterials, Testing of Biomaterials **8 hrs**

Surface properties of Biomaterials and their testing with reference to biological safety Biological Testing of Biomaterials, Biocompatibility of Materials, Biomaterials corrosion and wear

Term work

Term work consists of minimum eight assignments and a written test.

Text Books

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

Reference Books

- Encyclopedia of Medical Devises and Instrumentation: John G. Webster. Vol. I, II, III, IV (Marcel Dekkar Pub).
- Encyclopedia – Handbook of Biomaterials and Bioengineering: Part-A: Materials Vol I, II (Marcel Dekkar Pub) Part – B: Applications Vol. I, II.
- Design Engineering on Biomaterials for medical devices: David Hill, John Willey Publication

Biological Performance of Materials, 2nd Edition – Jonathan Black, Marcel Dekker Inc. New York. Basel. Hong Kong

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-I
4. Electronics Circuits Analysis and Design- I

Teaching Scheme:	Examination Scheme
Lectures- 4 Hours / week, 4 Credits	ESE- 70 Marks
Practical- 2Hours / week, 1 Credit	ISE - 30 Marks
	ICA- 25 Marks
	POE- 50* Marks

Course Objective:

1. Student should able to define and identify the theory and application of each semiconductor devices.
2. Student should be able to design the discrete circuits based on electronic devices
3. Student should able to handle the data sheets of each electronic devices
4. Student should able to think on biomedical oriented electronic circuit design

Course Outcome:

1. After completion of this course student able to define and identify the theory and application of each semiconductor devices.
2. After completion of this course student able to design the discrete circuits based on electronic devices
3. After completion of this course student able to handle the data sheets of each electronic devices
4. After completion of this course student able to think on biomedical oriented electronic circuit design

SECTION-I

UNIT - 1. Introduction to semiconductor diode: 6 hrs

PN junction diode: introduction of diode, biasing of diode (Forward biasing and reverse biasing), diode V-I characteristics ,
breakdown mechanism, diode as switch, AC & DC load line, effect of temperature on diode.
Zener diode: oeration of zener diode, characteristics,. Comparison of pn junction diode and zener diode.

UNIT - 2. Application of Diode 8 hrs

Half wave, full wave (center tap and Bridge) rectifier using PNJunction diode. Design of full wave rectifier with capacitor, inductor, LC, pi filter.
Clipper and Clapper: Positive clipper, Negative clipper and combination clipper circuit, positive clamper, negative clamper, voltage doublers and Tripler.

UNIT-3. Voltage Regulator 6 hr

Rgulator concept, short circuit protection, thermal shut down, current boosting method, Zener

diode voltage regulator, emitter follower regulator, series voltage regulator, shunt regulator. IC regulators 78xx,79xx, LM317, LM337

UNIT-4. Bipolar Junction transistor **6 hrs**

Introduction to BJT: Operation of BJT, Transistor current components,
Transistor configuration**:** Common base, common collector, Common emitter configuration, (with their input output characteristics)
Biasing of transistor – need of biasing, fixed bias, collector to base bias, emitter bias and voltage divider biasing, stability factor (Detailed analysis is expected),

SECTION-II

UNIT-5.Application of BJT **6 hrs**

h- Parameter model of common emitter configuration (voltage gain, current gain, input impedance and output admittance), working principle of BJT as switch, and BJT as amplifier.

UNIT-6. Field Effect Transistor **6 hrs**

JEET, V – I Characteristics, different configurations of JEET, parameters of JEET, Biasing of JFET and application as an amplifier and as VVR,
MOSFET, V – I Characteristics, different configurations of MOSFET, Application as an amplifier and as switch.

UNIT-7. Power Devices **6hrs**

Introduction to power devices like power diode, power transistor, SCR, GTO, IGBT, Power MOSFET, DIAC, TRIAC

UNIT-8. Waveform generator using IC 555 **6 hrs**

Monostable, Astable & Bistable Multivibrator, (study includes circuit diagram. & Analysis)., pulse generator using IC 74121 & 74123. Design of Astable & Monostable Multivibrator.

Term Work

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

1. Half wave ,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. JFET as switch
14. JFET as amplifier
15. MOSFET as switch
14. MOSFET as amplifier

Note:-* Linear Circuits Analysis 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
6. Electronic Device & Circuits, Millman Halkias ,Tata McGraw Hill, Third edition
7. Electronic Circuits Analysis and Design , Donald A Neamen ,Tata McGraw Hill

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-I
5. Linear Circuits Analysis

Teaching Scheme:	**Examination Scheme**
Lectures- 4 Hours / week, 4Credits	**ESE- 70 Marks**
Practical - 2Hours / week, 1 Credit	**ISE - 30 Marks**
	ICA- 25 Marks

Objective:

1. Student should able to understand theory and application of circuit analysis.
2. Student should be able to solve and simplify the circuits
3. Student should able to analysis the circuits with proper scope for practical implementation.
4. Student should able to think on biomedical oriented circuit analysis.

Outcome:

1. After completion of this course student able to understand theory and application of circuit analysis.
2. After completion of this course student able to solve and simplify the circuits
3. After completion of this course student able to analysis the circuits with proper scope for practical implementation.
4. After completion of this course student able to think on biomedical oriented circuit analysis

SECTION I

UNIT-1. DC circuit analysis **6hrs**

DC circuits analysis basics. Mesh & Nodal Analysis of circuits, Linearity, Superposition, Current & Voltage Source Transformation. Thevenin's & Norton's Theorem
Maximum power transfer theorem. Problems are restricted up to three mesh.

UNIT-2. AC circuit analysis **6hrs**

AC circuit analysis basics. Mesh & Nodal Analysis of circuits, Linearity, Superposition, Current
& Voltage Source Transformation. Thevenin's & Norton's Theorem
Maximum power transfer theorem. Problems are restricted up to three mesh.

UNIT-3. Transient Response of Circuits **6 hrs**

Concept of differential equation and particular solution using Laplace transform method. Transient response analysis to step input signal of RC, RL, RLC series circuits and RC, RL, RLC parallel circuits.

UNIT-4. Resonance **6hrs**

Concept of resonance, series and parallel resonance, RLC series and parallel resonance circuits, Q – factor, application of resonance.

SECTION II

UNIT-5. Two-Port Networks **6 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.

UNIT-6. Filters Circuits **6 hrs**

Concept of frequency filtering, low pass, high pass, band pass, band reject, notch filter using RC and RL circuits

UNIT-7. Attenuator Circuits **6 hrs**

Concept of frequency attenuation, T-type, pi – type, lattice, Bridged T type attenuators

UNIT-8. Pole zero analysis **6hrs**

Concept of transfer function, pole-zero plots, effect of pole and zero on circuit performance, stability analysis using pole and zero.

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. filters and attenuators
10. Any other experiments based on syllabus may be added

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

Note:-* Linear Circuits Analysis 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.

Solapur University, Solapur

S.E. (Biomedical Engineering) Semester-I

6. Software Lab (Programming with C++)

Teaching Scheme: **Examination Scheme**

ICA- 50 Marks

Lectures- 2 Hours / week, 2 Credits
Practical- 2Hours / week, 1 Credit

Course Objectives

1. Student should able to understand theory and application of **Object Oriented Programming**
2. Student should be able to solve and simplify the operators in C++,
3. Student should able to analysis the turbo C++ with proper scope for practical implementation. Turbo C+ + Techniques and application

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Course Outcome

1. After completion of this course student able to understand theory and application of circuit analysis.
2. After completion of this course student able to solve and simplify the circuits

After completion of this course student able to analysis the circuits with proper scope for practical implementation

UNIT 1 Introduction to Object Oriented Programming **3 hrs**

Comparison of object oriented programming and procedure oriented programming, Basic Data types, operators in C++, keywords, identifiers, constants, strings, input output functions, manipulators

Flow control **2 hrs** If, If – else, If – else If, ladder If else, Switch – case, Go to, for, while, do while loops

UNIT 2 Strings and Arrays **3 hrs**

Array declaration, array initialization, Single and multidimensional dimensional arrays, character arrays, string manipulation by using Standard Library functions

UNIT 3 User defined data types **2 hrs**

Structures, declarations, initializations, variables of structures, array of structures

UNIT 4 Classes and Objects **4 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

UNIT 5 Inheritance **3 hrs**

Types of inheritance - single, multi-level and hybrid, calling sequence of constructor and destructor, Derived objects, derived functions, friend functions, friend classes

UNIT 6 Polymorphism and Overloading **4 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

UNIT 7 File handling **3 hrs**

File reading, writing and appending of slandered text files

Term work should contain:

Minimum of 10 programs covering various aspects of C+ + language (TW 25).

Self-learning project based on C++ must be developed during term (TW 25)

Books and References:

1. Programming in C+ + by Dewhurst S.C. Stark K.T.

2. Programming with C+ + by Ravichandran D. (TMH)

3. Object oriented programming with C+ + by E. Balagurusamy. (TMH)

4. Let us C++ by Yashwant Kanitkar (BPB)

5. Turbo C+ + Techniques and application by Scoot, Robert Ladd.

6. Turbo C+ + Users Guide and Ref. Guide- Borland.

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
1. Transducers In Biomedical Instrumentation

Teaching Scheme:
Lectures- 4 Hours / week, 4 Credits
Practical - 2Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks
POE- 50 Marks

Course Objectives

1) The overall objective of this course is to introduce students to the basic principles and design issues of biomedical sensors and instrumentation.
2) Including: the physical principles of biomedical sensors, analysis of biomedical instrumentation systems, and the application specific biomedical sensor and instrumentation design.
3) calculate the static and dynamic characteristics of bioinstrumentation systems

Course Outcome

1) By the end of the course the students will be able to classify biomedical sensors and instrumentation.
2) Design the transducers that are applicable in acquisition of different bio potentials.
3) Study of different temperature, pressure, displacement transducer.

SECTION I

UNIT-1. Generalized Instrumentation System, General Properties of Transducer 6 hrs

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.

UNIT-2. Displacement and Pressure Measurement: (with applications) 6 hrs

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

UNIT-3. Temperature Measurement 4 hrs

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

UNIT-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

UNIT-5. Chemical Sensors **8 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.

UNIT-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.

UNIT-7. Fiber optic sensor **4 hrs**

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

UNIT-8. Radiation Sensors and Applications. **2 hrs**

Practical & Oral Examination

Oral exam will be based on entire subject.

Term work

Term work consists of minimum eight assignments

List of Experiments

1. To study characteristics of thermistor.
2. To study thermistor linearization.
3. To study dynamic behavior of thermometer system.
4. To study characteristics of light dependent resister.
5. To study working & principle of LVDT.
6. To study working & principle of thermocouple.
7. To study working & principle of Capacitive Transducer
8. To study working & principle of Inductive Transducer
9. To study Polarizable characteristics of electrodes.
10. To study Non polarizable characteristics of electrodes.
11. To study electrode skin interface. (Contact Impedance)

Text Books

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

References Books

- Principles of applied Biomedical Instrumentation by La Geddes and L.E. Baker
- Biomedical instrumentation and measurement by Leslie Cromwell, Fred. J. Weibell and Pfeiffer.
- Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merril Publishing Co., Columbus, 1990.
- Measurement Systems, Application and Design, Ernest O. Doeblin, McGraw-Hill, 1985

- Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, AIP press

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
2. Biomedical Prosthetics and Orthotics

Teaching Scheme:
Lectures- 3 Hours / week, 3 Credits
Tutorial - 1Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks
OE- 25 Marks

Course Objectives

1) Acquire and apply knowledge in engineering fundamentals.
2) Design Prosthetics and Orthotics systems, components or processes to fulfill current needs
3) Use techniques, skills, and current technologies in Prosthetics and Orthotics practical.

Course Outcome

1) Understand and committed to Prosthetic &Orthotic professional and ethical responsibility.
2) Understand social, global and environment responsibilities of Prosthetics an Orthotics engineers.
3) Understand the need to undertake lifelong learning, possessing the ability to do so and obtain information management skills.

SECTION I

BIOMECHANICS

UNIT - 1. Force system, General principles of Biomechanics **5 hrs**

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

UNIT - 2. 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.

UNIT - 3. Movement Biomechanics **8 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.

UNIT 4. Joint analysis **6 hrs**

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

SECTION II

PROSTHETICS AND ORTHOTICS

UNIT 5. Principles in designing orthoses and prostheses **4hrs**

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

UNIT 6. Positions of anatomical axis **3hrs**

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

UNIT 7. Prostheses and orthoses variation **3hrs**

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

UNIT 8. Classification in Prosthetics and Orthotics **10hrs**

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

Oral Examination:

Oral exam will be based on entire subject.

Text Books

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

Reference Books

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

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
3. Electronics Instrumentations

Teaching Scheme:
Lectures- 3 Hours / week, 3 Credits
Tutorial – 1 Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

Course Objectives

1) The Electronic Instrumentation deals with basic instrumentation systems.
2) This course aims at developing and understanding of the design of Calibration Methods, Standards of measurements
3) Understanding of various types of design and designing procedures

Course Outcome

1) The Electronic Instrumentation deals with basic instrumentation systems.
2) This course aims at developing and understanding of the design of Calibration Methods, Standards of measurements
3) Understanding of various types of design and designing procedures

SECTION I

UNIT-1. Fundamental Concepts of Measurement **4 hrs**

Introduction to measurement, System Configuration-Block Diagram of a generalized measurement system, performance characteristics -static and dynamic, measurement errors – gross, systematic & random, working principle D-Arsonval and PMMC Instrument.

UNIT-2. Electronic meter **6 hrs**

Principle 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

UNIT-3. Digital Voltmeter **4 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. Variable resistor network, R-2R ladder network, Binary ladder digital to analog converter, Resolution & Sensitivity of digital voltmeter

UNIT-4. Frequency Meter and Phase meter **3 hrs**

Analog and Digital frequency meter. Analog and Digital Phase meter

SECTION II

UNIT-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.

UNIT-6. Signal Generator **4 hrs**

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

UNIT-7. Data Acquisition **3 hrs**

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

UNIT-8. Medical Display & Writing System **6hr**

Ink jet, Potentiometric, UV, Thermal, Magnetic, Laser optics and Instrumentation tape recorders. 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 eight assignments

Text Books

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

Reference Books

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

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
4. Digital Design

Teaching Scheme:
Lectures- 4 Hours / week, 4 Credits
Practical – 2 Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks
POE- 50* Marks

Course Objective:

1. Student should able to define and identify the theory and application of each Logic devices.
2. Student should be able to design the Combinational Logic Circuits
3. Student should able to handle the data sheets of each Logic devices and ICs

Course Outcome:

1. After completion of this course student able to define and identify the theory and application of each Logic devices.
2. After completion of this course student able to design the Combinational Logic Circuits
3. After completion of this course student able to handle the data sheets of each Logic devices and ICs

SECTION-I

UNIT-1 Digital Arithmetic **6 hrs**

Review of the number system – Binary ,BCD, octal, hexadecimal, Gray code, seven segment display code, Hamming Codes, ASCII,
Addition- binary, BCD and excess -3 BCD, octal and hexadecimal, Subtraction – binary, 1's complement, 2's complement, Binary multiplication and division, fixed point number, floating point numbers.

UNIT - 2. Digital logic gates characteristics and interfacing **6 hrs**

Analog verses Digital, Binary code, Basic logic gates – AND, OR, INVERTER, NAND, NOR, XOR, XNOR, Universal gates, Theorems of Boolean algebra, DeMorgan's law; realization of digital circuits using basic gates and universal gates,Design Interfacing of logic gates to LED display and relays

UNIT – 3 Logic family: **6 hrs**

Definitions - noise margin, power dissipation, voltage and current parameters,propagation delay, Logic family characteristics – TTL,TTL NAND gate, schottky TTL, ECL, CMOS, Tri – state logic, interfacing logic families to one another.

UNIT -4 Combinational logic Design **6 hrs**

Combinational logic gates, K – map, Minterm, Maxterm, SOP and POS Implementation,Design problems. Design of half adder, full adder, half subtractor , full subtractor & comparator circuit,

SECTION-II

UNIT -5. Multiplexers **6hrs**

Multiplexer, Demultiplexers, Decoders, Encoders, PLAs, PALs

UNIT -6. Sequential logic Design **6 hrs**

Latches - S-R latch; flip-flops: S-R, J-K, D, T and master-slave, clocked flip flop shift register – SISO, SIPO, PISO, PIPO.

UNIT -7. Counters **6 hrs**

Asynchronous or ripple counter, Up/Down Counter, Synchronous counter, Design of divide by N counter/mode counter (÷2, ÷4, ÷8, ÷10, ÷12, ÷14, ÷16)

UNIT -8. 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

Practical & Oral Examination

Practical exam will be based on entire list of experiments performed.

Term work

Term work consists of minimum eight assignments

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

List of Experiments

1. To study the various logic gates and verify their truth table.
2. Realization of a given logic gate using universal gates (NOT, AND, OR):
   i) NAND gate.

   ii) NOR gate

3. Conversion from binary to gray code and gray to binary code.
4. Realization of a given function:
   i) Using all types of gate ICs
   ii) Using NAND gates only
   iii) Using NOR gates only
5. To study NAND Gate IC characteristics

6. Half and full adder, subtracter realization
7. To study J-K Flip-Flop using IC 7476.
8. To design & implement mod N synchronous up/down counter.
9. To design a ring counter using D Flip-Flop.
10. Design of full adder using gates and decoder.
11. To study of analog to digital conversion technique
12. To study of digital to analog conversion technique

Text Books

(1) R.P.Jain, "Modern Digital Electronics," Tata McGraw Hill, Latest reprint

(2) M Morris Mono, "Digital Design," Prentice Hall International- Latest reprint.

(3)Malvino & Leach, "Digital Principal and Applications", Tata McGraw Hill, 1991

Reference books

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

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
5. Electronics Circuit Analysis and Design II

Teaching Scheme:
Lectures- 4 Hours / week, 4 Credits
Practical – 2 Hours / week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

Course Objective:

1 Student should able to define and identify the theory and application of each semiconductor devices.
2 Student should be able to design the discrete circuits based on electronic devices
3 Student should able to handle the data sheets of each electronic devices
4 Student should able to think on biomedical oriented electronic circuit design

Course Outcome:

1. After completion of this course student able to define and identify the theory and application of each semiconductor devices.
2. After completion of this course student able to design the discrete circuits based on electronic devices
3. After completion of this course student able to handle the data sheets of each electronic devices
4. After completion of this course student able to think on biomedical oriented electronic circuit design

SECTION-I

UNIT-1. Multistage Transistor Amplifier **6 hr**

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

UNIT-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.

UNIT-3. Sinusoidal Oscillators **6 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.

UNIT-4.Power amplifiers **6 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

UNIT-5. Operational Amplifier **6 hr**

Introduction, Ideal operational amplifier, Block diagram representation of Opamp, 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

UNIT-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 time, Common mode configuration and common mode rejection ratio

UNIT-7. Application of operational amplifier **6 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

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 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

Solapur University, Solapur
S.E. (Biomedical Engineering) Semester-II
6. Electronic Work Shop

Teaching Scheme: **Examination Scheme**
Tutorial- 1 Hours / week, 1Credits
Practical – 2 Hours / week, 1 Credit

ICA- 50 Marks

Course Objectives

1 Student should able to define and identify the theory and application of each semiconductor devices.
2 Student should be able to design the discrete circuits based on electronic devices
3 The Electronic Instrumentation deals with basic instrumentation systems.
3 This course aims at developing and understanding of the design of Calibration Methods, Standards of measurements

Course Outcome:

1. After completion of this course student able to define and identify the theory and application of each semiconductor devices.
2. After completion of this course student able to design the discrete circuits based on electronic devices
3. The Electronic Instrumentation deals with basic instrumentation systems.
4. This course aims at developing and understanding of the design of Calibration Methods, Standards of measurements

UNIT - 1. Introduction

MATLAB basics, MATLAB window, input output, file types, general commands

UNIT - 2. Interactive computation

Matrices and vectors, Matrix and array operation

UNIT - 3. Scripts and functions

Script file, function file, variables, global variables, loops, branches and control flow, interactive input, recursion, input/output

UNIT - 4. Applications

Introduction to signal processing and image processing tool box

UNIT - 5. Graphics

2-D/3-D plots

Text books

1. Rudra Pratap “Getting started with MATLAB 7” Oxford university press

Reference Books

1. Chapman “MATLAB for engineers and scientist”

1. Minimum eight programs on above syllabus covering all aspect of MATLAB (TW 25)
2. Technical presentation based on biomedical field must be conducted (TW 25)