SEMESTER V

S.No.	Course Code	Category	Course Title	L	T	P	C
Theory							
1	BM20501	PC	Biomechanics	3	0	0	3
2	BM20502	PC	Biomedical Signal Processing	3	0	0	3
3	BM20503	PC	Microprocessor and Microcontroller	3	0	0	3
4	BM20504	PC	Biomaterials	3	0	0	3
5	BM20505	PC	Diagnostic and Therapeutic Equipment I	3	0	0	3
6	BM2015*	PE	Professional Elective I	3	0	0	3
Practical							
7	BM20506	PC	Microprocessor and Microcontroller Laboratory	0	0	4	2
8	BM20507	PC	Biomedical Signal Processing Laboratory	0	0	4	2
9	EN20501	EE	Career Development Laboratory I	0	0	2	1
			Total	**18**	**0**	**10**	**23**
			Cumulative Total				**107**

SEMESTER VI

S.No.	Course Code	Category	Course Title	L	T	P	C
Theory							
1	BM20601	PC	Human Assist Devices	3	0	0	3
2	BM20602	PC	Healthcare and Hospital Management	3	0	0	3
3	BM20603	PC	Diagnostic and Therapeutic Equipment II	3	0	0	3
4	BM20604	PC	Biocontrol Systems	3	0	0	3
5	BM2025*	PE	Professional Elective II	3	0	0	3
6	BM2090*	OE	Open Elective I	3	0	0	3
Practical							
7	BM20605	PC	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
8	BM20606	EE	Design Project	0	0	4	2
9	EN20601	EE	Career Development Laboratory II	0	0	2	1
			Total	**18**	**0**	**10**	**23**
			Cumulative Total				**130**

PROFESSIONAL ELECTIVE COURSES (PE)

S.No.	Category	Course Code	Course Title	L	T	P	C
V Semester Elective - PE I							
1	PE	BM20151	Biomedical Informatics	3	0	0	3
2	PE	BM20152	Virtual Bioinstrumentation	3	0	0	3
3	PE	BM20153	BioMEMS	3	0	0	3
4	PE	BM20154	Medical Optics	3	0	0	3
VI Semester Elective - PE II							
5	PE	BM20251	Telemedicine and Picture Archiving Communication System	3	0	0	3
6	PE	BM20252	Advanced Medical Instrumentation Technology	3	0	0	3
7	PE	BM20253	Pattern Recognition and Neural Networks	3	0	0	3
8	PE	BM20254	Advanced Medical Signal Processing	3	0	0	3
VII Semester Elective - PE III							
9	PE	BM20351	Fundamentals of Biomedical Nanotechnology	3	0	0	3
10	PE	BM20352	Tissue Engineering	3	0	0	3
11	PE	BM20353	Telehealth Technology	3	0	0	3
12	PE	BM20354	Design and Development of Medical Devices	3	0	0	3
VII Semester Elective - PE IV							
13	PE	BM20451	Medical Optics and Laser Applications	3	0	0	3
14	PE	BM20452	Medical Ethics Standards and Safety	3	0	0	3
15	PE	BM20453	Advanced Healthcare System Design	3	0	0	3
16	PE	BM20454	Artificial Intelligence for Biomedical Engineering	3	0	0	3
VIII Semester Elective - PE V							
17	PE	BM20551	Artificial Organs and Implants	3	0	0	3
18	PE	BM20552	Embedded Systems and Internet of Things in Healthcare	3	0	0	3
19	PE	BM20553	Physiological Modelling	3	0	0	3
20	PE	BM20554	Robotics and Automation in Medicine	3	0	0	3
VIII Semester Elective - PE VI							
21	PE	BM20651	Virtual Reality in Medicine	3	0	0	3
22	PE	BM20652	Wearable Devices and its Application	3	0	0	3

23	PE	BM20653	Quality Control in Biomedical Engineering	3	0	0	3
24	PE	BM20654	Medical Radiation Safety	3	0	0	3

OPEN ELECTIVE COURSES (OE)

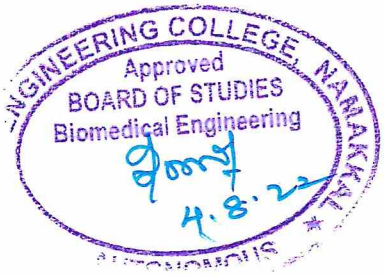
S.No.	Category	Course Code	Course Title	L	T	P	C
VI Semester Open Elective (OE) - I							
1	OE	BM20901	Industrial Nanotechnology	3	0	0	3
2	OE	BM20902	Biomedical Waste Management	3	0	0	3
VII Semester Open Elective (OE) - II							
3	OE	BM20903	Basics of Telemedicine	3	0	0	3
4	OE	BM20904	Patient and Device Safety	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	EE	EN20401	English Proficiency Course Laboratory	0	0	2	1
2	EE	EN20501	Career Development Laboratory I	0	0	2	1
3	EE	EN20601	Career Development Laboratory II	0	0	2	1
4	EE	BM20606	Design Project	0	0	4	2
5	EE	BM20703	Hospital Internship Training	0	0	2	1
6	EE	BM20705	Project Work (Phase I)	0	0	6	3
7	EE	BM20801	Project Work (Phase II)	0	0	12	6

HUMANITIES AND SOCIAL SCIENCES (HS)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	HS	EN20101	English Communication Skills I	3	0	0	3
2	HS	EN20201	English Communication skills II	3	0	0	3
3	HS	BA20151	Entrepreneurship Development	3	0	0	3



BM20501 **BIOMECHANICS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- explain the basic principles of mechanics in various applications.
- discuss the mechanics of physiological systems.
- elaborate about bio solid mechanics.
- describe the structure, movements and various loads applied on the hip, knee and soft tissues.
- illustrate the mathematical models used in the analysis of biomechanical systems.

UNIT I INTRODUCTION TO MECHANICS **10**

Introduction - Scalars and vectors, Statics; Forces - Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination; Dynamics - Basic principles, Linear motion, Newton's laws of motion, Impulse and Momentum; Work and Energy Kinetics - Velocity and acceleration; Kinematics - Link segment models; Force transducers, Force plates; Introduction to Constitutive equations - Constitutive equations of Non-viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid, Anthropometry.

UNIT II BIOFLUID MECHANICS **10**

Intrinsic fluid properties - Density, Viscosity, Compressibility and Surface Tension; Viscometers - Capillary, Coaxial cylinder and cone and plate; Rheological properties of blood Pressure - Flow relationship for Non-Newtonian Fluids; Fluid mechanics in straight tube - Steady Laminar flow, Turbulent flow, Viscous and Turbulent Sheer Stress; Effect of Pulsatility - Structure of blood vessels, Material properties and Modeling of Blood vessels; Heart - Cardiac muscle characterization; Native heart valves - Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics, Shear-stresses in extra-corporeal circuits.

UNIT III BIOSOLID MECHANICS **10**

Constitutive equation of visco elasticity - Maxwell and Voight models, Anisotropy, Fatigue analysis; Hard Tissues - Definition of stress & strain, Deformation mechanics, Bone structure & composition, Mechanical properties of bone, Cortical and Cancellous Bone; Blood circulation - Elasticity and Strength, Visco elastic properties, Functional adaptation; Soft Tissues - Structure, Functions, Material properties and Modeling of Soft Tissues, Cartilage, Tendons and Ligaments Skeletal Muscle, Hodgkin Huxley model; Mechanical testing of Soft tissue; Muscle action – Hill's models, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS **8**

Skeletal joints, Forces and Stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagram, Structure of joints, Types of joints, Biomechanical analysis of elbow, Shoulder, Spinal column, Hip, Knee and Ankle, Lubrication of synovial joints, Parameterization and Gait analysis, Motion analysis using video.

UNIT V MATHEMATICAL MODELS 7

Introduction to Finite Element Analysis; Mathematical models - Pulse wave velocities in arteries, Measurement/ Estimation of in-vivo elasticity of blood vessel, Dynamics of fluid filled catheters.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- illustrate the basic principles of mechanics in various applications.
- summarize the mechanics of physiological systems.
- determine biosolid mechanics.
- categorize the structure, movements and various loads applied on the hip,knee and soft tissues.
- illustrate the mathematical models used in the analysis of biomechanical systems.

TEXT BOOKS

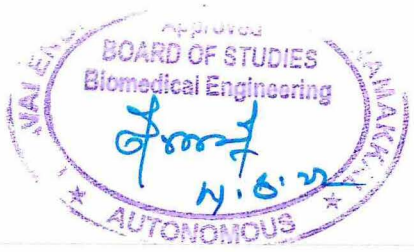
1. Y.G.Fung, Biomechanics, Springer-ver lag New York Inc, 2010.
2. Joseph D. Bronzino, "Biomedical Engineering Fundamentals", Taylor&Francis,2017.

REFERENCES

1. Susan J Hall, "Basics of Biomechanics'', Mc GrawHillPublishing.co.NewYork, 8thEdition, 2019.
2. C.Ross Ether and Craig A. Simmons,"Introductory Biomechanics from cells to organisms", Cambridge University Press,NewDelhi,2013.
3. Paul Brinckmann, Wolfgang Frobin; GunnarLeivseth; Burkhard Drerup, "Orthopaedic Biomechanics", 2ndedition, 2016.
4. Duane Knudson, "Fundamentals of Biomechanics", ,springer 2nd edition, 2007.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		3	3	3	3	3		2			3	3	3
CO2	2		3	3	3		3	2	2			2	3	2
CO3	3		3	2	3		2					2	3	
CO4	2		3	3	3		2	2	2			3	3	
CO5	3		3	3	2		2					3	3	2



BM20502 **BIOMEDICAL SIGNAL PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand the concept of DIF and DIT for the analysis of biosignal and system.
- choose the IIR Filter in frequency domain.
- learn to design the FIR filter in frequency domain.
- utilize the concepts acquired through cardio-vascular applications.
- utilize the concepts acquired through neurological applications and signal classification.

UNIT I FUNDAMENTALS OF SIGNAL PROCESSING **9**

Basics - Sampling and Aliasing, Simple signal conversion systems, Spectral analysis; FFT - Decimation In Time algorithm, Decimation in Frequency algorithm; Objectives of Biomedical signal analysis; Bio electric signals and its basic characteristics - Bio signal Characteristics of Electro gastrogram (EGG), Event Related Potentials (ERPs), Speech signal.

UNIT II INFINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of Practical frequency selective filters; Characteristics of commonly used Analog filters - Butterworth filters, Chebyshev filters; Design of IIR filters from analog filters (LPF, HPF) - Approximation of derivatives, Impulse in variance method, Bilinear transformation, Frequency transformation in the analog domain; Structure of IIR filter - direct form I, direct form II, Cascade, Parallel realizations.

UNIT III FINITE IMPULSE RESPONSE FILTERS **9**

Design of FIR filters - Symmetric and Anti-symmetric FIR filters, FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method; FIR filter structures - Linear phase structure, Direct form Realizations.

UNIT IV CARDIOVASCULAR APPLICATIONS **9**

Noise and Artifacts; ECG Signal Processing - Baseline Wandering, Power line interference, Muscle noise filtering, QRS detection; Adaptive noise canceling in ECG; Improved adaptive filtering in FECG; Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA).

UNIT V NEUROLOGICAL APPLICATION AND SIGNAL CLASSIFICATION **9**

EEG rhythms & waveforms; EEG applications - Epilepsy, Sleep disorders, Brain computer interface; Modelling EEG - Linear, Nonlinear modeling of EEG; Artifacts in EEG and their characteristics and

processing; Spectral Analysis - Nonparametric spectral analysis, Model based spectral analysis; EEG spectral analysis - EEG segmentation, Joint Time-Frequency analysis, Correlation analysis of EEG channels, Coherence analysis of EEG channels; Evoked potentials - noise characteristics, Noise reduction by linear filtering; Statistical signal classification linear discriminant function - Direct feature selection and ordering, Back propagation neural network; Analysis of EEG using Empirical Model Decomposition(EMD).

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- apply DIF and DIT for the analysis of bio signal and system.
- apply the knowledge on the design of IIR Filter in frequency domain.
- apply the knowledge on the design of FIR filter in frequency domain.
- develop the applications based on the acquired cardio-vascular signals.
- utilize the concepts acquired through Neurological applications and signal classification.

TEXT BOOKS

1. John G. Proakis&Dimitris G. Manolakis, - Digital Signal Processing - Principles, Algorithms &Applications ǁ, Fourth Edition, Pearson Education / Prentice Hall,2007.
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis A Case-Study Approach", John Wiley & Sons, Reprint 2016.

REFERENCES

1. Reddy D.C,"Biomedical signal processing: Principles and techniques", Tata McGraw-Hill,NewDelhi,2nd edition,2005.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal processing- A Practical Approach'', Pearson educationLtd.,2004.
3. Semmlow, Biosignal and Biomedical Image Processingǁ, Marcel Dekker,2004 (UNITIV-V).
4. Sergio Cerutti Carlo Marchesi, "Advanced Methods of Biomedical Signal Processing", Wiley,2011.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		3	2			2			2		3
CO2		2	3	2	2		2		2					2
CO3		2	2	2	3	3	1	2		3			2	
CO4	2	2	3	2	3	3						3	3	
CO5	2	3	3	2	3			2		2				2

PANIMALAR ENGINEERING COLLEGE, NAZARATHPET
Approved
BOARD OF STUDIES
Biomedical Engineering
H.8.22
AUTONOMOUS

BM20503 MICROPROCESSOR AND MICROCONTROLLER 3 0 0 3

COURSE OBJECTIVES

To enable students to

- explain the architecture of 8086 microprocessor.
- learn the design aspects of I/O and memory interfacing circuits.
- interface microprocessors with supporting chips.
- familiarize about ARM microcontroller.
- acquire knowledge on applications of microprocessor and microcontroller in biomedical domain.

UNIT I OVERVIEW OF 8085 AND 8086 MICROPROCESSOR 9

8- BIT and 16 - BIT MICROPROCESSOR; 8085 Architecture - Instruction set, Addressing modes, Interrupts, Timing diagrams, Memory and I/O interfacing; Evolution of Microprocessor and its importance in biomedical domain - Architecture and signal description of 8086, Minimum and maximum mode, Addressing modes, Instruction set, Simple assembly level programs.

UNIT II 8051 MICROCONTROLLER 9

Introduction to 8 bit Microcontroller - Signal descriptions of 8051, Architecture of 8051, Register set of 8051, Instruction set, Addressing mode, Simple assembly level programs.

UNIT III INTERFACING WITH I/O DEVICES 9

Timer - serial communication, interrupts programming, Interfacing to external memory, Basic techniques for reading & writing from I/O port pins; Interfacing 8051- ADC, Liquid crystal display (LCD), Keyboard, Stepper motor.

UNIT IV ARM MICROCONTROLLER 9

Fundamentals - Registers, Current program status register, Pipeline, Exceptions, Barrel Shifter, Interrupts and vector table; ARM architecture - ARM instruction set, Thumb instruction set.

UNIT V APPLICATIONS IN MEDICINE 9

Mobile phone based bio signal recording; Design of pulse oximeter circuit using ARM microcontroller; Design of EOG based home appliances using ARM microcontroller; Design of heart rate monitoring circuit using ARM microcontroller.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- demonstrate the architecture and assembly language for a processor.
- determine the architectural and pipelining concepts for Microprocessors.
- design and deploy the Interfacing peripherals in real time scenario.
- design, develop and trouble shoot microcontroller-based system.
- implement microcontroller-based systems in biomedical domain.

TEXT BOOKS

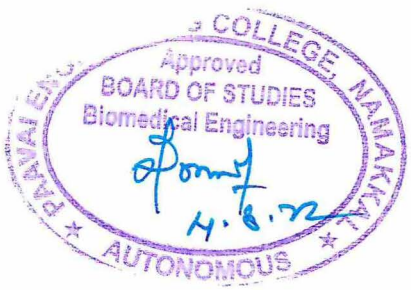
1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.
2. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", Glencoe, 2nd edition, 2010.

REFERENCES

1. Andrew N.Sloss,DonimicSymes, Chris Wright, "ARM System Developer's Guide", Elsevier, 1st edition, 2009.
2. Muhammad Ali Mazidi and JanicaGilliMazidi, 'The 8051 microcontroller and embedded systems', Pearson Education, 2nd edition Indian reprint, 2014.
3. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3rd edition, 2015.
4. B. Ram, " Fundamentals of microprocessor and microcontroller", Dhanpat Rai Publication, ISBN 13 9789383182107.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2								3	3
CO2	3	3	3	3	3			3					3	3
CO3	3	3	3	3	3	2	2						3	3
CO4	3	3	3	3	3			3					3	3
CO5	3	3	3	3	2	3	2						3	3



BM20504 **BIOMATERIALS** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn characteristics and classification of Biomaterials.
- understand different metals, ceramics and its nanomaterial's characteristics as biomaterials.
- learn polymeric materials and its combinations that could be used as a tissue replacement implants.
- get familiarized with the concepts of Nano Science and Technology.
- understand the concept of biocompatibility and the methods for biomaterials testing.

UNIT I INTRODUCTION TO BIOMATERIALS 9

Definition and classification of biomaterials - Mechanical properties, Visco elasticity, Biomaterial performance, Body response to implants, Wound healing, Blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS 9

Metallic implants - Stainless steels, Co-based alloys, Ti-based alloys, Shape memory alloy, Nanostructured metallic implants; Degradation and corrosion; Ceramic implant - Bioinert, Biodegradable or Bioresorbable, Bioactive ceramics, Nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization - Factors influencing the properties of polymers, Polymers as biomaterials, Biodegradable polymers; Biopolymers - Collagen, Elastin and chitin, Medical Textiles; Materials for ophthalmology - Contact lens, Intraocular lens; Membranes for plasma separation and Blood oxygenation; Electro spinning - A new approach.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair - Extra cellular Matrix; Soft tissue replacements - Sutures, Surgical tapes, Adhesive, Percutaneous and skin implants, Maxillofacial augmentation, Vascular grafts, Hard tissue replacement Implants, Joint replacements; Tissue scaffolding and engineering using Nanobiomaterials.

UNIT V TESTING OF BIOMATERIALS 9

Biocompatibility - Blood compatibility and Tissue compatibility tests, Toxicity tests, sensitization, Carcinogenicity, Mutagenicity and special tests; Invitro and Invivo testing; Sterilisation of implants and devices - ETO, Gamma radiation, autoclaving; Effects of sterilization.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
- identify significant gap required to overcome challenges and further development in metallic and ceramic materials.
- identify significant gap required to overcome challenges and further development in polymeric materials.
- create combinations of materials that could be used as a tissue replacement implant.
- apply the testing standard of biomaterials.

TEXT BOOKS

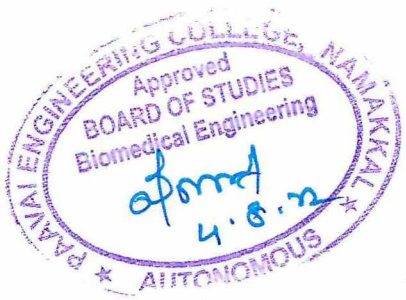
1. Sujata V. Bhatt, "Biomaterials", Springer Netherlands, 23 August 2014.
2. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.

REFERENCES

1. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
2. Joon B. Park., "Biomaterials Science and Engineering", Springer US, 23 Jan 2014.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,"Woodhead Medical Textiles and Biomaterials for Healthcare", Publishing Limited 2006.
4. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		3	2			2			2		3
CO2		2	3	2	2		2		2					2
CO3		2	2	2	3	3		2		3			2	
CO4	2	2	3	2	3	3	1					3	3	
CO5	2	3	3	2	3			2		2				2



BM20505 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT I 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the medical equipment used in the measurement of parameters related to cardiology.
- understand the medical equipment used in the field of neurology.
- learn some of the cardiac assist devices.
- understand the principle of biotelemetry.
- understand the function of various extracorporeal devices.

UNIT I CARDIAC EQUIPMENT **9**

Electrocardiograph - Normal and Abnormal Waveforms, Heart rate monitor, Heart rate variability, Holter Monitor; Cardiac Pacemaker - Internal and External Pacemaker, Types, Batteries; AC and DC Defibrillator- Internal and External, Types, Precautions.

UNIT II NEUROLOGICAL EQUIPMENT **9**

Multi channel EEG recording system - Clinical significance of EEG, Sleep patterns, Epilepsy; Evoked Potential - Visual, Auditory and Somato sensory, EEG Bio Feedback Instrumentation; Psychophysiological Measurements for testing sensory Responses - MEG (Magneto Encephalograph), Sensing principle and instrumentation.

UNIT III MUSCULAR EQUIPMENT **9**

EMG - Recording and analysis of EMG waveforms, Fatigue characteristics, Muscle stimulators, Nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation; EGG (Electro Gastro Graph); MMG (Magneto Myo Graph).

UNIT IV PATIENT MONITORING AND BIOTELEMETRY **9**

Patient monitoring systems - ICU/CCU Equipment, Infusion pumps, Bed side monitors, Central monitoring console; Architecture of Biotelemetry system - Single and multi-channel Biotelemetry, Inductively coupled Biotelemetry , Optical Biotelemetry, Readout formats; Concept of m-Health 2.0; Point of care devices - Disposable hematology sensors.

UNIT V EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES **9**

Need for heart lung machine - Functioning of bubble, Disc type and membrane type oxygenators, Finger pump, Roller pump, Hemodialyser unit, Peritoneal dialyser unit, Wearable artificial kidney; Tonometer; Auto Refractometer; Audiometer- Beksey's type, Pure tone, Speech; Galvanic skin resistance (GSR) - Polygraph.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- apply different medical devices in the measurement of parameters related to cardiology, neurology.
- use various cardiac assist devices.
- measure and analyze signals generated by muscles.
- perform continuous monitoring and transmission of vital parameters.
- comprehend the need for special diagnostic and therapeutic devices and extra-corporeal devices.

TEXT BOOKS

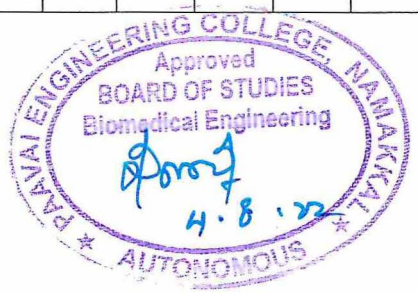
1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

REFERENCES

1. Myer Kutz, "Biomedical Engineering & Design Handbook: Volume 2", McGraw-Hill Publisher, 2nd Edition, 2009.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
4. R. S. Khandpur, " Handbook of Biomedical Instrumentation", McGraw-Hill Publisher, 3rd Edition, 2014.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3		3		3	3	3		3	3	
CO2	3	3	3	3		3		3	3	3		3	3	
CO3	3	3		3		3		3	3	3		3		3
CO4	3	3		3		3		3	3	3		3	3	3
CO5	3					3		3		3		3		3



BM20506	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	0 0 4 2

COURSE OBJECTIVES

To enable students to

- design the programming language of 8051.
- develop skill in program writing for microprocessors and controllers.
- introduce microprocessor and microcontroller-based system design.
- ability to design, develop and trouble shoot microcontroller-based system.

LIST OF EXPERIMENTS

1. Programs for 8 / 16 bit Arithmetic, Sorting, Searching and String operations.
2. Basic arithmetic and Logical operations.
3. Programming using Bit Manipulation instructions of the 8051microcontroller.
4. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontrollers.
5. Interfacing DAC and ADC and 8051 based temperature measurement.
6. Interfacing Stepper motor and traffic light control system.
7. Interfacing LED and LCD.
8. Basic programs using ARM controller.
9. Learn and understand how to configure the PWM and ADC modules of the MSP-EXP430G2 Launchpad to control the DC motor using external analog input.
10. Implement Pulse Width Modulation to control the brightness of the on-board, green LED using ARM Microcontroller.

TOTAL PERIODS: 60

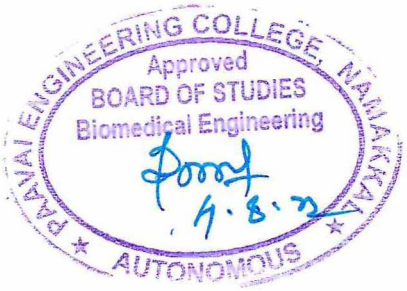
COURSE OUTCOMES

At the end of this course, the students will be able to

- write program for various applications using 16-bit processor.
- write assembly language programs for 8051 microcontrollers.
- interface various peripherals with 8-bit microcontroller.
- design microcontroller-based projects.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	3	3				2	2		3	3	2
CO2	3	2	3	3	2		2					2	3	3
CO3	3	3	3	3	3	2						2	3	2
CO4	3	2	3	2			2			2			2	2
CO5	2		3		3					2				2



BM20507 **BIOMEDICAL SIGNAL PROCESSING LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable students to

- basic discrete time signals and analyzes it.
- realizing Linear and Circular Convolution.
- designing the IIR and FIR filter.
- analyzing various types of bio signals and study its characteristics

LIST OF EXPERIMENTS

1. Representation of basic signals (ECG, EEG, EMG, SPEECH SIGNAL).
2. Sampling and Quantization (ECG, EEG, EMG, SPEECH SIGNAL).
3. Fast Fourier transform of the signals.
4. Circular convolution and Linear convolution.
5. Digital IIR filter (Butter worth and Chebyshev).
6. FIR filter design (Hamming and Hanning).
7. Correlation of the signals.
8. EEG and ECG signal processing basics using MATLAB.
9. Analysis of heart rate variability.
10. Spectral analysis of EEG signals.

TOTAL PERIODS: 60

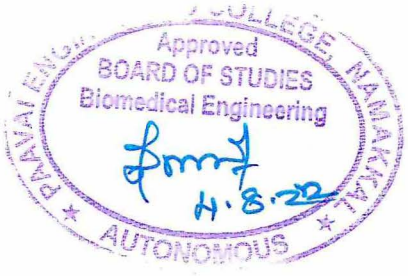
COURSE OUTCOMES

At the end of this course, the students will be able to

- ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
- demonstrate their abilities towards DSP processor-based implementation of DSP systems.
- analyze Finite word length effect on DSP systems.
- implement adaptive filters for various applications of DSP.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2					2	2		2	2
CO2	3	2	3	2	2					2			2	3
CO3	3	3	3	3	3					2			3	3
CO4	3	2	3	3						2			3	3



EN20501 **CAREER DEVELOPMENT LABORATORY I** **0 0 2 1**

COURSE OBJECTIVES

To enable students to,

- enhance their writing skills.
- evaluate their presentation skill to face the corporate world.
- solve the quantitative aptitude problems and improve their mental ability.
- improve the critical thinking and reasoning skills.

UNIT I WRITING SKILLS **6**

Writing Skills: The Essentials of Writing – The Importance of Structure – Types of Writing – Common Mistakes in Writing

Activities: Email Writing - Paragraph writing – Report Writing – Story Writing - Story Telling Session: 2 – JAM Session 1

UNIT II PRESENTATION SKILLS AND GROUP DISCUSSION **6**

Presentation Skills: Types of Presentation – Methods of Delivering Presentation – Ways to improve the Presentation – Presentation Aids; Group Discussion: Introduction – Types and Importance – Why GD – Types of GD- Evaluation Criteria – Do's and Don'ts of GD

Activities: Presentation Session I ,Group Discussion Session I, Role Play Session (Team): Level II – Personality Profile Session II – Company Profile Analysis Session II

UNIT III QUANTITATIVE APTITUDE **6**

Simplification – Cubes and Cube Roots – Squares and Roots – Boats and Streams – Trains – Profit and Loss – Pipes and Cisterns

UNIT IV LOGICAL REASONING - I **6**

Series Completion – Letter Series – Symbol Series – Number Series – Arithmetic Reasoning

UNIT V LOGICAL REASONING - II **6**

Blood Relations – Seating Arrangement - Character Puzzle

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of the course, the students will be able to

- excel in drafting mails and speaking
- demonstrate the participative skills in group discussions.
- solve problems based on quantitative aptitude.
- enhance their logical and verbal reasoning.

TEXTBOOKS

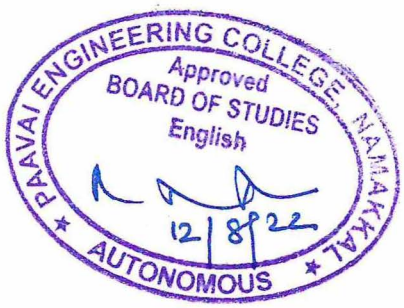
1. Agarwal, R.S. "A Modern approach to Verbal and Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi 2015.
2. Agarwal, R.S. "Objective General English", S.Chand & Co 2016.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude", Tata-Mcgraw Hill 2015.
2. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications 2016.
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon 2019.
4. Infosys Campus Connect Program – students' guide for soft skills 2015.

CO PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	Programme Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO4	2	3	3	2	1	3	3	1	-	1	2	-	2	3



BM20601 **HUMAN ASSIST DEVICES** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- study various mechanical techniques that will help failing heart.
- learn the functioning of the unit which does the clearance of urea from the blood.
- understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- know the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- understand electrical stimulation techniques used in clinical applications.

UNIT I CARDIAC ASSIST DEVICES **9**

Principle of External counter pulsation techniques - Intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, Prosthetic heart valves; Drug delivery systems for cardiovascular ailments.

UNIT II HEMODIALYSERS **9**

Artificial kidney - Dialysis action, Hemodialyzer unit, Membrane dialysis, Portable dialyser monitoring and functional parameters; Automated insulin delivery systems for type 1 diabetes people.

UNIT III HEARING AIDS **9**

Common tests - Audiograms, Air conduction, Bone conduction, Masking techniques, SISI; Hearing aids - Principles, Drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES **9**

Hand and arm replacement - Different types of models, Externally powered limb prosthesis, Feedback in orthotic system; Hip & knee replacement, Spinal Orthoses, Ocular drug delivery, Sensory assist devices.

UNIT V RECENT TRENDS **9**

Drug delivery systems in cancer therapy; Pain management - Chronic back pain; 3D-printed prosthetics and orthoses; Smart eyewear - Artificial iris; Regulation of software as a medical device.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- explain the functioning and usage of electromechanical units which will restore normal functional ability of particular organ that is defective temporarily or permanently.
- analyze different types and uses of dialyzer units.
- discuss external devices that can work under supervision.
- outline the importance of patient safety against electrical hazard.
- describe the measurement techniques of sensory responses.

TEXT BOOKS

1. Albert M. Cook, Janice Miller Polgar, Pedro Encarnação, "Assistive Technologies - Principles and Practice ", Vol. I, II, IV, Elsevier - Health Sciences Division, 2019.

2. Tammy Gagne, "Artificial Organs", Focus Readers USA, May 2019.

REFERENCES

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

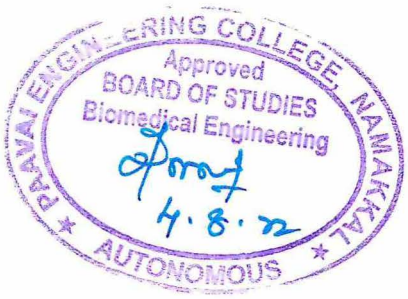
2. Eric Chappel, "Drug Delivery Devices and Therapeutic Systems", Elsevier Science, 7 November 2020.

3. Shunei Kyo, "Ventricular Assist Devices in Advanced Stage Heart Failure", Springer, 2014.

4. Ron Seymour, "Prosthetics and Orthotics: Lower limb and Spinal", Lippincott Williams and Wilkins, 2002.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		3	2			2			2		3
CO2		2	3	2	2		2		2					2
CO3		2	2	2	3	3		2		3			2	
CO4	2	2	3	2	3	3	1					3	3	
CO5	2	3	3	2	3			2		2				2



BM20602 HEALTHCARE AND HOSPITAL MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable students to

- expose the students for planning and operation of hospitals in a detailed manner.
- impart the facts of hospital planning activities.
- teach the regulatory requirements and its standards.
- introduce the equipment maintenance management skills.
- expose how to protect equipment from electromagnetic interferences.

UNIT I HEALTH SYSTEM IN A HOSPITAL 9

Health organization of the country - The State, The Cities and the Region, Health Financing System, Organization of Technical Section; Different Departments of Hospital, Functions of Hospitals, Types of Hospitals; Primary Healthcare - An Introduction, Ambulatory care.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT 9

Management of Hospital Organization - Nursing Sector, Medical Sector, Central Services, Technical Department; Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Teamwork, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEALTHCARE CODES 9

ICRP, FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, International Standards, Radiation protection AE(RP)R-2004, Medical Device Inspection ISO17020; Indian Standards Biomedical Equipment Management and Maintenance Program (BMMP), NABA, JCI, NABL, NABH.

UNIT IV EQUIPMENT AND ASSET MAINTENANCE MANAGEMENT 9

Organizing Maintenance Operations, Maintenance Work Measurement and Standards; Contract Maintenance; Hospital Planning, Equipment Planning, AMC, Functional Planning; Function of Clinical Engineer.

UNIT V COMPUTERS AND INFORMATION TECHNOLOGY IN MEDICINE AND HEALTHCARE 9

Computer application in ICU, Picture Archival System (PACS) for Radiological images department, Clinical laboratory administration, Patient data and medical records, Communication, Simulation.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- demonstrate the various health policies.
- invent activities at health care centers.
- organizing maintenance operations.
- determine the function of a clinical engineer in a hospital.
- describe the technologies used.

TEXT BOOKS

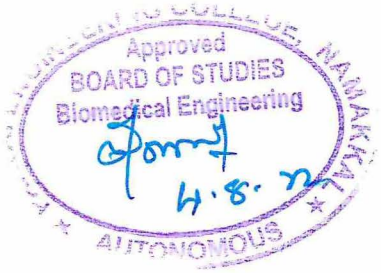
1. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. San Diego 2017 Fourth Edition.
2. Human Resource in Hospital Management, Erickson Thomas, Global Vision Publishing House, 2019 Edition.

REFERENCES

1. Edda Weimann, Peter Weimann, High Performance in Hospital Management - A Guideline for Developing and Developed Countries, Springer Berlin Heidelberg, 22 May 2017.
2. Cesar A.Caceres, The Practice of Clinical Engineering, Elsevier Science,2 December 2012.
3. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003
4. Kieran Walshe and Judith Smith, " Healthcare Management", McGraw Hill, 2010.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3		3	2			2			2		3
CO2			3		2	2			2					2
CO3			2		3					3			2	
CO4	2		3		3							3	3	
CO5	2		3		3					2				2



BM20603 **DIAGNOSTIC AND THERAPEUTIC EQUIPMENT II** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- gain knowledge about measurements of parameters related to respiratory system.
- understand biomedical laser principles and applications.
- understand different types and uses of diathermy units.
- know the principles of ultrasound and its use in diagnosis.
- know the importance of patient safety against electrical and laser hazards.

UNIT I RESPIRATORY MEASUREMENT AND ASSIST SYSTEMS **9**

Lung Volume and vital capacity - Spirometer, Measurements of residual volume; Pneumotachometer - Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor; Types of Ventilators - Pressure, Volume, and Time controlled, Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT II LASER BASED EQUIPMENTS AND THERMAL TECHNIQUES **9**

Lasers in Medicine - Types, Tissue reactions; Lasers in ophthalmology - Flow Cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser Micro irradiation, Laser Doppler Velocimetry; Neurosurgical Laser Techniques - Lithotripsy, Cryogenic technique; Thermography - Recording Principle and clinical application.

UNIT III DIATHERMY **9**

IR and UV lamp - Application; Need for different diathermy units - Short wave diathermy, Ultrasonic diathermy, Microwave diathermy; Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

UNIT IV ULTRASOUND EQUIPMENT **9**

Diagnosis - Tissue Reaction, Basic principles of Echo technique, Display techniques A, B and M mode, B Scan; Application of ultrasound as diagnostic tool - Echocardiogram, Echoencephalogram, Abdomen, Obstetrics and Gynecology, Ophthalmology.

UNIT V PATIENT SAFETY **9**

Physiological effects of electricity - Important susceptibility parameters, Macro shock, Micro shock hazards, Patient's electrical environment, GFI units, Earthing Schemes; Electrical safety codes and standards - Basic Approaches to protection against shock, Protection equipment design, Electrical

safety analyzer, Testing the Electrical safety of medical equipment, Biomedical Laser Safety.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- illustrate the measurements of parameters related to respiratory system.
- perform the use of advanced laser technology in diagnosis and minimally invasive therapies.
- analyze different types of diathermy units.
- summarize the concept of ultrasound equipment.
- identify the electrical hazards and implement methods of patient safety.

TEXT BOOKS

1. Leslie Cromwell, Fred J.Weibell, Erich A. P feiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
2. Joseph J. Carrand John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.

REFERENCES

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rdEdition,2014.
2. Richard Aston, "Principles of Biomedical Instrumentation and Measurement" Merril Publishing Company, digitized on 27 November 2007.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rdEdition, John Wiley and Sons, Reprint 2008.
4. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, NewYork, 4thedition, 2009.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3										3	3	
CO2	3					3	3	3				3	3	
CO3	3					3	3	3				3		3
CO4	3			3		3	3	3				3	3	3
CO5	3					3	3	3				3		3

PANIMALAR ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Biomedical Engineering
AUTONOMOUS

BM20604 **BIOCONTROL SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand bio control systems modeling technique.
- learn the analysis of given system in time domain.
- study the stability analysis of the given system.
- learn the analysis of given system in time frequency domain.
- study the concept of physiological control system.

UNIT I MODELING OF SYSTEMS **9**

Basic structure of control system - Positive and Negative feedback, Transfer functions, Modeling of electrical systems; Block diagram and Signal flow graph representation of systems - Conversion of block diagram to signal flow graph, Reduction of block diagram and signal flow graph.

UNIT II TIME RESPONSE ANALYSIS **9**

Step responses of first order and second order systems - Determination of time domain specifications of first and second order systems from its output responses; Definition of steady state error constants and its computations.

UNIT III STABILITY ANALYSIS **9**

Definition of stability - Routh- Hurwitz criteria of stability, Root locus technique, Construction of root locus and study of stability; Definition of dominant poles and relative stability.

UNIT IV FREQUENCY RESPONSE ANALYSIS **9**

Frequency response - Nyquist stability criterion, Nyquist plot and Determination of closed loop stability, Definition of gain margin and phase margin; Bode plot - Determination of gain margin and phase margin using Bode plot.

UNIT V PHYSIOLOGICAL CONTROL SYSTEM **9**

Example of physiological control system; Difference between engineering and physiological control systems; Generalized system properties; Models with combination of system elements - Linear models respiratory mechanism and muscle mechanism, Model of regulation of cardiac output.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- represent the system in various forms.
- interpret the response of the system in time domain.
- examine the stability of the system.
- analyze simple system in frequency domain.
- compute the mathematical model of Physiological systems.

TEXT BOOKS

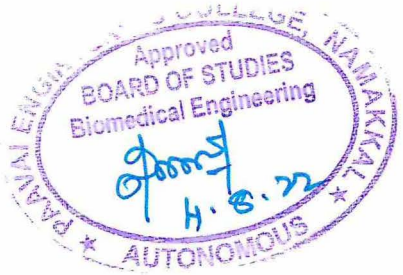
1. M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002 (Units I, II, III & IV).
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001 (Unit V).

REFERENCES

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 2009.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004.
4. I. J. Nagrath, M. Gopal, "A Textbook of Control Systems Engineering", New Age International Publishers, 1st Edition 2010.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3					3		3		3	3	3	2
CO2	2	3					3		3		3	3	3	3
CO3	3	3					3				3	3	3	3
CO4	2	3				3	3		3			3	3	3
CO5	3	3		3	3	3	3		3		3	3	3	3



BM20605	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	0 0 4 2

COURSE OBJECTIVES

To enable students to

- study the function of different therapeutic equipments.
- provide practice on recording and analysis of different Biopotentials.
- formulate the measurement of respiratory parameters using diathermy.
- formulate the skin resistance measurement and muscle stimulator.

LIST OF EXPERIMENTS

1. Simulation of ECG – detection of QRS complex and heart rate
2. Recording of Audiogram.
3. Recording and analysis of ECG signals.
4. Recording and analysis of EMG signal and plotting of fatigue characteristics.
5. Recording and Analysis of EEG Signals and Evoked Potential.
6. Measurement of Respiratory parameters using spirometry
7. Electrical safety measurements.
8. Analyze the working of ESU–cutting and coagulation modes.
9. Analysis of characteristics of surgical diathermy.
10. Galvanic skin resistance(GSR) measurement.
11. Study of muscle stimulator.

TOTAL PERIODS: 60

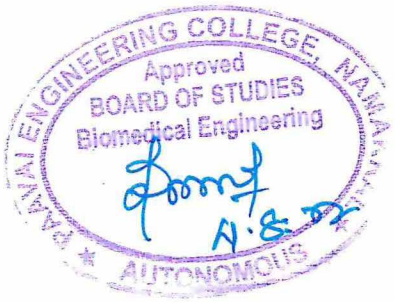
COURSE OUTCOMES

At the end of this course, the students will be able to

- measure different bioelectrical signals using various methods.
- examine the electrical safety measurements.
- analyze the different bio signals using suitable tools.
- analyze the skin resistance measurement and muscle stimulator.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3				3	3	3	3	3	3	3	2	2
CO2	3	3		3	3	3	3	3	3	3	3	3	2	2
CO3	3	3		3	3	3	3	3	3	3	3	3	2	2
CO4	3	3		3	3	3	3	3	3	3	3	3	2	2



BM20606 **DESIGN PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable students to

- improve the skills to formulate a technical project.
- explain the various tasks of the project and standard procedures.
- teach the use of new tools, algorithms and techniques required to carry out the design project.
- analyze the various procedures for validation of the product and analyze the cost effectiveness.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped upto 4 members and work under a project supervisor. The proposed model kit has to be submitted to the supervisor. A Design Project Report to be submitted by the group and the model will be reviewed and evaluated for internal assessment by a Committee Constituted by the Head of the Department. At the end of the semester examination, the design project work is evaluated based on oral presentation and the Design Project Report is examined jointly by external and internal examiners constituted by the Controller of Examinations. It is desirable to publish their Design Project in State/ National Level Conferences or Symposiums duly by interest of the students in accordance with their supervisor.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this project, the students will be able to

- formulate the real-world problem, identify the requirement and develop the design solutions.
- identify the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques that contribute to obtain the solution of the design project.
- analyze and validate through conformance of the developed prototype and analysis the cost. effectiveness

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3					3	3			2	3	3
CO2	3	3	3	3	3	2	2		2			3	3	2
CO3	3		3	3	3	3	2		2	2		3	2	3
CO4	3	3	3				2	3	3	3	2	3	2	2

PANIMALAR ENGINEERING COLLEGE NAAC Approved BOARD OF STUDIES Biomedical Engineering AUTONOMOUS

EN20601 **CAREER DEVELOPMENT LABORATORY II** **0 0 2 1**

COURSE OBJECTIVES

To enable students to,

- draft resume and enhance their skills to manage stress to survive in corporate world.
- excel in interview skills.
- solve the quantitative aptitude problems and improve their problem-solving skills.
- improve their reasoning skills to get placed in reputed companies.

UNIT I **RESUME WRITINGS** **6**

Resume Writing Skills: Curriculum Vitae and Resume – Things to do while writing a Resume – Mistakes and Pitfalls to Avoid- Cover Letter: General Guidelines – The Content - Stress Management – Dressing Etiquette

Activities: Corporate Resume Building Session I – JAM Session: Level III – Role Play Session (Individual): Level III - Company Profile Analysis Session III – Personality Profile Analysis Session III

UNIT II **INTERVIEW SKILLS** **6**

Interview Skills: Introduction – Before the Interview – During the Interview – After the Interview – Types of Interview

Activities: Presentation Session: Level II- Group Discussion Session: Level III, Mock Interview Practice Session, Corporate Resume Building Session II

UNIT III **QUANTITATIVE APTITUDE** **6**

Permutation and Combination – Probability: Dice, Colours, Coin, Cards ; Partnership – Ages – Calendars

UNIT IV **LOGICAL REASONING -I** **6**

Making Judgments – Matching Definitions – Cause and Effect

UNIT V **LOGICAL REASONING II** **6**

Directions – Syllogism – Analogy – Statements and Arguments

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of the course, the students will be able to

- write resume and enhance their etiquettes.
- demonstrate the interpersonal skills in group discussions.
- compute problems based on quantitative aptitude.
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies.

TEXTBOOKS

1. Agarwal, R.S. "A Modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi 2015.
2. Agarwal, R.S. "Objective General English", S.Chand & Co 2016.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill 2015.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications 2016.
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon 2019.
4. Infosys Campus Connect Program – students' guide for soft skills 2015.

CO PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	Programme Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO4	2	3	3	2	1	3	3	1	-	1	2	-	2	3

BM20151 **BIOMEDICAL INFORMATICS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- gain fundamental knowledge of Hospital Information system.
- understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.
- explain how to manage medical databases.
- gain knowledge in ICT applications in medicine with an introduction to health informatics.
- study the concepts of telemedicine, its issues and reliability.

UNIT I MEDICAL INFORMATICS **9**

Introduction - Medical Informatics, Bioinformatics Health Informatics, Structure of Medical Informatics; Functional capabilities of Hospital Information System - On-line services and off–line services ,History taken by computer, Dialogue with the computer.

UNIT II MEDICAL STANDARDS **9**

Evolution of Medical Standards - IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records; Healthcare Standard Organizations - JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation); Evidence Based Medicine; Bioethics.

UNIT III MEDICAL DATA ACQUISITION AND STORAGE **9**

Plug-in Data Acquisition and Control Boards Data Acquisition using Serial Interface; Medical Data formats - Signal, Image and Video Formats, Medical Databases; Automation in clinical laboratories - Intelligent Laboratory Information System, PACS, Data mining.

UNIT IV HEALTH INFORMATICS **9**

Bioinformatics Databases - Bio-information technologies, Semantic web and Bioinformatics; Genome projects - Clinical informatics, Nursing informatics, Public health informatics, Education and Training.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS **9**

Medical Expert Systems; Virtual reality applications in medicine; Virtual Environment - Surgical simulation; Radiation therapy and planning Telemedicine; Virtual Hospitals; Smart Medical Homes Personalized e-health services - Biometrics, GRID and Cloud Computing in Medicine.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- analyze health informatics and different ICT applications in medicine.
- summarize the function of Hospital Information Systems
- determine and adopt medical standards.
- demonstrate the virtual reality tools.
- paraphrase the concept and need of different information systems.

TEXT BOOKS

1. Radulae, "Computers in Medicine: Progress in Medical Informatics'',Tata McGraw Hill Publishing computers Ltd, NewDelhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Computers Ltd, NewDelhi, 2003.

REFERENCES

1. N. Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd - New Delhi, 2007.
2. Yi –Ping Phoebe Chen, "Bioinformatics Technologies", Springer International Edition, NewDelhi, 2014.
3. H. sinnchun Chen, "Medical Informatics: Knowledge Management and Data Mining in Biomedicine", Springer, 2010.
4. Dinesh Bhatia, " Medical Informatics", Prentice Hall of India Pvt.Ltd, ISBN: 9788120350755.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3										3	3	2
CO2			3	3	3						3	3	2	3
CO3					3	3		3		3		3	2	2
CO4				3	3	3	3	3				3	2	2
CO5			3	3	3							3	3	3

BM20152 **VIRTUAL BIOINSTRUMENTATION** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand virtual instrumentation and realize the architecture of VI.
- familiarize with the VI software and learn programming in VI.
- enlighten the concepts in programming, automation and measurement.
- study various instrument interfacing and data acquisition methods.
- design various analysis tools and develop programs for process control applications.

UNIT I INTRODUCTION **9**

History of Virtual Instrumentation - Advantages, Block diagram and Architecture of a virtual instrument; Programming paradigms Virtual Instrumentation - LabVIEW software, LabVIEW basics, LabVIEW environment.

UNIT II PROGRAMMING TECHNIQUES **9**

VIS and sub-VIS - Loops and charts, Arrays, Clusters, Graphs, Case and sequence structures; Formula modes - Local and global variable, String and file input; Publishing measurement data in the web.

UNIT III DATA ACQUISITION AND CONTROL IN VIRTUAL INSTRUMENTATION **9**

Plug-in DAQ boards Organization of the DAQ VI System; Performing analog input and analog output - Scanning multiple analog channels, Driving the digital I/Os, Buffered data acquisition, Simple problems.

UNIT IV INSTRUMENT INTERFACES **9**

Current loop - RS 232C/RS 485; GPIB - System basics; Interface basics - USB, PCMCIA; Networking basics for office and industrial application VISA & IVI; Image acquisition and processing; Motion Control - ADC, DAC, DIO, DMM, Waveform generator.

UNIT V APPLICATION OF VIRTUAL INSTRUMENTATION **9**

Design of virtual applications - Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Non invasive Blood Pressure Measurement; Biofeedback; Virtual Reality and 3D graphical modelling - Virtual Prototyping.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- comprehend and appreciate the significance and role of this course in the present contemporary world.
- identify salient traits of a virtual instrument.
- apply the use of VI for data acquisition.
- experiment, analyze and document different types of interfaces.
- apply the virtual instrumentation technologies for medical applications.

TEXT BOOKS

1. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2003.
2. Gary Johnson, LABVIEW Graphical Programming, 4thEdition, McGraw Hill, 2006.

REFERENCES

1. Jeffrey Travis, Jim Kring, LABVIEW for Everyone, Prentice Hall, 2015.
2. Ozkul, Data Acquisition and Process Control Using Personal Computers, CRC Press,2017.
3. Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 1stEdition, 2010.
4. Technical Manuals for DAS Modules of Advantech and National Instruments.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			3							3	3	2
CO2	3	3	3		3							3	3	3
CO3		3	3	3	3							3	3	3
CO4		3	3	3	3							3	3	2
CO5				3	3	3				3	3	3	3	3

BM20153 **BIOMEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- analyze the working principle of MEMS and microsystems in healthcare domain.
- learn various MEMS fabrication techniques.
- understand different types of sensors and actuators and their principles of operation at the micro scale level.
- determine the working principles of microsystems and micro fluidic Systems.
- illustrate the concepts of BioMEMS with suitable examples.

UNIT I MEMS MATERIALS AND FABRICATION 9

Typical MEMs and Microsystems; Materials for MEMS - Active substrate materials, Silicon and its compounds, Silicon piezo resistors, Gallium Arsenide, quartz, polymers; Micromachining - photolithography, Thin film deposition, Doping, Etching, Bulk machining, Wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL - SENSORS AND ACTUATORS 9

Mechanics for MEMs design - Static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics; Mechanical sensors and actuators - beam and cantilever, microplates, strain, pressure and flow measurements; Thermal sensors and actuators - Actuator based on thermal expansion, thermal couples, thermal resistor; Shape memory alloys; Inertia sensor; flow sensor.

UNIT III ELECTROSTATIC, PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor - Pull in effect; Electrostatic sensors and actuators - Inertia sensor, Pressure sensor, Flow sensor, Tactile sensor, Comb drive; Piezoelectric sensor and actuator - Properties of piezoelectric materials, inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROSYSTEMS AND MICROFLUIDS 9

Microsystems - General principles, Microsensors, Actuators; Electrostatic forces - Piezoelectric crystals, Intelligent materials and structures; Fundamentals of micro fluids - Lab on a chip devices, Silicon and glass micromachining for micro total analysis systems, Surface chemistry in polymer microfluidic systems.

UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs; Drug delivery; micro total analysis systems (MicroTAS) detection and measurement methods; Microsystem approaches to polymerase chain reaction (PCR); DNA sensor; MEMS based drug delivery; Neural Prosthesis - shape memory implants; Introduction to 3D printing; Emerging

Bio-MEMS Technology - Endoscopy, Oncology, Ophthalmology, Tissue Engineering, Cell-Based biosensors, Home land Security.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- summarize MEMS materials and the fabrication techniques.
- demonstrate the concepts of mechanical,thermal sensor and actuators.
- categorize the types of sensors and actuators and their principles of operation at the micro scale level.
- illustrate the characteristics of fluid flow and actuation through micro channels.
- design MEMS devices for different medical applications.

TEXT BOOKS

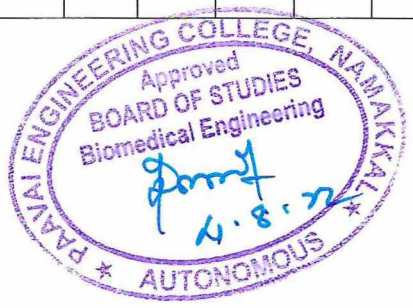
1. Tai Ran Hsu, "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2nd Edition, 2011.

REFERENCES

1. Wanjun Wang, Steven A. Soper , "Bio-MEMS Technologies and Application", 1st Edition, 2007, CRC Press.
2. Tuhin S. Santra, "Microfluidics and Bio-MEMS Devices and Applications", 1st Edition Jenny Stanford Publishing, 2020.
3. Eun Sok Kim, "Fundamentals of Microelectromechanical Systems", McGraw Hill, 1st Edition, 2021.
4. Shekhar Bhansali, Abhay Vasudev, " MEMS for Biomedical Applications", Woodhead Publisher, 1st Edition, 2012.

CO/PO MAPPING:

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3									3	3	2
CO2	3		3									3	2	3
CO3						3	3	3	3	3		3	2	3
CO4				3	3							3	3	3
CO5			3	3	3	3	3	3	3	3	3	3	3	3



BM20154 **MEDICAL OPTICS** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- acquire knowledge about the impact and interaction of light with biological tissue.
- identify optical properties of the tissues and the interactions of light with tissues.
- list medical lasers and their applications.
- summarize about optical diagnostic applications.
- choose emerging optical therapeutic techniques.

UNIT I INSTRUMENTATION IN PHOTONICS 9

Review of basic properties of light - Reflection, Refraction, Scattering, Fluorescence and Phosphorescence; Instrumentation for absorption - Scattering and emission measurements, Excitation light sources - High pressure arc lamp, LEDs, Lasers, Optical filters; Optical detectors - Time resolved and phase resolved detectors, Optical tweezers.

UNIT II OPTICAL PROPERTIES OF THE TISSUES 9

Light transport inside the tissue; Optical properties of tissue; Laser Characteristics as applied to medicine and biology; Laser tissue Interaction - Chemical, Thermal, Electromechanical; Photo ablative processes.

UNIT III SURGICAL APPLICATIONS OF LASERS 9

Lasers in ophthalmology - Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding.

UNIT IV NON-THERMAL DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography; Elastography; Laser Induced Fluorescence (LIF) – Imaging, FLIM Raman Spectroscopy and Imaging; FLIM Holographic and speckle application of lasers in biology and medicine.

UNIT V THERAPEUTIC APPLICATIONS 9

Principle and mechanism - Phototherapy, Photodynamic therapy (PDT); Oncological and non-oncological applications of PDT - Bio stimulation effect ,Applications; Laser Safety Procedures.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- comprehend and appreciate the significance and role of this course in the present contemporary world.
- demonstrate knowledge of the fundamentals of optical properties of tissues.
- categorize surgical applications of laser.
- describe photonics and its therapeutic applications.
- apply the concepts of laser and light to understand the laser safety procedures.

TEXT BOOKS

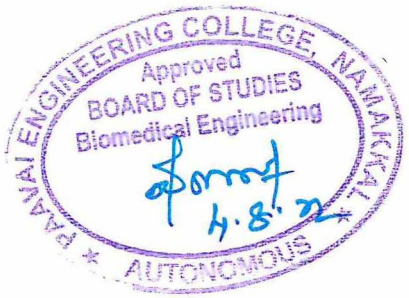
1. Markolf H.Niemz,"Laser - Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. Paras N.Prasad, "Introduction to Biophotonics", A. John Wiley and sons, Inc. Publications, 2006.

REFERENCES

1. TuanVo Dinh,"Biomedical photonics– Handbook",CRCPressLLC,2015.
2. Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications", Academic Press, 2nd edition, 2013.
3. R.Splinter and B.A. Hooper,"An Introduction to BiomedicalOptics", Taylorand Francis, 2007.
4. Helena Jelinkova, "Lasers for Medical Applications: Diagnostics, Therapy and Surgery'', Woodhead Publishing, 1stEdition, 2013.

CO/PO MAPPING:

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3				2	2		3	3	2
CO2	3	2	3	3	2		2					2	3	3
CO3	3	3	3	3	3	2						2	3	2
CO4	3	2	3	2			2			2			2	2
CO5	3	2		2		2	2	2				2	2	2



BM20251 **TELEMEDICINE AND PICTURE ARCHIVING COMMUNICATION SYSTEM** 3 0 0 3

COURSE OBJECTIVES

To enable students to

- know about the basics of telemedicine.
- study about various types of communication and networking.
- learn the basic concepts of networks, network configuration and network security.
- study of various applications of telemedicine.
- know about picture archiving and communication system.

UNIT I INTRODUCTION 9

Fundamentals of Telemedicine - Block diagram of Telemedicine; History of telemedicine - Main phases of Telemedicine, Pre electronic Telemedicine, Electronic Telemedicine; Scope, Benefits and Limitation of Telemedicine.

UNIT II COMMUNICATION AND NETWORK 9

Types of information - Audio, Video, Data, Fax, Still Image; Types of Communication and Networks - Overview of PSTN, POTS, ISDN, ATM, Video conferencing; Wireless Communication RF; GSM Satellite and Microwave; CDPD.

UNIT III DATA EXCHANGE AND NETWORK SECURITY 9

Basic concepts of internet - Network Configuration, Circuit and Packet Switching; H.320 series; h.324Protocols - TCP/IP, Standards for DICOM; Security - Encryption DES, RSA, and Cryptography.

UNIT IV APPLICATIONS OF TELEMEDICINE 9

Tele radiography - Basic parts of a Tele radiography System, Image acquisition and display system, Communication, Interpretation; Telepathology - Applications, Requirements, Security and Confidentiality tools; Tele cytology - Applications; Telecardiology; Tele home Care - Home based Applications; Teleoncology - Applications; Techniques - Tele surgery, Tele psychiatry, Tele dermatology.

UNIT V PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

Picture Archiving and Communication System - Components and Workflow; Communications and Networking; Integration of HIS, RIS, PACS, and ePR.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- apply the development and transmission techniques used in telemedicine.
- classify the types of communication and network systems.
- demonstrate the technologies used in data exchange and privacy of telemedicine.
- illustrate the current system of tele-health and mobile health.
- describe the currents and futures perspective of telemedicine.

TEXT BOOKS

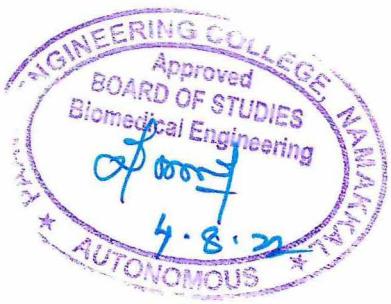
1. Shashi Gogia, "Fundamentals of Telemedicine and Telehealth", Elsevier Science, 27 October 2019.
2. Ling Guan, "Multimedia image and video processing", CRC Press, 2nd edition, 2017.

REFERENCES

1. Thorsten M Buzug, Heinz Handels, Dietrich Holz, "Telemedicine: Medicine and communication", Springer US, 26 Oct 2012.
2. Halit Eren, John G. Webster, "Telemedicine and Electronic Medicine", CRC Press. 8 October 2018.
3. A. C Norris, "Essentials of Telemedicine and Telecare", John Wiley & Sons, 2010.
4. H. K. Huang, "PACS and Imaging Informatics", Wiley-Blackwell, Second Edition, 2010.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2	3	2			2				2	2
CO2	2	2	2		3					2			2	2
CO3			2	2	1		2			3			2	3
CO4	3	2	3		3	2				2			3	3
CO5	2		3		2		2			3			3	3



BM20252 ADVANCED MEDICAL INSTRUMENTATION TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn the advanced understanding of biomedical instrumentation.
- learn the various assistive devices systems and monitoring equipments.
- learn the working principle of various radiography and diathermy equipments.
- learn the ultrasonic and neonatal instruments.
- understand the need of various biological safety instruments.

UNIT I BIOMEDICAL SIGNALS AND ELECTRODES 9

Sources of biomedical signals; Basic medical instrumentation system; Bioelectric signals - Tread Mill Test for ECG, EPG; Electrodes for ECG, EPG; Medical surface electrodes and problems - Microelectrodes; Tread mill Electrocardiograph - Block diagram, ECG leads, Faults and troubleshooting; Phonocardiograph - origin of heart sounds, Microphones and amplifiers for PCG, Operating Rooms.

UNIT II ASSISTIVE DEVICES CARDIAC SYSTEM AND MONITORS 9

Cardiac Pacemakers; Heart lung machine; Different types of Oxygenators, Pumps, Monitoring Process; Hemodialyzer - Principle of Hemodialysis, Dialysate composition, Different types of hemodialyzers, Wearable Artificial Kidney; Defibrillators - Implantable defibrillators, Functional electrical stimulator (FES).

UNIT III RADIOLOGICAL, SURGICAL SCOPY AND DIATHERMY EQUIPMENTS 9

Digital radiography; Digital Fluoroscopy; Mammography; Angiography; Bone densitometry; Endoscopy; Laparoscopy; Bronchoscopy, Gastroscopy; Physiological effects of HF radiation; Depth of Penetration; Diathermy - Short wave, Ultrasonic and microwave diathermy, Surgical diathermy.

UNIT IV ULTRASONIC AND NEONATAL INSTRUMENTS 9

Basic principles of Echo technique - Display techniques A, B, M modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, Obstetrics and Gynecology; Infusion Pumps; Baby incubator, Phototherapy; Radiant warmer - Working principle, Block diagram, Description, and Function of basic blocks.

UNIT V BIOTELEMETRY, TELEMEDICINE AND SAFETY MEASUREMENTS 9

Elements of Biotelemetry system - Design of a biotelemetry system; Implantable Units - Problems, Application of Telemetry in Patient Care; Fundamentals of Telemedicine - Block diagram of Telemedicine, Scope, Benefits and Limitation of Telemedicine; Applications - Teleradiography, Telecardiology, Telesurgery; Electric shock hazards - Gross shock, Effects on human body, Micro and

macro electric shock, Leakage current and types, Testing of Biomedical Equipments.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- describe the principles of various types of biomedical signals and electrodes.
- demonstrate appropriate assistive devices cardiac system and monitor.
- illustrate the radiological, surgical scopy and diathermy equipments.
- determine the ultrasonic and neonatal instrument.
- identify the application of biotelemetry and telemedicine.

TEXT BOOKS

1. Joseph J Carr and John M Brown , "Introduction to Biomedical equipment Technology", Pearson Education 4th edition New Delhi 2001.
2. Albert M Cook and Webster J G, "Therapeutic medical devices", Prentice Hall Nee York,2008.

REFERENCES

1. Webster J.G, "Medical Instrumentation application and design", John Wiley and sons New York 3rd edition,2009.
2. Paul Ganney, Richard Axell,"Clinical Engineering - A Handbook for Clinical and Biomedical Engineers", Elsevier Science, 18 Dec 2019.
3. Andrew G. Webb,"Principles of Biomedical Instrumentation", Cambridge University Press,11 January 2018.
4. Khandpur R.S, "Hand Book of Biomedical Instrumentation", Tata McGraw Hill Publication, New Delhi, 3rd edition, 16 Jun 2014.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3				3	3	3		3	3	
CO2	3	3	3	3		2		3	3	3		3		3
CO3	3	3		3		3		3	3	3		3		3
CO4	3	3		3		3		3	3	3		2	3	
CO5	3					3		3		3		3	2	

ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Biomedical Engineering

BM20253 **PATTERN RECOGNITION AND NEURAL NETWORKS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- apply the fundamentals of pattern recognition and its application.
- develop algorithms suitable for pattern classification.
- have some knowledge on Neural Network.
- create back propagation network and associative memory.
- develop applications of pattern recognition and classification in image.

UNIT I SUPERVISED LEARNING **9**

Overview of Pattern recognition - Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier; Discriminant function, Non-parametric density estimation, Histograms, Kernels,Window estimators, K- nearest neighbor classifier, Estimation of error rates.

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS **9**

Unsupervised learning - Hierarchical clustering, Single-linkage Algorithm, Complete linkage Algorithm, Average Linkage Algorithm and Ward 's method; Partitional clustering; Forgy's Algorithm and k-means algorithm; Case studies.

UNIT III INTRODUCTION TO NEURAL NETWORK **9**

Elementary neurophysiology and biological neural network; Artificial neural network - Architecture, Biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT IV BACK PROPAGATION NETWORK AND ASSOCIATIVE MEMORY **9**

Back Propagation Network; Generalized delta rule; Bidirectional Associative memory; Hopfield Network.

UNIT V NEURAL NETWORKS BASED ON COMPETITION **9**

Kohonen Self organizing map, Learning Vector Quantization, Counter Propagation Network, Case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- classify patterns using statistical pattern classifier.
- perform unsupervised classification using clustering techniques.
- determine the fundamentals of neural networks.
- design Back Propagation and Hopfield network.
- perform classification using competitive neural networks.

TEXT BOOKS

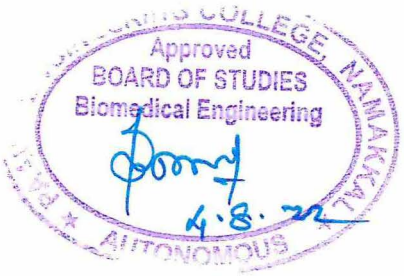
1. Richard O. Duda, Peter E. Hart, Peter Elliot Hart, Peter Edward Hart ,"Pattern Classification'', Wiley Edition, ebook edition, 9 Nov 2012.
2. Freeman J. A, Skapura B. M, "Neural networks, algorithms, applications and programming techniques", Addison-Wesley,2011.

REFERENCES

1. Hagan, Demuth and Beale, "Neural Network Design", Vikas Publishing House Pvt Ltd., NewDelhi, 2nd edition,2016.
2. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches", John Wiley and Sons(Asia) PvtLtd., Singapore,2005.
3. Laurene Fausett, "Fundamentals of Neural Networks - Architectures, Algorithms and Application", Prentice Hall, 2008.
4. Brian D. Ripley, "Pattern Recognition and Neural Networks", Cambridge University Press, 2007.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3		2					3	2	2
CO2	3	3	3		3		3		3			3	2	2
CO3	3	3	3		3				2			3	2	3
CO4	3	3	3		3							3	2	3
CO5	3	3	3		3							3	2	3



BM20254 ADVANCED MEDICAL SIGNAL PROCESSING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn and understand the concepts of classification of bio signals.
- understand the concepts of ECG Data Reduction.
- learn the different types of noise removal techniques.
- design the concepts of Spectral Estimation for bio signal interference.
- study the of noise removal techniques.

UNIT I INTRODUCTION 9

Introduction - General measurement and diagnostic system, Classification of signals; Introduction to biomedical signals - Biomedical signal acquisition and processing, Difficulties in signal acquisition; ECG - ECG signal origin; ECG parameters - QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

UNIT II ECG DATA REDUCTION 9

Direct data compression Techniques - Turning Point, AZTEC, Cortes, FAN; Transformation Compression Techniques - Karhunen - Loeve Transform; Other data compression Techniques - DPCM, Huffman coding, Data compression Techniques comparison; Signal Averaging - Basics of signal averaging, Signal averaging as a digital filter.

UNIT III ANALYSIS 9

Removal of high frequency noise (power line interference); Motion artifacts (low frequency) and power line interference in ECG; Time Series Analysis - Introduction, AR models, Estimation of AR parameters by method of least squares and Durbin's algorithm, ARMA models; Spectral modelling and analysis of PCG signals.

UNIT IV SPECTRAL ESTIMATION 9

Introduction - Blackman- Tukey method, The periodogram, Pisarenko's Harmonic decomposition, Prony' method, Evaluation of prosthetic heart valves using PSD techniques; Comparison of the PSD estimation methods; Event Detection and waveform analysis - Need for event detection, Detection of events and waves.

UNIT V ADAPTIVE FILTERING 9

Introduction - General structure of adaptive filters, LMS adaptive filter; Adaptive noise cancellation - Cancellation of 60 Hz interference in ECG, Cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG; EEG - EEG signal characteristics, Sleep EEG classification and epilepsy.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- implement the various types of processing techniques carried out on biomedical signals which meet the current industry needs.
- develop an interest to design new modeled algorithm more and more continually.
- develop an interest to simulate the models and validate its functionality in real time systems.
- analyzing the bio signal.
- demonstrate an ability to integrate different concepts to develop new models that suits current trends of industries and analyze its performance.

TEXT BOOKS

1. Luca Mesin, "Introduction to Biomedical Signal Processing" , ilmiolibro self-publishing, 2017.
2. D. C. Reddy, "Biomedical Signal Processing Principles and Techniques", Tata Mc Graw Hill, 2012.

REFERENCES

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis - A case study approach", Wiley IEEE Press, 2015.
2. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice-Hall, 2006.
3. Iyad Obeid, Ivan Selesnick, Joseph Picone, "Biomedical Signal Processing", Springer, 1st Edition 2021.
4. Sergio Cerutii, Carlo Marchesi, "Advanced Methods of Biomedical Signal Processing", 2011, ISBN: 9780470422144.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2								3	3
CO2	3	3	3	2	2						3		3	3
CO3	3	3	3	2	2	3	2				2		3	3
CO4	3	3	3	2	2	3					2		3	3
CO5	3	3	3	2	2	3	3						3	3

BM20901 INDUSTRIAL NANOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the advantages of nanotechnology based applications in each industry.
- provide instances of contemporary industrial applications of nanotechnology.
- provide an overview of future technological advancements.
- increasing role of nanotechnology in each industry.
- know the applications of nanotechnology in the field of biomedicine.

UNIT I NANOELECTRONICS 9

Advantages of nano electrical and electronic devices - Electronic circuit chips; Lasers - Micro and NanoElectromechanical systems, Sensors, Actuators; Optical switches; Data memory - Lighting and Displays; Batteries - Fuel cells and Photo-voltaic cells, Electric double layer capacitors, Lead-free solder, Nanoparticle coatings for electrical products.

UNIT II BIONANOTECHNOLOGY 9

Nanoparticles in bone substitutes and dentistry - Implants and Prosthesis; Nanorobotics in Surgery; Nanosensors in Diagnosis; Neuro-electronic Interfaces; Therapeutic applications.

UNIT III NANOTECHNOLOGY IN CHEMICAL INDUSTRY 9

Nanocatalyts - Smart materials, Heterogenous nanostructures and composites, Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes); Molecular Encapsulation and its applications - Nanoporous zeolites; Self-assembled Nanoreactors.

UNIT IV NANOTECHNOLOGY IN TEXTILES AND COSMETICS 9

Nanofibre production - Electrospinning, Controlling morphologies of nanofibers, Tissue engineering application, Polymer nanofibers, Nylon-6 nanocomposites from polymerization; Nano-filled polypropylene fibers; Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning, Flame retardant finishes) - Modern textiles; Cosmetics - Formulation of Gels, Shampoos, Hair-conditioners.

UNIT V BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY 9

Nano-bio conjugates and their significance; Nanoscaffolds, Magnetic Nanoparticles; Multi-functional Inorganic and organic nanoparticles and their biomedical applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- demonstrate the advantages of nanotechnology based applications in each industry
- analyze contemporary industrial applications of nanotechnology
- summarize future technological advancements
- recongnize increasing role of nanotechnology in each industry
- apply nanotechnology in the field of biomedicine.

TEXT BOOKS

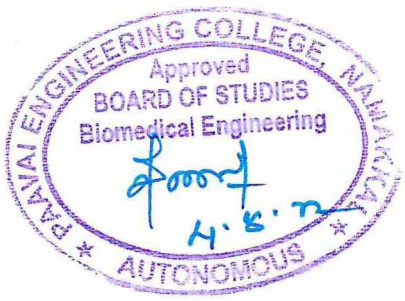
1. "An introduction to nanoparticles and nanotechnology", Maria Benelmekki, Published April 2015 .
2. W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds), "Handbook of nanoscience, Engineering and Technology", CRC Press, 2002

REFERENCES

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural nanomaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		**Programmes Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3										2	3	3
CO2		3	3	3	2	2	2	2	2			2	3	2
CO3					3	3	2	2	2	2		2	2	3
CO4	3				3			3			2	2	2	2
CO5	3				3							2	2	2



BM20902	BIOMEDICAL WASTE MANAGEMENT	3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the sources of the different types of medical waste.
- characterize the medical waste and its segregation.
- understand the storage, handling rules and transport of the medical waste.
- understand treatment and disposal of the hazardous waste.
- know the safety aspects from the medical waste.

UNIT I INTRODUCTION 9

Definition and description of Medical Waste- Classification of hazardous medical waste, Characterization of health-care waste; Overview of Hazard - Public sensitivity, Public Health impact.

UNIT II FUNDAMENTAL PRINCIPLES OF A WASTE MANAGEMENT PROGRAMME 9

Responsibilities and duties - hospital project manager, Water and habitat engineer, Local waste manager, Hospital administrator, Head nurse, Chief pharmacist, Head of laboratory; Preparing the waste management plan - Estimating costs, Implementing the waste management plan.

UNIT III RECYCLING PROCESS 9

Waste minimization - Recycling symbols for plastics, Recycling and recovery; Environmental management systems; Minimum approach to waste minimization.

UNIT IV TREATMENT AND DISPOSAL 9

Treatment and disposal methods - Incineration, Chemical disinfection, Needle extraction or destruction, Encapsulation; Personal protective equipment; Personal hygiene; Emergency measures; Training.

UNIT V SORTING, RECEPTACLES AND HANDLING 9

Sorting principles - Handling of bags, Hazardous waste handling rules; Various methods and Precautions during collection, Storage and Transportation of Hospital Waste.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- classify the types of medical waste and identify the risks of medical waste.
- describe the handling and disposal requirements for health care waste.
- collect each category of wastes in the proper container.
- clean up safely after an accidental spill of regulated medical waste.
- describe the health risks to health workers or patients related to sharps injuries.

TEXT BOOKS

1. Shishir Basarkar, "Hospital Waste Management: A Guide for Self-Assessment and Review", Jaypee Brothers, Medical Publishers Pvt. Limited,2009.
2. Khalid Maryam, "Evaluation of Biomedical Waste Management System", LAP Lambert Academic Publishing.2015.

REFERENCES

1. Peter A, "Infectious and Medical Waste Management", Pub.: CRC Press, 2018.
2. Ram Chandra, "Environmental Waste Management", Pub.: CRC Press, 2016.
3. Singh, Singh Anantpreet, Kaur Sukhjit, "Biomedical Waste Disposal", Jaypee Brothers Medical Publishers, 2012.
4. P. N. Harikumar, Ann Naisy Jacob, "Medical Waste Management", Abhijeet Publications, 1st Edition 2021.

CO/PO MAPPING :

CO/PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			2							2	3	
CO2	3	3	3		2							2	3	
CO3		3	3	2	2						2	2	3	
CO4		3	3	2	2						2	2	3	
CO5				2	2	2				2	2	2	3