INTEGRAL UNIVERSITY
LUCKNOW

SYLLABUS
&
EVALUATION SCHEME

for

B.Tech. Biomedical Engineering
2nd Year onwards
(with effect from 2021-22)

STUDY & EVALUATION SCHEME
B. TECH. Biomedical Engineering
(with effect from 2021-2022)

2nd Year **3rd Semester**

S. No	Course Category	Subject Code	Name of the Subject	Periods				Evaluation Scheme				Sub. Total
								Sessional (CA)			(ESE)	
				L	T	P	C	CT	TA	Total		
1.	DC	EC231	Fundamental of Biomedical Electronics	3	1	0	4	40	20	60	40	100
2.	DC	EC232	Fundamentals of Circuits and Networks	3	1	0	4	40	20	60	40	100
3.	DC	MT201	Engineering Mathematics-III	3	1	0	4	40	20	60	40	100
4	DC	BE272	Human Anatomy and Physiology for Engineers	3	1	0	4	40	20	60	40	100
5.	ESA	CS203	Cyber Law & Information Security	2	1	0	3	40	20	60	40	100
6	DC	BE273	Biochemical Analysis and Techniques	3	1	0	4	40	20	60	40	100
7.	ESA	ES202	Disaster Management	2	1	-	3	40	20	60	40	100
8.	HM	BM226	Human Values &Professional Ethics	3	-	-	*	40*	20*	60*	40*	100*
Practicals												
9.	ESA	BE274	Human Anatomy and physiology Lab	0	0	2	1	40	20	60	40	100
10.	DC	EC233	Electronics Circuits Lab	0	0	2	1	40	20	60	40	100
11.	DC	EC249	Circuit Theory Lab	0	0	2	1	40	20	60	40	100
				22	7	6	29	400	200	600	400	1000
* A non-credit foundation course. Candidate has to pass the course by securing at least 50 % marks up to fourth semester												

L – Lecture **T** – Tutorial **P** – Practical **C** – Credits **CT** – Class Test
TA – Teacher Assessment

Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

BS – Basic Sciences**, DC** – Departmental Core, **HM** – Humanities, **OE** – Open Elective,
DE – Departmental Elective,

ESA – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

FUNDAMENTAL OF BIOMEDICAL ELECTRONICS

EC231

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Objective: To introduce the basics of various electronic components used for the construction of medical devices.

UNIT I	**Diodes** Review of PN Junction Diode- characteristics and application Special purpose diodes: Tunnel diode, Varactor Diode, Schottkey Diode, Light Emitting Diode, Laser Diode and photo voltaic cell, with their working principle and characteristics.	**8**
UNIT II	**Bipolar Junction Transistor** Review of Configuration and V I characteristics of BJT, Small signal and low frequency analysis of BJT amplifier, Darlington pair, cascode amplifier Classification of Amplifiers: Class A,B,C amplifiers, Audio Amplifiers, Power amplifier.	**8**
UNIT III	**MOSFET :** Review of device structure, operation & V I characteristic. Ohmic and saturation region equations. Classification of MOS (NMOS, PMOS, CMOS) principle of working and comparison, MOSFET as an amplifier and switch, biasing of MOS amplifier circuit, CS, CG, CD configuration using NMOS, frequency response of a single stage CS amplifier.	**8**
UNIT IV	**Feedback Amplifiers:** Basic concept of feedback, General Characteristics of negative feedback amplifiers, Classification of feedback, Voltage/Current shunt and series feedback, stability of feedback amplifiers, Multistage Amplifiers.	**8**
UNIT V	**Oscillators & Voltage Regulator Oscillators;** Condition for oscillation, generalized form of oscillator circuit, The phase shift oscillator, Hartley &Colpitt‟s oscillator. The Wein Bridge oscillator, Crystal oscillator, frequency stability. Regulated Power Supplies: SMPS,UPS (block diagram).	**8**

Books Recommended:

1. Millman&Halkias/ Integrated Electronics / McGraw-Hill Education India.
2. Sedra, and Smith,/ Microelectronic Circuits/ Oxford University Press India/ 5th Edition.
3. Diffenderfer Robert/Electronic Devices: Systems and Applications/Cengage Learning.

Reference materials:

1. Shilling & Belove Electronic Circuit/ McGraw-Hill Education India.
2. Streetman, B.G. Banerjee, Sanjay/ Solid State Electronic Devices/ PHI.
3. Salivahanan, Kumar, Suresh &Vallavraj/ Electronic Devices & Circuits/ McGraw-Hill Education India.

FUNDAMENTAL OF CIRCUITS AND NETWORKS

EC232

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Objective: To enable the students to acquire knowledge about the basics of circuit analysis, network theorems and AC circuits.

UNIT I	**Introduction** Review of D.C. & A.C. circuits,DC Circuits: Current & Voltage Source Transformation. Mesh & Node Analysis of D.C., concept of network, active and passive network	**8**
UNIT II	**Network Theorem** Superposition Theorem, Thevenin‘s Theorem, Norton‘s Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Tellegen's Theorem , Dual & Duality	**8**
UNIT III	**Circuit Analysis** Introduction to Graph Theory. Tree, link currents, branch voltages, cut set & tie set, Mesh & Node Analysis	**8**
UNIT IV	**Time and Frequency Response of Circuits:** 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.	**8**
UNIT V	**Two-Port Networks:** 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**

Books Recommended:

1. Sudhakar& S.P. Shyammohan, Circuits and Networks, Tata McGraw Hill, thirteenth reprint, 2000.
2. William H. Hayt, Jack E. Kemmerly& Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill International, sixth edition, 2202.
3. Raymond A. DeCarlo& Pen-Min Lin, Linear Circuit Analysis, Oxford University Press, second edition, 2001.

ENGINEERING MATHEMATICS-III

MT201

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Course Objectives:

The objectives of offering this course are

1. To develop the ability to solve problems usingprobability.
2. To introduce students to some of the basic methods of statistics and prepare them for further study instatistics.
3. To develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to basic probability.
4. To study the basic concepts and definitions of partial differentialequations.
5. To apply the basic series and transform for solution to partial differentialequations.
6. To provide an application oriented computation for solving wave equation, heat equation and steady state two dimensional heatflow.
7. To make students familiar with complex variable.
8. To create zeal of working with higher mathematics in the widespread field of Biomedicalengineering.
9. To introduce the basic statistical dataanalysis.

Course Outcomes:

On the successful completion of this course; student shall be able to

1. Use a statistical package, both for numerical work and to help to analyze the data required for Biomedical engineering.
2. Demonstrate an understanding of basic principles of probability, and samplespaces.
3. Know how to calculate fundamental concepts such as the cumulative distribution function, expectations, and distributions for functions of randomvariables.
4. Know how to describe distributions using graphs and numericaldescriptors.
5. Evaluate estimators, construct confidence intervals, and perform hypothesis tests in the context of a single population sample.
6. Set up probability models for a range of random phenomena, both discrete andcontinuous.
7. Solve partial differential equations corresponding to vibration and radiationphenomena.
8. Understand analytic function of a complex variable and able to apply Cauchy integral theorem and residue theorem to solve contourintegrations.
9. Find the sample regressionline.
10. Apply partial differential equations to Biomedical engineeringproblems.
11. Solve ordinary differential equations using series solutions; describe special functions as solutions to differential equations.

UNIT I	Series Solutions and Special Functions Series solutions of ODE of 2nd order with variable co-efficient with special emphasis to differential equations of Legendre and Bessel, Legendre polynomials, Bessel functions and their properties.	**8**
UNIT II	Integral Transforms Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z-transform and its application to solve difference equations.	**8**
UNIT III	Functions of a Complex Variable-I Analytic functions, C-R equations and harmonic functions, Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions, Liouville's theorem, Fundamental theorem of Algebra.	**8**
UNIT IV	Functions of a Complex Variable-II Representation of a function by power series, Taylor's and Laurent's series, singularities, zeros and poles, Residue theorem, evaluation of real integrals of type $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$, conformal mapping and bilinear transformations.	**8**
UNIT V	Statistics and Probability Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	**8**

Suggested Text / Reference Books:

1. Kreyszig E. (1993) : Advanced Engg. Mathematics John Willey & Sons inc.
2. B.S. Grewal : Higher Engineering Mathematics, Khanna Pub.
3. Dennis G. Zill : Advanced Engineering Mathematics, CBS Pub.
4. I.N. Sneddon : Partial Differential Equations, Mc Graw-Hill
5. Paopoulis : Signal Analysis 3 r d Edition (1988), Mc Graw-Hill
6. I.N. Sneddon : Use of integral transforms, Tata Mc Graw-Hill
7. W. Felser : Introduction to probability and its Applications. Wiley Eastern Pub.
8. H.K. Dass : Advanced Engineering Mathematics, (S. Chand & Company)
9. Lipschutz&Lipson,Schaum's Outline in Probability(2ndEd).
10. Colburn, Fundamentals of Probability andStatistics.
11. Advanced Ordinary & Partial Diff.Equation by M DRaisinghania.
12. Complex Variables and Applications (Brown andChurchill).
13. Probability and Statistics by N.G.Das.

HUMAN ANATOMY AND PHYSIOLOGY FOR ENGINEERS

BE272

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Course Objective:

- Students will be able to get an in-depth understanding of anatomy and physiology of the cardiovascular system (heart and blood vessel), the pulmonary system (lung), the renal system, the digestive system, the nervous system, the muscular system and the skeletal system.
- The discussion of these physiological systems will cover the levels of cell, tissue and organ.
- Students will be able to understand the corresponding structure function relationship of these physiological systems.
- Students will be able to relate the structure and function of the cardiovascular, circulatory, respiratory, excretory, nervous and digestive systems in humans.
- Make measurements on and interpret data of physiological processes in living systems.
- Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance.
- Extend students' vocabulary of anatomical concepts and terms.
- Students will understand and postulate physiological concepts based on anatomical information
- Enable students to develop their critical reasoning skills in the field of Engineering Physiology & anatomy.

Course Outcome:

- Students will be able to get an in-depth understanding of anatomy and physiology of the cardiovascular system (heart and blood vessel), the pulmonary system (lung), the renal system, the digestive system, the nervous system, the muscular system and the skeletal system
- The discussion of these physiological systems will cover the levels of cell, tissue and organ
- Students will be able to understand the corresponding structure function relationship of these physiological systems
- Students will be able to relate the structure and function of the cardiovascular, circulatory, respiratory, excretory, nervous and digestive systems in humans
- Make measurements on and interpret data of physiological processes in living systems
- Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance
- Extend students' vocabulary of anatomical concepts and terms
- Students will understand and postulate physiological concepts based on anatomical information

- Enable students to develop their critical reasoning skills in the field of Engineering Physiology & anatomy

UNIT I	**Blood Vascular system** Composition and functions of blood. Plasma proteins – normal values, origin and functions. Brief idea on Bone marrow. Formed elements of blood – origin, formation, functions and fate. Hemoglobin – functions, compounds and derivatives. Abnormal hemoglobin-overview. Erythrocyte sedimentation rate (ESR) and its significance. Hematocrit. PCV, MCV, MCH, MCHC. Blood coagulation –factors, process, anticoagulants, Prothrombin time. Clotting time. Bleeding time. Blood groups – ABO systems and Rh factors. Blood transfusion. Ultra structure & functions ofblood vessels (artery, vein, capillary). Differences between artery & vein.	**8**
UNIT II	**Cardio Vascular System** Structure & function of Heart, Anatomical position, chambers of heart, Blood circulation through heart. Special junctional tissue of heart. Cardiac cycle. Heart Sound. Systemic & pulmonary circulation. Cardiac output. Blood Pressure-regulation & controlling factors.	**8**
UNIT III	**Muscular & Skeletal System:** Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. Difference between skeletal, smooth and cardiac muscles. The sarcotubular system. Red and white striated muscle fibers. Properties of muscle: excitability and contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period. Muscle contraction – E C Coupling, Muscle fatigue, Rigor mortis, Sliding filament theory, Slow & fast muscle fibers, Isotonic & Isometric contraction. Types of Bones, Structure and Composition of Bone, Classification of Joints, Structure of Synovial Joint, Cartilage, Tendon, Ligament.	**8**
UNIT IV	**Renal System** Function of kidney, Anatomy & Histology of Nephron & collecting duet. Urine formation (Filtration, reabsorption and secretion) Counter – current system of urine concentration, Anomalies in urine concentration. **Digestive System** Organization of GI system, Digestion and Absorption, Movement of GI tract, Liver, Intestine, Pancreas, Role of Enzymes in Digestion. **Respiratory System** Respiratory Pathways, Mechanism of Respiration, Respiratory membrane and gaseous exchange, Lungs, Role of Lungs in Respiration and Thermoregulation.	**8**
UNIT V	**Neuro Physiology** Electron microscopic structure of nerve cell or neurons. Neuroglia. Myelinated and non-myelinated nerve fibers. The resting membrane potential. The action potential. Propagation of nerve impulse in different types of nerve fibers. Compound action potentials. Conduction velocity of nerve impulse in relation to myelination and diameter of nerve fibers. Synapses – types, structure, synaptic transmission of the impulse, synaptic potentials, neurotransmitters. Autonomic nervous system – Introduction. Structure of sympathetic and parasympathetic division. Neuromuscular Junction – structure, events in transmission, end-plate potential, post titanic potential. CNS- Brain and Spinalcord.	**8**

Books Recommended:

1. Essential of Medical Physiology - Anil Baran Singha Mahapatra, Current Books International
2. Human Physiology - C.C.Chatterjee, Medical Allied Agency
3. Text book of Medical Physiology- Guyton
4. Concise Medical Physiology - Chauduri
5. Anatomy and Physiology – Ross & Wilson, Churchill Livigstone publications.
6. Modern Physiology & Anatomy for Nurses - J Gibson, Black-well Scientific Publishers

Reference materials:

4. Reference material.

CYBER LAW AND INFORMATION SECURITY

CS203

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The aim of the course is to enable students to understand the implications of Information technology and the need for regulating the cyber space and the information exchange in the information super highway.

UNIT I	Fundamentals of Cyber Law: Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, Copy Right, Trademark law, Law related to semiconductor layout & design.	**8**
UNIT II	E-Commerce: Security Threats to E-Commerce, Virtual Organization, Business Transactions on Web, E-Governance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E-Agreement, Legal recognition of electronic and digital records, E-Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures-Technical issues, legal issues, Electronic Records, Digital Contracts, Requirements of Digital Signature System.	**8**
UNIT III	Investigation and Ethics: Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security treats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs. Introduction to biometric security and its challenges, Finger prints. Cyber crime forensic: CASE STUDY in Cyber Crime.	**8**
UNIT IV	Information security- Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security servicesAuthentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection.	**8**

Books Recommended:

1. Harish Chander "Cyber Law and IT Protection" , PHI Publication, New Delhi
2. Merkov, Breithaupt " Information Security", Pearson Education
3. "Cyber Law in India" - Farooq Ahmad-Pioneer books.
4. K. K. Singh, Akansha Singh "Information Security and Cyber law", Umesh Publication, Delhi

BIOCHEMICAL ANALYSIS AND TECHNIQUES

BE273

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Course Objective:

This course is intended to impart the fundamental knowledge of versatile analytical & diagnostic equipments used in the healthcare system

Course Outcome:

After completion of this course the students will be able to

1. Identify, understand and explain the working principle of basicanalytical& diagnostic equipments used in biomedical engineering domain
2. Understand and explain the working principle of Blood gas analyzers andOximeters
3. Understand and explain the working principle of Blood cell counters and Blood pressureapparatus
4. Understand and explain the working principle of Blood Flowmeters
5. Understand and explain the working principle of Pulmonary function analyzers
6. Understand and explain the working principle ofEndoscopy

UNIT I	**Clinical equipments** Principles of photometric measurement, Radiation sources, Optical filters, Colorimeter, Spectrometer , Design of Monochromators, Flame photometer, Atomic absorption spectrophotometer, Automated biochemical analyzer- Auto analyzer, Electromechanical analyzer – Chromatographs, Microscopes, Scanning Electron Microscope, Transmission Electron Microscope, Centrifuge-principles andapplications.	**8**
UNIT II	**Blood gas analyzers andOximeters** Blood pH measurement, Blood pCO2 measurement, Blood pO2 measurement, a complete blood gas analyzer, Fiber optic based blood gas sensors, Oximetry, Principles of oximetric measurements, Ear oximeter, Pulse oximeter, Intravascular oximeter.	**8**
UNIT III	**Blood cell counters and Blood pressure apparatus** Methods of cell counting, Flow cytometry, Coulter Counters, automatic recognition and differential counting of cells, Sphygmomanometer, Automated indirect and specific direct method of B.P. monitor.	**8**
UNIT IV	**Blood Flow meters** Electromagnetic blood flow meter, Ultrasonic blood flow meter-Transit time and Doppler blood flow meter, Cardiac output measurement-Dye dilution method and Impedancetechnique.	**8**

	Pulmonary function analyzers Respiratory volumes and capacities, Compliance and related pressure, Spirometer, Pneumo-tachometer, impedance pneumograph / plethysmograph, apnea detector.	
UNIT V	**Endoscopy** Basic endoscopic equipments, Fibreoptic instruments and video-endoscopes, Accessories-illumination, instrument tips, instrument channels, tissue sampling devices, suction traps and fluid-flushing devices,Various endoscopic applications. Maintenance and Storage.	**8**

Text Books:

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGrawHill.
2. J.J.Carr&J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education,Asia.

3. Cromwell, Weibell& Pfeiffer, “Biomedical Instrumentation & Measurement”, Prentice Hall,India

References:

1. Joseph Bronzino, “Biomedical Engineering and Instrumentation”, PWS Engg . ,Boston.
2. J.Webster, “Bioinstrumentation”, Wiley &Sons.
3. Joseph D.Bronzino, “The Biomedical Engineering handbook”, CRCPress.

DISASTER MANAGEMENT

ES202

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The objective of this course is to familiarize the student with basic management principles relating to disaster management and mitigation techniques.

UNIT I	Concept of disaster management. Types of disaster and their impact: Natural and Man- Made, Like- Earthquakes, Floods, Tsunami, Droughts, Cyclones, Avalanches, Forest Fire, Terrorism related Disaster etc. Assessment of human and Economic losses.	**8**
UNIT II	Impact of extensive Industrialization. Impact of Global Warming and Environmental Degradation. National and global disasters.	**8**
UNIT III	National policy for disaster Management, Elementary Knowledge of the Disaster Management Act 2005. Types of Responses: Central, State, District Level, Peoples Community participation in Disaster Management. Post-Disaster Management and Rehabilitation measures.	**8**
UNIT IV	Capacity Building for meeting disasters. Long term measures for preventions of disasters. Mitigation technique/strategies: Early warning systems, Data sharing at national and international level.	**8**

Books Recommended:

1. Disaster management by Dr. V.K. Sethi.
2. The great Sumatra Earthquakes and Indian Ocean tsunami of December 2004- the effects of main land India and in the Andaman and Nicobar Island, published by IIT Kanpur.
3. Environmental management by Dr. Shakeel Ahmad
4. Hazards, disasters and your community, ministry of home affairs.

HUMAN VALUES & PROFESSIONAL ETHICS

BM226

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	0	0	0

Objective:

UNIT I	Human Value Education: Understanding the need, basic guidelines, content and process for Value Education, Self Exploration - Its content and process; 'Natural Acceptance' and Experiential Validationas the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly.	**8**
UNIT II	Introduction to Ethical Concept: Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law	**8**
UNIT III	Professional Responsibility: The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, hazards and risks.	**8**
UNIT IV	Engineers Ethics: Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment.	**8**
UNIT V	Global Issues: A Glimpse of Life Stories: Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs. Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership	**8**

Reference Readings:

Text Book

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA

HUMAN ANATOMY AND PHYSIOLOGY LAB

BE274

Pre-requisite	Co-requisite	L	T	P	C
None	None	**0**	**0**	**2**	**1**

Objectives:

1. The objective of Engineering Physiology & Anatomy Laboratory class is to understand the practical aspects of the body's internal organs and how they function.
2. Provide an active learning environment to teach the basic principles of human physiology & anatomy.
3. Teach students the principles of experimental documentation in a laboratory notebook.
4. Provide students with a hands on opportunity to use commonly used physiological variables measuring equipments.
5. Promote and encourage team work and collaboration among students in the lab.
6. Students are encouraged to create additional test conditions and run additional experiments during the lab time that extend from the guided lesson plan.

Outcome:

1. Develop a visual knowledge of body structure at the cellular, tissue, organ, & system levels.
2. Understand the gross & microscopic approach to Anatomy & Physiology.
3. Provide the students with all necessary lab tools such as anatomical models, histology slides as well as experimental & physiological problems that promote the critical understanding of the human body.
4. Familiarize the students with a variety of lab assignments, help visualize most of the anatomical models of all the body systems that have been covered in the Anatomy & Physiology course.

Experiment 1	Study on Compound Microscope.	**4**
Experiment 2	Identification of fixed histological slides: Cerebellum, Cerebral cortex, Spinal cord, Renal tissues, Blood vessels (artery & vein), Skin, Tongue, Liver.	**4**
Experiment 3	Hemoglobin estimation.	**2**
Experiment 4	Determination of blood pressure.	**2**
Experiment 5	Blood film making & identification of different blood corpuscle.	**2**
Experiment 6	ECG wave identification.	**2**
Experiment 7	DC of WBC.	**2**
Experiment 8	Determination of Blood Group (ABO; Rh).	**2**
Experiment 9	Measurement of Bleeding Time (BT) & Clotting Time (CT).	**2**

ELECTRONICS CIRCUITS LAB
EC233

Pre-requisite	Co-requisite	L	T	P	C
None	None	**0**	**0**	**2**	**1**

Course Objective:

1. To understand application of p-n junction Diode, Zener diode , Rectifieretc.
2. To analyze the performance of multistage amplifier and poweramplifier
3. To study and analyze the performance ofmulti-vibrators
4. To understand application of OP AMP

Course Outcome:

After learning this subject, students will be able to

1. Design voltage regulator using ZenerDiode
2. Design a DC voltage supplycircuit
3. Design and analyze amplifier circuit usingtransistor
4. Design different Wave Form generatorcircuit
5. Design and analyze different circuits using OPAMP
6. Design different filter circuits and study theirperformance

List of Experiments:

1. Study of Diode as clipper &clamper
2. Study of Zener diode as a voltageregulator
3. Study of ripple and regulation characteristics of full wave rectifier without and with capacitorfilter
4. Study of characteristics curves ofB.J.T
5. Construction of a two-stage R-C coupled amplifier & study of it'sgain.
6. Study of class A & class B poweramplifiers.
7. Study of timer circuit using NE555 & configuration for monostable&astablemulti-vibrator.
8. Construction & study of RC phase shiftoscillator.
9. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator ICchip.
10. Construction of a simple function generator usingIC.

CIRCUITS THEORY LABORATORY

EC249

Pre-requisite	Co-requisite	L	T	P	C
None	None	**0**	**0**	**2**	**1**

Course Objective

1. To familiarize students MATLAB Software and its application in circuitanalysis.
2. To introduce students in evaluating electrical parameters in resonant circuits usingMATLAB.
3. To implement MATLAB in verification of Networktheorems.
4. To familiarize students in measuring electrical parameters in transient circuits usingMATLAB.
5. To introduce students with the generation of various waveforms usingMATLAB.
6. To apply MATAB in evaluating impedance and admittance parameters in acircuit.
7. To familiarize students with poles & zeros concepts and the techniques in evaluating thesame.
8. To enumerate application of Laplace transform and its inverse in analysis ofcircuits.

Course Outcome

After completion of this course the students will be able to

1. Describe Analyze and Design series and parallel RLC circuits usingMATLAB.
2. Analyze circuits using Node Voltage & Mesh Current Analysis in electrical networks usingMATLAB.
3. Verify and analyze Network Theorems to electrical networks usingMATLAB.
4. Understand Describe, Analyze and Design Graph and Trees for a given network and solve related problems using MATLAB.
5. Understand Analyze and Design Coupled Circuits and solve related problem usingMATLAB.
6. Understand, Describe and Analyze the Transients in electrical networks and solve related problems usingMATLAB
7. Implement Laplace Transform and its Inverse transform on various waveforms usingMATLAB

Implementation of Following Experiments using Software (e.g. MATLAB/Pspice) or Hardware

1. Characteristics of Series & Parallel Resonantcircuits
2. Verification of NetworkTheorems
3. Transient Response in R-L & R-C Networks ; simulation /hardware
4. Transient Response in RLC Series & Parallel Circuits & Networks; simulation /hardware
5. Determination of Impedance (Z), and Admittance (Y) parameters of Two-portnetworks
6. Generation of periodic, exponential, sinusoidal, damped sinusoidal, step, impulse, and Rampsignals.
7. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion ins-domain.
8. Determination of Laplace Transform, different time domain functions, and Inverse LaplaceTransformation.

STUDY & EVALUATION SCHEME
B. TECH. Biomedical Engineering
(with effect from 2021-2022)

2nd Year **4th Semester**

S No	Course Category	Subject Code	Name of the Subject	Periods and Credits				Evaluation Scheme				Subject Total
								Sessional (CA)			(ESE)	
				L	T	P	C	CT	TA	Total		
1.	DC	BE275	Biomechanics	3	1	0	4	40	20	60	40	100
2.	DC	BE276	Biomedical Signals and Systems	3	1	0	4	40	20	60	40	100
3.	DC*	EC235	Digital Logic circuits for Clinical Engineers	2	1	0	3	40	20	60	40	100
4.	DC*	EC239	Biomedical Sensors and Measurement	2	1	0	3	40	20	60	40	100
5.	DC	BE277	Biomaterials and Artificial Organs	3	1	0	4	40	20	60	40	100
6.	ESA	BM227	Management concepts in engineering	2	1	0	3	40	20	60	40	100
Practicals												
7	DC*	EC237	Digital Logic Lab	0	0	2	1	40	20	60	40	100
8	DC*	EC238	Bio Instrumentation Lab	0	0	2	1	40	20	60	40	100
9	DC	BE278	Biomaterials & Biomechanics Laboratory	0	0	2	1	40	20	60	40	100
Total				15	6	6	24	360	180	540	360	900
* An inter-disciplinary program offered by the Department of Bioengineering in association with the Department of Electronics and Communication Engineering.												

L – Lecture **T** – Tutorial **P** – Practical **C – Credits** **CT** – Class Test **TA** – Teacher Assessment

Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

BS – Basic Sciences**, DC** – Departmental Core, **HM** – Humanities, **OE** – Open Elective, **DE** – Departmental Elective,

ESA – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

BIOMECHANICS

BE275

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Course Objective:

1. To describe the fundamental of biomechanics.
2. To Study the deformability, strength, visco elasticity of bone and flexible tissues, modes of loading and failure.
3. To describe the types and mechanics of skeletal joints.
4. To describe movement precisely, using well defined terms (*kinematics*) and also to consider the role of force in movement (*kinetics*).
5. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
6. To teach students approximation methods in fluid mechanics and their constraints.
7. To consider the mechanics of orthopedic implants and joint replacement , mechanical properties of blood vessels and Alveoli mechanics

Course Outcomes:

After completion of the course student will be able to

1. Understand and describe the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments.
2. Gain broad knowledge about the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement of the human body.
3. Be able to computationally analyze the dynamics of human movement from the most commonly used measurement devices in the field, such as motion capture and force platform systems.
4. Use knowledge gained to competently interpret the current understanding of human movement and present recommendations for further study.

UNIT I	**Introduction to Biomechanics** Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplaner & Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.	**8**
UNIT II	**Tissue Biomechanics** **Hard Tissues:** Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Electrical properties of bone, type of fractures, biomechanics of fracture healing. **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modeling: Cartilage, Tendon, Ligament, and Muscle.	**8**

UNIT III	**Joints Biomechanics:** Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. **Movement Biomechanics** Gait analysis, body & limbs: mass & motion characteristics actions, forces transmitted by joints. Joints forces results in the normal & disable human body, normal & fast gait on the level. Patterns: Push/Throw Continuum Biomechanics of push - like motions, Biomechanics of throw - like motions.	**8**
UNIT IV	**Cardiac & Respiratory Mechanics** Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. artificial heart valves, biological and mechanical valves development, testing of valves. Alveoli mechanics, Interaction of blood and lung, P-V curve of lung, Breathing mechanism, Airway resistance, Physics of lung diseases. **Biofluid Mechanics** Newton's law, stress, strain, elasticity, Hooke's law, viscosity, Newtonian fluid, Non- Newtonian fluid, viscoelastic fluids, Vascular tree. Relationship between diameters, Velocity and pressure of blood flow, Resistance against flow.	**8**
UNIT V	**Implant Mechanics:** General concepts of Implants, classification of implants, Soft tissues replacements and Hard tissue replacements, basic consideration and limitation of tissue replacement, Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.	**8**

Text Books

1. R. M. Kennedy, A textbook of Biomedical Engineering, GTU, 2010
2. Richard Shalak & Shu Chien, Handbook of Bioengineering,
3. Sean P. Flanagan, Flanagan, Biomechanics: A case based Approach, Jones & Bartlett Publishers, 2013
4. Y. C. Fung, Yuan-Cheng Fung, Biomechanics: mechanical Property of living Tissue, Springer, 1996.
5. Carol A. Oatis, The Mechanics and Patho-mechanics of Human Movement, Lippincott Williams & Wilkins, 2010
6. Sean P. Flanagan, Flanagan, Biomechanics: A Case Based Approach, Jones & Bartlett Publishers, 2013.

Reference Books

1. Prof. Ghista,Biomechanics, Private Publication UAF, 2009
2. White &Puyator, Biomechanics, Private publication UAE, 2010

BIOMEDICAL SIGNALS AND SYSTEMS

BE276

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Objective: To purpose of learning this course on biomedical signals and systems for biomedical engineering students is to acquire knowledge for analyzing the continuous time discrete time signals & systems and its biosignal applications.

UNIT I	**Basics of signals** Signal Classification; continuous time versus discrete time, periodic versus not periodic, analog versus digital, deterministic versus random, Basic signals; Sinusoidal, exponential, unit impulse, unit step, unit Ramp, Mathematical operations on signals; scaling, folding, time shifting, addition, multiplication, convolution, correlation	**8**
UNIT II	**Basics of systems** Classification of systems: static and dynamic systems, timeinvariant and time variant, linear and nonlinear systems,causal and non-causal systems, stable and unstable systems, Linear Time invariant systems (LTI) representation; impulse response, transfer function, constant coefficient differential equation	**8**
UNIT III	**Analysis of Continuous Time Signals and System** Fourier series analysis; complex formFourier transform; properties Relation between Laplace transform and Fourier transform, Fourier transform application to LTI systems	**10**
UNIT IV	**Analysis of discrete Time Signals and System** Sampling Theorem; ideal sampling and reconstructionZ transform; properties, region of convergence (ROC)- representationof poles and zeros in z transformRelation between Z transform and DTFT Z transform application to LTI systems	**6**
UNIT V	**Application to Bio Signals** Introduction, Characteristics of Bio–Signals, Types of Signals, Measurement, Transformation and reduction, Application areas of Bio - Signals analysis – EEG, ECG, Phonocardiogram,	**8**

Books Recommended:

1. Allan V. Oppenheim, Alan S. Willsky and S. Hamid, "*Signals and systems"*, Prentice Hall of India Pvt.Ltd, 2nd edition, 1997.

Reference materials:

1. M.J. Roberts, *"Signals and Systems: Analysis using transform methods & MATLAB*" Tata McGraw Hill,2nd edition, 2007.
2. Suresh R, Devashayam, *"Signals and Systems in Biomedical Engineering",* Springer US, 2nd edition,

DIGITAL LOGIC CIRUITS FOR CLINICAL ENGINEERS

EC235

Pre-requisite	Co-requisite	L	T	P	C
None	**None**	**2**	**1**	**0**	**3**

Objective: To impart knowledge of digital logic circuits for and its application in the bio-medical field.

UNIT I	**Boolean Algebra and Logic gates** Review of Number system: Binary, Octal, Hexadecimal number system, Complements Logic gates, Boolean algebra postulates and theorems, Boolean function minimization:, Karnaugh map, QuineMcCluskey method	**8**
UNIT II	**Combinational Circuit** Analysis and design of combinational circuit, Half adder and full adder circuits, parallel adder /Subtractor, magnitude comparator Encoder and decoder, Multiplexer and de-multiplexer,	**8**
UNIT III	**Sequential Circuit** Latches, Flip Flops; JK, D,T, Characteristics table and equation Analysis and design of clocked sequential circuits 4 bit shift register Counters: Modulo N counter, ring counter, ripple counter	**8**
UNIT IV	**Logic families and Memory** Logic family characteristics and their comparison, Types of Memory: RAM, ROM, PLD's **Medical Applications** Digital Blood pressure Monitor, Digital Blood Glucose monitor, Digital thermometer, Heart rate Monitor Digital stethoscope, Hearing Aid	**8**

Books Recommended:

1. M.Morris Mano and Michael D.Ciletti, "Digital design", Pearson, 5th edition 2013.William H. Hayt, Jack e. Kemmerly& Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill International, sixth edition, 2202.
2. Thomas L. Floyd, "Digital fundamentals", Pearson, 11th edition 2015.

Reference materials:

1. https://www.nxp.com/applications/solutions/internet-of-things/smart-things/healthcare:HEALTHCARE-MEDICAL

BIOMEDICALSENSORS AND MEASUREMENT

EC239

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: To impart adequate knowledge about the sensors and measuring instruments used for measurement and detection of physical quantities.

UNIT I	**Standards and Measuring errors** Scientific notations and metric prefixes. SI electrical units, SI temperature scales, Other unit systems, dimensions and standards. Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, PMMC instrument, Galvanometer, Conversion to ammeter and voltmeter	**8**
UNIT II	**Transducer** Classification of transducers and characteristics for selection of transducers, Resistive transducers, Inductive transducers, Capacitive transducers, Piezoelectric effect transducer, Thermoelectric Transducers	**8**
UNIT III	**Multimeter and CRO** Digital voltmeter systems, Digital multimeter CRT, Wave Form Display, Time Base, Dual Trace Oscilloscope, measurement of voltage, frequency and phase by CRO, DSO, DSO applications.	**8**
UNIT IV	**Medical Applications of Sensors:** Biosensors: Principles and, classification,Optical biosensors for measurement of blood glucose level, Smart sensor, Electronic nose.	**8**

Books Recommended:

1. David A. Bell, “Electronic Instrumentation and Measurements”, Oxford University Press
2. Sawhney A.K, “A Course in electrical and electronic measurements and instrumentation”, DhanpatRai & Co (P) Ltd, Educational and Technical Publishers, 19th Revised edition 2011

Reference materials:

1. Patranabis D, “Sensors and transducers”, PHI, 2nd edition,2004.
2. R.S. Khanpur, “Handbook of Biomedical Instrumentation” Tata McGraw Hill
3. H.E. Thomas, “Handbook of Biomedical Instrumentation and Measurement” Restone Publishing Company

BIOMATERIALS AND ARTIFICALS ORGANS

BE277

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Course Objectives:

- The student would be able to learn characteristics and classification of Biomaterials.
- Understand the characteristics of different metals and ceramics used as biomaterials.
- Understand polymeric materials, composites and combinations that could be used as a tissue replacement implants.
- Students should be able to understand how to develop artificial organ using these materials.
- Instill a fundamental understanding of the properties and applications of biomaterials, both natural and synthetic that are used in contact with biological systems in the area of various tissues and organ replacement.
- To acquaint students with the interactions between biomaterials and the human body that lead to failure of devices.
- This course presents a balanced perspective on the evolving discipline of Biomaterials Science by including information on hard biomaterials and soft biomaterials, orthopedic ideas, cardiovascular concepts, ophthalmologic ideas, and dental issues.
- Demonstrate in-depth knowledge of the mechanical and biological properties of both natural and synthetic biomaterials used in implant design and artificial tissue or organ making.
- Describe the role of adsorbed proteins and cells in the tissue response to biomaterials.
- Demonstrate an understanding of the host response to implant biomaterials and be able to compare the responses to different materials.
- Describe the methods of testing for biomaterials biocompatibility.
- Distinguish the events that lead to the degradation of materials in the biological environment.
- Demonstrate an in-depth knowledge of the application of biomaterials, both natural and synthetic, in implant design and artificial tissue or organ making.
- Demonstrate an understanding of implant failure from a biological perspective.
- Appreciate the complex mechanical and biological interactions between biomaterials and biological systems.
- Gain a solid appreciation for the special significance of the word biomaterial as well as the rapid and exciting evolution and expansion of biomaterials science and its applications in health care.

Course Outcome:

- Identify and understand the main terms largely used in biomaterials literature, basic properties of various biomaterials, correctly associate terms with processes/phenomena, and be able to correlate related events.
- Able to design basic tissue or organ replacement implants using clear understanding of Biomaterials as tools of Biomedical Implant Engineering.
- They will be able to apply knowledge in the design of various biocompatible implants and artificial organ to develop and improve Health Care Service and will be able to serve mankind and society.
- Include a balance of fundamental biological concepts, materials science background, medical/clinical concerns, as well as coverage of biomaterials past, present, and future.
- Develop an ability to identify, formulate, and solve engineering problems, particularly in the context of biomaterials selection and design.
- An ability to understand environmental considerations and sustainable engineering solutions in the field of Biomaterials.

- Develop an ability to understand professional ethics and legal issues related to Biomaterials, Implant design and artificial tissue grafting.
- Develop an ability to function effectively as an individual and a member in diverse team.

UNIT I	Introduction: Definition of biomaterials, requirements of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties. Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress- corrosion cracking. Host tissue reaction with biometal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Heart valve implants-Tailor made composite in medium.	**8**
UNIT II	Polymeric implant materials: Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. (Classification according to thermosets, thermoplastics and elastomers). Viscoelastic behavior: creep-recovery, stress relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications.	**8**
UNIT III	Ceramic implant materials: Definition of bioceramics. Common types of bioceramics: Aluminium oxides, Glass ceramics, Carbons. Bioresorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.	**8**
UNIT IV	Biocompatibility & toxicological screening of biomaterials: Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intra-cutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests. Sterilization techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties.	**8**
UNIT V	Testing of biomaterials/Implants: In vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness. In-vivo testing (animals): biological performance of implants. Ex- vivo testing: in vitro testing simulating the in vivo conditions. Standards of implant materials.	**8**

Books Recommended:

1. J B Park, Biomaterials - Science and Engineering, Plenum Press , 1984.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. Bronzino JD, ed. The Biomedical Engineering Handbook, Second Edition, Vol-II, CRC Press

Reference materials:

1. Jonathan Black, Biological Performance of materials, Marcel Decker, 1981
2. C.P.Sharma & M.Szycher, Blood compatible materials and devices, Tech.Pub.Co. Ltd., 1991.
3. Piskin and A S Hoffmann, Polymeric Biomaterials (Eds), Martinus Nijhoff Publishers.
4. Eugene D. Goldbera , Biomedical Ploymers, Akio Nakajima.
5. L. Hench & E. C. Ethridge, Biomaterials - An Interfacial approach.
6. Buddy D.Ratner, Allan S. Hoffman, Biomaterial Sciences – Int. to Materials in Medicine
7. Frederick H. Silver, Biomaterials, Medical devices and Tissue Engineering, Chapman & Hall

MANAGEMENT CONCEPTS IN ENGINEERING

BM227

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The objective of this course is to provide fundamental knowledge about management strategies and leadership qualities required in managing technical manufacturing organizations.

UNIT I	**CONCEPTS OF MANAGEMENT:** Definition, Nature, Scope and significance of Management, the evolution of Management thought, contributions of F.W. Taylor, Henri Fayol and Chester Bernard to Management Science. Functions of Management,Values and Ethics in Management.	**8**
UNIT II	**PLANNING:** Definition, Objectives, Steps of Planning, The process and techniques of Decision Making, Strategies and policies. Management by objectives.	**8**
UNIT III	**ORGANISATION & DIRECTING:** Definition, Line and Staff relationship. Delegation and Decentralization, Committee system, Issues in managing Human factors, Motivation: theories of Motivation. Leadership: Concept, Nature, Styles. Decision making: Concept, Nature, Process, Tools & techniques	**8**
UNIT IV	**CONTROLLING:** Definition and Elements Control Techniques, Coordination, Determinants of an Effective Control System, Managerial Effectiveness. **ECONOMIC & FINANCIAL ANALYSIS:** National Income, Inflation, GDP & Interest rates. Financial Function & Goals, Financial Statement & Ratio Analysis.	**8**

Books Recommended:

1. Stoner Freeman & Gilbert Jr , Management, Prentice Hall of India, 6th Edition.
2. Koontz, Principles of Management, Tata Mc Graw Hill, Ist Edition 2008.
3. Robbins & Coulter, Management, Prentice Hall of India, 8th Edition.
4. Robbins S.P. & Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
5. Hillier Frederick S. & Hillier Mark S., Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets, Tata McGraw Hill, 2008

DIGITAL LOGIC LAB

EC237

Pre-requisite	Co-requisite	L	T	P	C
None	None	0	0	2	1

Course Objective:

1. To familiarize students with different Digital ICs corresponding to different logicgates
2. To show the working operation of basic logic gates & Universal logicgates.
3. To familiarize students with the design of combinationalcircuits.
4. To introduce students with basic components of sequentialcircuits.
5. To familiarize students with the design of sequentialcircuits.

Course Outcome:

1. Understand and describe Digital ICs of different logicgates.
2. Describe, design and analyze combinationalcircuits.
3. Describe, design and analyze sequentialcircuits.

List of Experiments

1. Familiarization with different digitalICs.
2. Realization of different gates like AND, OR, NOT, NAND, NOR, EX-OR andEX-NOR.
3. Realization of basic gates using universal logicgates.
4. Grey Code to Binary Code Conversion and ViceVersa.
5. Code Conversion between BCD and Excess-3
6. Four-bit parity generator and comparatorcircuits.
7. Construction of simple Decoder and Multiplexer circuits using logic gates.
8. Construction of simple arithmetic circuits-Adder,Subtractor.
9. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display usingmultiplexer.
10. Realization of RS-JK and D flip-flops using Universal logicgates.
11. Realization of Universal Register using JK flip-flops and logicgates.
12. Realization of Universal Register using multiplexer and flip-flops.
13. Realization of Asynchronous Up/Downcounter.

BIOMEDICAL INSTRUMENTATION LAB

EC238

Pre-requisite	Co-requisite	L	T	P	C
None	None	0	0	2	1

Course Objective

1. To familiarize students with the operation of DC to DC converter & itsapplication.
2. To introduce students with timer circuits & heart-ratemeter.
3. To emphasis on the study of EMG, ECG, EEG & PCG waveform &analysis.
4. To familiarize students with the design of bio-potentialamplifiers.
5. To introduce students with basic operation of X-ray system.
6. To introduce students on the study of isolation ofbio-signals.

Course Outcome

After completion of this course the students will be able to

1. Understand and implement isolation techniques in designing biomedicalinstruments.
2. Measure and Analyze EMG, ECG, EEG and PCG waveforms in diagnostic point ofviews
3. Measure and Analyze QRS components from diagnostic point ofview.
4. Design and analyze the characteristics of Bio-potentialamplifiers.
5. Understand & describe the basic operation of an X-raysystem.
6. Measure heart rate meter using F-VConverter.
7. Measure ON-Time & OFF-Time delay of a waveform using Timercircuit.

List of experiments:

1. Power isolation: isolation transformer and DC-DCconverters
2. Timer circuits: ON delay and OFF delaystudy
3. Measurement of heart rate using F-Vconverter
4. ECG processing andanalysis
5. EMG processing andanalysis
6. EEG processing andanalysis
7. Detection of QRS component from ECGsignals
8. Study on InstrumentationAmplifier-Design
9. Study on X-ray radiography systems / X-raysimulator
10. Characterization of bio-potential amplifier for ECG & EMGsignals
11. PCG processing and analysis / electronics stethoscope
12. Isolation of bio-signal (EMG /ECG)