PAAVAI ENGINEERING COLLEGE
REGULATIONS – 2019
CURRICULUM

SEMESTER I

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	EN20101	English Communication Skills I	3	0	0	3
2	BS	MA20101	Matrices and Calculus	3	1	0	4
3	BS	PH20101	Engineering Physics	3	0	0	3
4	BS	CH20101	Engineering Chemistry	3	0	0	3
5	ES	CS20101	Programming in Python	3	0	0	3
6	ES	EE20101	Basic Electrical Engineering	3	0	0	3
Practicals							
7	BS	CH20102	Chemistry Laboratory	0	0	2	1
8	ES	CS20103	Programming in Python Laboratory	0	0	2	1
			Total	**18**	**1**	**4**	**21**
			Cumulative Total				**21**

SEMESTER II

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	EN20201	English Communication Skills II	3	0	0	3
2	BS	MA20201	Complex Variables and DifferentialEquations	3	1	0	4
3	BS	PH20201	Physics for Electronics Engineering	3	0	0	3
4	ES	ME20201	Engineering Graphics	2	1	0	3
5	ES	MD20201	Circuits Analysis	3	0	0	3
6	MC	MC20201	Environmental Science and Engineering	3	0	0	0
Practicals							
7	BS	PH20205	Physics Laboratory	0	0	2	1
8	ES	GE20201	Engineering Practices Laboratory	0	0	4	2
9	ES	MD20202	Electrical Circuits Laboratory	0	0	2	1
			Total	**17**	**2**	**8**	**20**
			Cumulative Total				**41**

SEMESTER III

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	BS	MA20302	Linear algebra and Partial Differential equations	3	1	0	4
2	PC	MD20301	Analog Electronics	3	0	0	3
3	PC	MD20302	Signals and Systems	3	1	0	4
4	PC	MD20303	Sensors and Measurements	3	0	0	3
5	PC	MD20304	Digital Design and HDL	3	0	0	3
6	MC	MC20301	Value Education	3	0	0	0
Practicals							
7	PC	MD20305	Analog Electronic Circuits Laboratory	0	0	4	2
8	PC	MD20306	Sensors and Measurements Laboratory	0	0	4	2
9	PC	MD20307	Digital Electronic Circuits Laboratory	0	0	4	2
			Total	**18**	**2**	**12**	**23**
			Cumulative Total				**64**

SEMESTER IV

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	EE	BA19151	Entrepreneurship Development	3	0	0	3
2	BS	MA20403	Probability and Statistics	3	1	0	4
3	ES	IT20404	Object Oriented Programming with C++	3	0	0	3
4	PC	MD20401	Linear Integrated Circuits	3	0	0	3
5	PC	MD20402	Biomedical Instrumentation	3	0	0	3
6	PC	MD20403	Anatomy and Physiology	3	0	0	3
Practicals							
7	EE	EN20402	English Proficiency Course Laboratory	0	0	2	1
8	PC	MD20404	Medical Instrumentation Laboratory	0	0	4	2
9	ES	IT20407	Object Oriented Programming with C++ Laboratory	0	0	4	2
			Total	**18**	**1**	**6**	**24**
			Cumulative Total				**88**

SEMESTER V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20501	Biomechanics	3	0	0	3
2	PC	MD20502	Analog and Digital Communication	3	0	0	3
3	PC	MD20503	Microprocessor and Microcontroller	3	0	0	3
4	PC	MD20504	Biocontrol Systems	3	0	0	3
5	PC	MD20505	Diagnostic and Therapeutic Equipment	3	0	0	3
6	PE	MD2015*	Professional Elective I	3	0	0	3
Practicals							
7	PC	MD20506	Microprocessor and Microcontroller Laboratory	0	0	4	2
8	PC	MD20507	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
9	EE	EN20501	Career Development Laboratory I	0	0	2	1
			Total	**18**	**0**	**10**	**23**
			Cumulative Total				**111**

SEMESTER VI

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20601	Human Assist Devices	3	0	0	3
2	PC	MD20602	Biomaterials	3	0	0	3
3	PC	MD20603	Biomedical Signal Processing	3	0	0	3
4	PE	MD2025*	Professional Elective II	3	0	0	3
5	OE	MD2090*	Open Elective I	3	0	0	3
Practicals							
7	PC	MD20604	Biomedical signal Processing Laboratory	0	0	4	2
8	EE	EN20601	Career Development Laboratory II	0	0	2	1
			Total	**18**	**0**	**10**	**18**
			Cumulative Total				**129**

SEMESTER VII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20701	Medical Image Processing	3	0	0	3
2	PC	MD20702	Medical Imaging Techniques and Radio Therapy	3	0	0	3
3	PC	MD20703	Medical Informatics	3	0	0	3
4	PE	MD2035*	Professional Elective III	3	0	0	3
5	PE	MD2045*	Professional Elective IV	3	0	0	3
6	OE	MD2090*	Open Elective II	3	0	0	3
Practicals							
7	PC	MD20704	Medical Image Processing Laboratory	0	0	4	2
8	EE	MD20705	Hospital Internship	0	0	2	1
9	EE	MD20706	Project Work (Phase I)	0	0	6	3
			Total	**18**	**0**	**12**	**24**
			Cumulative Total				**153**

SEMESTER VIII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	MD2055*	Professional Elective V	3	0	0	3
2	PE	MD2065*	Professional Elective VI	3	0	0	3
Practicals							
3	EE	MD20801	Project Work (Phase II)	0	0	12	6
			Total	**6**	**0**	**12**	**12**
			Cumulative Total				**165**

HUMANITIES AND SOCIAL SCIENCES (HS)

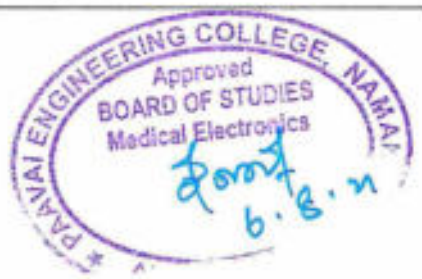
S.No.	Category	Course Code	Course Title	L	T	P	C
1	HS	EN20101	English Communication Skills I	3	0	0	3
2	HS	EN20201	English Communication Skills II	3	0	0	3
			Total				**6**

BASIC SCIENCES (BS)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	BS	MA20101	Matrices and Calculus	3	1	0	4
2	BS	PH20101	Engineering Physics	3	0	0	3
3	BS	CH20101	Engineering Chemistry	3	0	0	3
4	BS	CH20102	Chemistry Laboratory	0	0	2	1
5	BS	MA20201	Complex Variables and Differential Equations	3	1	0	4
6	BS	PH20201	Physics for Electronics Engineering	3	0	0	3
7	BS	PH20205	Physics Laboratory	0	0	2	1
8	BS	MA20302	Linear algebra and Partial Differential equations	3	1	0	4
9	BS	MA20403	Probability and Statistics	3	1	0	4
			Total				**27**

ENGINEERING SCIENCES (ES)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	ES	CS20101	Programming in Python	3	0	0	3
2	ES	EE20101	Basic Electrical Engineering	3	0	0	3
3	ES	CS20103	Programming in Python Laboratory	0	0	2	1
4	ES	ME20201	Engineering Graphics	2	1	0	3
5	ES	MD20201	Circuits Analysis	3	0	0	3



6	ES	MD20202	Electrical Circuits Laboratory	0	0	2	1
7	ES	GE20203	Engineering Practices Laboratory	0	0	4	2
8	ES	IT20404	Object Oriented Programming with C++	3	0	0	3
9	ES	IT20407	Object Oriented Programming with C++ Laboratory	0	0	4	2
							21

PROFESSIONAL CORE COURSES (PC)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PC	MD20301	Analog Electronics	3	0	0	3
2	PC	MD20302	Signals and Systems	3	1	0	4
3	PC	MD20303	Sensors and Measurements	3	0	0	3
4	PC	MD20304	Digital Design and HDL	3	0	0	3
5	PC	MD20305	Analog Electronic Circuits Laboratory	0	0	4	2
6	PC	MD20306	Sensors and Measurements laboratory	0	0	4	2
7	PC	MD20307	Digital Electronic Circuits Laboratory	0	0	4	2
8	PC	MD20401	Linear Integrated Circuits	3	0	0	3
9	PC	MD20402	Biomedical Instrumentation	3	0	0	3
10	PC	MD20403	Anatomy and Physiology	3	0	0	3
11	PC	MD20405	Medical Instrumentation Laboratory	0	0	4	2
12	PC	MD20501	Biomechanics	3	0	0	3
13	PC	MD20502	Analog and Digital communication	3	0	0	3
14	PC	MD20503	Microprocessor and Microcontroller	3	0	0	3
15	PC	MD20504	Biocontrol Systems	3	0	0	3
16	PC	MD20505	Diagnostic and Therapeutic Equipment	3	0	0	3
17	PC	MD20506	Microprocessor and Microcontroller Laboratory	0	0	4	2

18	PC	MD20507	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
19	PC	MD20601	Human Assist Devices	3	0	0	3
20	PC	MD20602	Biomaterials	3	0	0	3
21	PC	MD20603	Biomedical Signal Processing	3	0	0	3
22	PC	MD20604	Biomedical signal Processing Laboratory	0	0	4	2
23	PC	MD20701	Medical Image Processing	3	0	0	3
24	PC	MD20702	Medical Imaging Techniques and Radio Therapy	3	0	0	3
25	PC	MD20703	Medical Informatics	3	0	0	3
26	PC	MD20704	Medical Image Processing Laboratory	0	0	4	2
			Total				**71**

PROFESSIONAL ELECTIVE COURSES (PE)

S.No	Category	Course Code	Course Title	L	T	P	C
Professional Elective-I							
1	PE	MD20151	Robotics and Automation	3	0	0	3
2	PE	MD20152	Neural Network and its applications	3	0	0	3
3	PE	MD20153	Bio MEMS	3	0	0	3
4	PE	MD20154	Medical Expert Systems	3	0	0	3
Professional Elective-II							
5	PE	MD20251	VLSI Design	3	0	0	3
6	PE	MD20252	Pattern Recognition	3	0	0	3
7	PE	MD20253	Advanced Medical Instrumentation Technology	3	0	0	3
8	PE	MD20254	Telehealth Technology	3	0	0	3
Professional Elective-III							
9	PE	MD20351	Fundamentals of Biomedical Nanotechnology	3	0	0	3

10	PE	MD20352	Smart Wearable Systems	3	0	0	3
11	PE	MD20353	Rehabilitation Engineering	3	0	0	3
12	PE	MD20354	Cloud Computing for Healthcare	3	0	0	3
Professional Elective-IV							
13	PE	MD20451	Nanotechnology and its applications	3	0	0	3
14	PE	MD20452	Physiological Modeling	3	0	0	3
15	PE	MD20453	Medical Devices Regulations	3	0	0	3
16	PE	MD20454	Artificial Intelligence in Healthcare	3	0	0	3
Professional Elective-V							
17	PE	MD20551	Artificial Organs and Implants	3	0	0	3
18	PE	MD20552	Body Area Networks	3	0	0	3
19	PE	MD20553	Medical Ethics and Safety	3	0	0	3
20	PE	MD20554	Embedded Systems and Internet of Things in Healthcare	3	0	0	3
Professional Elective-VI							
21	PE	MD19651	Virtual Bioinstrumentation	3	0	0	3
22	PE	MD19652	Digital Video Processing	3	0	0	3
23	PE	MD19653	Quality control in Biomedical Engineering	3	0	0	3
24	PE	MD19654	Brain Computer Interface and its Applications	3	0	0	3
			Total				**72**

OPEN ELECTIVE COURSES (OE)

S.No.	Category	Course Code	Course Title	L	T	P	C
OPEN ELECTIVE COURSE -I							
1	OE	MD20901	Biomedical Equipments	3	0	0	3
2	OE	MD20902	Basics of Bioinformatics	3	0	0	3

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OPEN ELECTIVE COURSE -II							
3	OE	MD20903	Product design and development	3	0	0	3
4	OE	MD20904	Electrical safety and Quality Assurance in Healthcare	3	0	0	3
			Total				**12**

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	EE	BA20151	Entrepreneurship Development	3	0	0	3
2	EE	EN20402	English Proficiency Course Laboratory	0	0	2	1
3	EE	EN20501	Career Development Laboratory I	0	0	2	1
4	EE	EN20601	Career Development Laboratory II	0	0	2	1
5	EE	MD20705	Hospital Internship	0	0	2	1
6	EE	MD20706	Project work (Phase I)	0	0	6	3
7	EE	MD20801	Project work (Phase II)	0	0	12	6
			Total				**16**

MANDATORY COURSES (MC)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	MC	MC20201	Environmental Science and Engineering	3	0	0	0
2	MC	MC20301	Value Education	3	0	0	0
			Total				0

CURRICULUM STRUCTURE

S.No.	Category	Credit Range		Total Credits	Number of Courses
		Min	Max		
1	Humanities and Social Sciences (HS)	10	14	6	2
2	Basic Sciences (BS)	25	28	27	9
3	Engineering Sciences (ES)	20	24	21	9
4	Professional Core Courses (PC)	55	70	71	26
5	Professional Elective Courses (PE)	15	18	18	6
6	Open Elective Courses (OE)	6	6	06	2
7	Employability Enhancement Courses (EE)	11	13	16	7
Total				165	62

SUMMARY

S.NO.	CATEGORY	CREDITS AS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HS	03	03							06
2	BS	11	08	04	04					27
3	ES	07	09		05					21
4	PC			19	11	19	11	11		71
5	PE					03	03	06	06	18
6	OE						03	03		06
7	EE				04	01	01	04	06	16
8	TOTAL	21	20	23	24	23	18	24	12	165
9	NON-CREDIT/ MANDATORY		0	0						

SEMESTER V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20501	Biomechanics	3	0	0	3
2	PC	MD20502	Analog and Digital Communication	3	0	0	3
3	PC	MD20503	Microprocessor and Microcontroller	3	0	0	3
4	PC	MD20504	Biocontrol Systems	3	0	0	3
5	PC	MD20505	Diagnostic and Therapeutic Equipment	3	0	0	3
6	PE	MD2015*	Professional Elective I	3	0	0	3
Practicals							
7	PC	MD20506	Microprocessor and Microcontroller Laboratory	0	0	4	2
8	PC	MD20507	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
9	EE	EN20501	Career Development Laboratory I	0	0	2	1
			Total	**18**	**0**	**10**	**23**
			Cumulative Total				**111**

SEMESTER VI

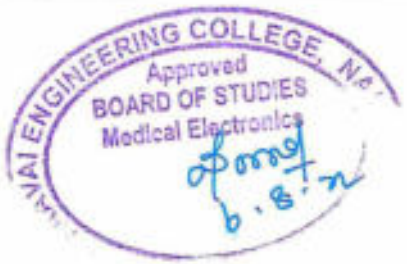
S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20601	Human Assist Devices	3	0	0	3
2	PC	MD20602	Biomaterials	3	0	0	3
3	PC	MD20603	Biomedical Signal Processing	3	0	0	3
4	PE	MD2025*	Professional Elective II .	3	0	0	3
5	OE	MD2090*	Open Elective I	3	0	0	3
Practicals							
7	PC	MD20604	Biomedical signal Processing Laboratory	0	0	4	2
8	EE	EN20601	Career Development Laboratory II	0	0	2	1
			Total	**18**	**0**	**10**	**18**
			Cumulative Total				**129**

PROFESSIONAL ELECTIVE COURSES (PE)

S.No	Category	Course Code	Course Title	L	T	P	C
Professional Elective-I							
1	PE	MD20151	Robotics and Automation	3	0	0	3
2	PE	MD20152	Neural Network and its applications	3	0	0	3
3	PE	MD20153	Bio MEMS	3	0	0	3
4	PE	MD20154	Medical Expert Systems	3	0	0	3
Professional Elective-II							
5	PE	MD20251	VLSI Design	3	0	0	3
6	PE	MD20252	Pattern Recognition	3	0	0	3
7	PE	MD20253	Advanced Medical Instrumentation Technology	3	0	0	3
8	PE	MD20254	Telehealth Technology	3	0	0	3

OPEN ELECTIVE

S.No.	Category	Course Code	Course Title	L	T	P	C
OPEN ELECTIVE COURSE -I							
1	OE	MD20901	Biomedical Equipments	3	0	0	3
2	OE	MD20902	Basics of Bioinformatics	3	0	0	3



SEMESTER VII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20701	Medical Image Processing	3	0	0	3
2	PC	MD20702	Medical Imaging Techniques and Radio Therapy	3	0	0	3
3	PC	MD20703	Medical Informatics	3	0	0	3
4	PE	MD2035*	Professional Elective III	3	0	0	3
5	PE	MD2045*	Professional Elective IV	3	0	0	3
6	OE	MD2090*	Open Elective II	3	0	0	3
Practicals							
7	PC	MD20704	Medical Image Processing Laboratory	0	0	4	2
8	EE	MD20705	Hospital Internship	0	0	2	1
9	EE	MD20706	Project Work (Phase I)	0	0	6	3
			Total	18	0	12	24
			Cumulative Total				151

SEMESTER VIII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	MD 2055*	Professional Elective V	3	0	0	3
2	PE	MD 2065*	Professional Elective VI	3	0	0	3
Practicals							
3	EE	MD 20801	Project Work (Phase II)	0	0	12	6
			Total	**6**	**0**	**12**	**12**
			Cumulative Total				**163**

S.No.	Category	Course Code	Course Title	L	T	P	C
Professional Elective-III							
1	PE	MD20351	Fundamentals of Biomedical Nanotechnology	3	0	0	3
2	PE	MD20352	Smart Wearable Systems	3	0	0	3
3	PE	MD20353	Rehabilitation Engineering	3	0	0	3
4	PE	MD20354	Cloud Computing for Healthcare	3	0	0	3
Professional Elective-IV							
5	PE	MD20451	Nanotechnology and its Applications	3	0	0	3
6	PE	MD20452	Physiological Modeling	3	0	0	3
7	PE	MD20453	Medical Devices Regulations	3	0	0	3
8	PE	MD20454	Artificial Intelligence in Healthcare	3	0	0	3
Professional Elective-V							
9	PE	MD20551	Artificial Organs and Implants	3	0	0	3
10	PE	MD20552	Body Area Networks	3	0	0	3
11	PE	MD20553	Medical Ethics and Safety	3	0	0	3
12	PE	MD20554	Embedded Systems and Internet of Things in Healthcare	3	0	0	3
Professional Elective-VI							
13	PE	MD20651	Virtual Bioinstrumentation	3	0	0	3
14	PE	MD20652	Digital Video Processing	3	0	0	3
15	PE	MD20653	Quality control in Biomedical Engineering	3	0	0	3
16	PE	MD20654	Brain Computer Interface and its Applications	3	0	0	3

OPEN ELECTIVE

S.No.	Category	Course Code	Course Title	L	T	P	C
OPEN ELECTIVE COURSE -II							
3	OE	MD20903	Product Design and Development	3	0	0	3
4	OE	MD20904	Electrical Safety and Quality Assurance in Healthcare	3	0	0	3

MD20501 **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 biosolid 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 **9**

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 **9**

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 **9**

Constitutive equation of viscoelasticity – Maxwell and Voight models, anisotropy, fatigue analysis; Hard Tissues– Definition of stress and strain, Deformation mechanics, Bone structure and composition, mechanical properties of bone, cortical and Cancellous Bone, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation.

Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues, Cartilage, Tendons and Ligaments Skeletal Muscle, Hodin, huxley model; Mechanical testing of Soft tissue; Muscle action, Hill's models, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS **9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, 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 9

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

- discuss the basic principles of mechanics in various applications
- discuss the mechanics of physiological systems.
- acquired knowledge on biosolid 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

TEXT BOOKS

1. Y.G.Fung, Biomechanics, Springer-verlag NewYork Inc, 2010
2. Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor&Francis,2017.

REFERENCES

1. SusanJ Hall, "Basics of Biomechanics'', McGraw Hill Publishing.co. NewYork, 8th Edition, 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; Gunnar Leivseth; Burkhard Drerup, "Orthopaedic BioMechanics", 2nd edition, 2016.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3					3							3		
CO 2	2						3						3		
CO 3	3						2						3		
CO 4	2						2						3		
CO 5	3						2						3		

MD20502 ANALOG AND DIGITAL COMMUNICATION 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand analog and digital communication techniques.
- learn data and pulse communication techniques.
- be familiarized with source and Error control coding.
- gain knowledge on multi-user radio communication.
- acquire the knowledge on the applications of analog and digital communication

UNIT I ANALOG COMMUNICATION 9

Noise- Source of Noise, External Noise, Internal Noise, Noise Calculation; Introduction to Communication Systems; Modulation – Types, Need for Modulation; Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

UNIT II DIGITAL COMMUNICATION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK), Minimum Shift Keying (MSK); Phase Shift Keying (PSK) – BPSK, QPSK, 8 PSK, 16 PSK; Quadrature Amplitude Modulation (QAM) – 8 QAM, 16 QAM; Bandwidth Efficiency; Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT III DATA AND PULSE COMMUNICATION 9

Data Communication- History of Data Communication, Standards Organizations for Data Communication, Data Communication Circuits, Data Communication Codes, Error Detection and Correction Techniques; Data communication Hardware – serial and parallel interfaces; Pulse Communication- Pulse Amplitude Modulation (PAM), Pulse Time Modulation (PTM), Pulse code Modulation (PCM); Comparison of various Pulse Communication System (PAM – PTM – PCM).

UNIT IV SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, ARQ techniques

UNIT V MULTI-USER RADIO COMMUNICATION 9

Advanced Mobile Phone System (AMPS) – Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply analog and digital communication techniques.
- use data and pulse communication techniques.
- analyze Source and Error control coding.
- utilize multi-user radio communication.
- implement applications based on the knowledge acquired in analog and digital communication

TEXT BOOKS

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.
2. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004

REFERENCES

1. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
2. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
3. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
4. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	3			3								3		
CO 2	2	2			3								3		
CO 3	3	3			3								3		
CO 4	2	2			3								3		
CO 5	3	3			3								3		

MD20503 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 and writing from I/O port pins, Interfacing 8051 to ADC, Liquid crystal display (LCD), keyboard, Stepper motor.

UNIT IV ARM MICROCONTROLLER 9

Principles and applications nanomaterials- DNA and protein based nanobiosensors; Future direction in biosensor research; MEMS and NEMS; Quantum dots– Synthesis, Properties, applications and drawbacks. Biochips and In-vivo imaging - Integrated nano sensor networks.

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

- relate any architecture and assembly language for a processor.
- comprehend 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 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. Andrew N.Sloss,DonimicSymes, Chris Wright, "ARM System Developer's Guide", Elsevier, 1st edition, 2009.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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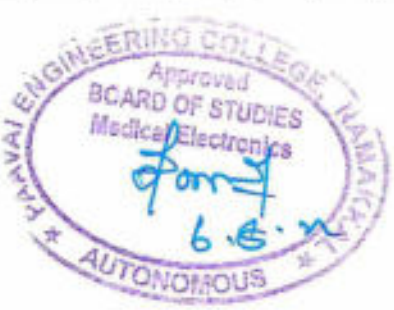
CO 1	3	3		3	2								3	2	2
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



MD20504 **BIOCONTROL SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand biocontrol 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 AND CONTROLLER **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. Controllers (PI, PD, PID) basic concepts.

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.
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001.

REFERENCES

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 1995.
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.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3

MD20505 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT 3 0 0 3

COURSE OBJECTIVES

To enable students to

- gain knowledge about measurements of parameters related to cardio –pulmonary system.
- understand the need of neuro muscular equipments.
- understand different types and uses of diathermy and laser units.
- know the principles of ultrasound and its use in diagnosis.
- know the importance of patient safety against electrical and laser hazards.

UNIT I CARDIO-PULMONARY MEASUREMENTS 9

Electrocardiograph, Heart rate monitor- Holter Monitor, Cardiac Pacemaker- Internal and External Pacemaker, types, Batteries. AC and DC Defibrillator- types. Lung Volume and vital capacity measurements, Spirometer; Pneumo tachometer – 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, Need for heart lung machine, Functioning of bubble, Disc type and membrane type oxygenators, finger pump, roller pump; Humidifiers, Nebulizers, Inhalators.

UNIT II NEURO-MUSCULAR EQUIPMENTS 9

Multi channel EEG recording system recording of various sleep patterns, Evoked Potential –Visual, Auditory and Somatosensory, EEG Bio Feedback Instrumentation, MEG (Magneto Encephalograph) -sensing principle and instrumentation. 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 III DIATHERMY AND LASER BASED EQUIPMENTS 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. Artificial kidney - Hemodialyser unit, Peritoneal dialyser unit. Lithotripsy, Cryogenic technique, Thermography – Recording Principle and clinical application. Tonometer, Auto Refractometer. Audiometer- Beksey's type, Pure tone, Speech. Galvanic skin resistance (GSR)- polygraph.

UNIT IV ULTRASOUND AND SPECIAL DIAGNOSTIC TECHNIQUES 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; Artificial kidney - Hemodialyser unit, Peritoneal dialyser unit. Lithotripsy, Cryogenic technique, Thermography – Recording Principle and clinical application. Tonometer, Auto Refractometer. Audiometer- Beksey's type, Pure tone, Speech. Galvanic skin resistance (GSR)- polygraph.

UNIT V BIOTELEMETRY AND PATIENT SAFETY 9

Patient monitoring systems - ICU/CCU Equipment, Infusion pumps, bed side monitors, Central monitoring console; Architecture of Biotelemetry system – single and multi-channel Biotelemetry. Concept of m-Health 2.0. Physiological effects of electricity – Macro shock, Micro shock hazards, Patient's electrical environment, GFI

units, Earthing Schemes. Electrical safety codes and standards, 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

- explain about measurements of parameters related to cardio-pulmonary system.
- appreciate the use of advanced minimally invasive therapies.
- analyze different types of diathermy units and lasers.
- understand the concepts of ultrasound equipment and special techniques.
- identify the communication aspects in medicine, electrical hazards and Implement methods of patient safety.

TEXT BOOKS

1. Leslie Cromwell, Fred J. Weibell, Erich A.Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
2. Joseph J.Carrand JohnM. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4thEdition, 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, 1990.
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 :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3			2								3	2	2
CO 2	2			3						2			3	3	3
CO 3		3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3						1			3	3	3

MD20506	MICROPROCESSOR AND MICROCOINTROLLER LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

- learn to write programs for sorting and manipulation using 8086.
- acquire the programming knowledge for arithmetic and logical operations in 8086 and 8051.
- learn how the devices interfaced with processor.
- acquire programming knowledge for understanding of communication standards in 8086, 8051 and ARM Microcontroller.

LIST OF EXPERIMENTS

1. Programs for 8/16 bit arithmetic, sorting searching and string operations.
2. Basic arithmetic and logic operations.
3. Programming using bit manipulation instructions of the 8051 microcontroller.
4. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
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 Launch pad 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 this course, students will be able to

- enumerate the programs for sorting, string manipulation using 8086.
- apply the programming knowledge for arithmetic and logical operations in 8086 and 8051.
- contrast how the devices interfaced with processor.
- apply the programming knowledge for the communication standards in Microcontroller.

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3			3	2					1			3	2	2
CO 2	2	3			3								3	3	3
CO 3	3	3		3	3	2							3	3	3
CO 4	2	3	2	2	3								3	3	3

MD20507	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the 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. Analysis of characteristics of surgical diathermy.
9. Galvanic skin resistance (GSR) measurement
10. Study of muscle stimulator.

TOTALPERIODS 60

COURSE OUTCOMES

At the end of the course, the student should 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:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 1	3			3	2					1			3	2	2
CO 2	2	3			3								3	3	3
CO 3	3	3		3	3	2							3	3	3
CO 4	2	3	2	2	3								3	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

MD20601 **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 orthodic devices and prosthetic devices to overcome orthopaedic 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, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II HEMODIALYSERS 9

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS 9

Common tests – audiograms, airconduction, 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 orthodic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, biofeedback,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. Levine S.N. (ed), "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968 (Unit I, IV, V).
2. Kolff W.J, "Artificial Organs", John Wiley and sons, New York, 1976. (Unit II).

REFERENCES

1. Albert M.Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey,1982 (Unit III)
2. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 2		2	3	2	2		2		2					2	
CO 3		2	2	2	3	3		2		3			2		
CO 4	2	2	3	2	3	3	1					3	3		2
CO 5	2	3	3	2	3			2		2				2	2

MD20602 **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 BIO-MATERIALS **9**

Definition and classification of bio-materials, 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 – bio inert, 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, Bio polymers: 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 Nano biomaterials.

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.
- understand the testing standards applied for biomaterials.

TEXT BOOKS

1. Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.

REFERENCES

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003
2. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005
3. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984
4. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,"Woodhead Medical Textiles and Biomaterials for Healthcare", Publishing Limited 2006

CO/PO MAPPING :

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CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3

MD20603 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; Bioelectric signals and its basic characteristics- Biosignal Characteristics of Electro Gastro Gram (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 invariance 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 Hanningwindow),Frequencysamplingmethod;FIRfilterstructures-linearphasestructure,directform 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 and waveforms; EEG applications- Epilepsy, sleep disorders, brain computer interface; Modeling 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, Backpropagation neural network; Analysis of EEG using Empirical mode 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 biosignal 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 cardiovascular signals
- utilize the concepts acquired through Neurological applications and signal classification

TEXT BOOKS

1. JohnG. Proakis & Dimitris G.Manolakis,—Digital Signal Processing–Principles, Algorithms & Applicationsl, 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. Semmlow, —Biosignal and Biomedical Image Processingl, Marcel Dekker,2004.
2. Sergio Cerutti Carlo Marchesi, "Advanced Methods of Biomedical Signal Processing" Wiley.
3. Reddy D.C, "Biomedical signal processing : Principles and techniques", Tata McGraw-Hill, New Delhi, 2nd edition, 2005.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing- A Practical Approach'', Pearson education Ltd., 2004.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3		3	2								3	2	2
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3

MD20604 BIOMEDICAL SIGNAL PROCESSING LABORATORY 0 0 4 2

COURSEOBJECTIVES

To enable the students to

- examine the representation of basic sine, cosine, ramp, exponent signal, triangular wave.
- understand the sampling, quantization process and apply the knowledge on transformation of signals and convolution process.
- acquire the knowledge on the representation of IIR Filter and FIR Filter design.
- acquire the knowledge on representation of heart rate based on ECG signal and spectral analysis of EEG Signal using MATLAB.

LISTOFEXPERIMENTS

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 (Butterworth 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

TOTALPERIODS 60

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

- validate the representation of basic sine, cosine, ramp, exponent signal, triangular wave.
- formulate the sampling, quantization process and apply the knowledge on transformation of signals and convolution process.
- interpret the representation of IIR Filter and FIR Filter design.
- analyze the heart rate based on ECG signal and spectral analysis of EEG Signal using MATLAB.

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 1	3			3	2					1			3	2	2
CO 2	2	3			3								3	3	3
CO 3	3	3		3	3	2							3	3	3
CO 4	2	3	2	2	3								3	3	3

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

MD20151 **ROBOTICS AND AUTOMATION** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- illustrate the basic concepts associated with the design, functioning, applications, and social aspects of robots.
- interpret the electrical drive systems and sensors used in robotics for various applications
- analyze robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- demonstrate various motion planning techniques and the associated control architecture
- inference the AI and other trending concepts of robotics

UNIT I FOUNDATION FOR BEGINNERS **9**

Introduction to Robotics - Brief history, definition, anatomy, types, classification, specification and need based applications; Role and need of robots for the immediate problems of the society;Future of mankind and automation-Ethical issues, industrial scenario local and global;Case studies on mobile robot research platform and industrial serial arm manipulator

UNIT II BUILDING BLOCKS OF A ROBOT **9**

Types of electric motors - DC, Servo, Stepper; specification;Drives for motors - speed and direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation;Obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self-driving cars

UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS AND END EFFECTORS **9**

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics, Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study

UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE **9**

Mapping and Navigation – SLAM, Path planning for serial manipulators; Types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS **9**

Application of Machine and Deep learning - AI, Expert systems; Telerobotics and Virtual Reality, Micro and Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids and Augmented Reality

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots and automation
- examine different sensors and actuators for applications like maze solving and self-driving cars.
- design a 2R robot and an end-effector and solve the kinematics and dynamics of motion for robots.
- formulate the navigation and path planning techniques along with the control architectures adopted for robot motion planning.
- build the impact and progress in AI and other research trends in the field of robotics

TEXT BOOKS

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002.
2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2011.

REFERENCES

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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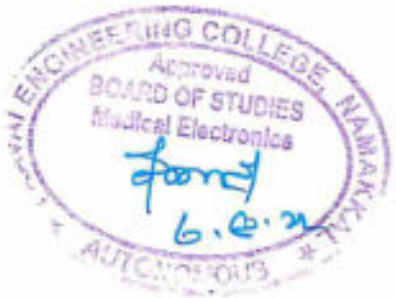
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



MD20152 **NEURAL NETWORK AND ITS APPLICATIONS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the basics of biology in terms of artificial neural networks
- understand the concept of supervised learning in neural network
- acquire the knowledge on the associative network and network based on competition
- understand the concept of micro sensors and micro actuators
- acquire the knowledge on the applications of neural networks

UNIT I INTRODUCTION **9**

History of Neural Networks- Biological Neural Networks; Components of Artificial Neural Networks – Connections, Propagation function and Network Inputs, Common Activation Functions, Threshold, Network Topologies, Bias Neuron; Fundamentals of Learning and Training – Supervised, Unsupervised, Reinforcement, Training Pattern and Teaching Input, Learning Curve and Error measurement.

UNIT II SUPERVISED NETWORK LEARNING PARADIGMS **9**

Perceptron and backpropagation – Single Layer Perceptron, Convergence theorem, delta rule, Linear Separability, Multilayer Perceptron, Backpropagation of error, variation and extension to backpropagation; Recurrent perceptron like networks.

UNIT III ASSOCIATIVE NETWORK AND NETWORK BASED ON COMPETITION **9**

Associative Memory – Different types of Pattern Association, Bidirectional Associative Memory, and Hopfield Memory; Self-Organizing feature maps - Linear Vector Quantization, Counter Propagation Networks.

UNIT IV ADVANCE NEURAL NETWORKS **9**

Radial Basis Functions; Support Vector Machines; Extreme Learning Machine; Extended Extreme Learning Machine; Principle component Analysis; Deep Learning and Hierarchical Temporal Memory, DNN architecture.

UNIT V APPLICATION OF NEURAL NETWORKS **9**

ANN Applications - ANN in Computer Aided Diagnosis, ANN as multivariate statistical model, ANN for medical Image segmentation, ANN as a predictive model, ANN as a optimizer.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- summarize the basics of biology in terms of artificial neural networks

- illustrate the concept of supervised learning in neural network
- apply the knowledge on the associative network and network based on competition
- enumerate the concept of micro sensors and micro actuators
- develop applications based on the knowledge acquired in neural networks

TEXT BOOKS

1. David Kriesel, —A Brief Introduction to neural networks
2. Simon O. Haykins, Neural Networks: A Comprehensive Foundation, 2nd Edition, Pearson 1994

REFERENCES

1. Laurene Fausett, —Fundamentals of neural networks- Architectures, algorithms and applicationsl, Prentice Hall, 1994.
2. James A Freeman and David M.Skapra, Neural Networks: Algorithms, Applications, and Programming Techniques, Addison-Wesley, 1991, Digital Version 2007.
3. Edited by Kenji Suzuki, Artificial Neural Networks - Methodological Advances and Biomedical Applications, ISBN 978-953-307-243-2, 374 pages, Publisher: InTech, Chapters published April 11, 2011 under CC BY-NC-SA 3.0 license DOI: 10.5772/644

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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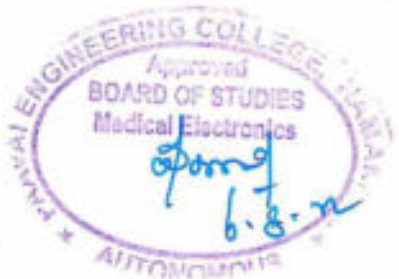
CO 1	3	3			3								3		
CO 2	2	2			3								3		
CO 3	3	3			3								3		
CO 4	2	2			3								3		
CO 5	3	3			3								3		



MD20153 **BIO MEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the materials used in MEMs process of Microsystems.
- understand the concepts of mechanical, thermal sensor and actuators.
- learn the different types of sensors and actuators and their principles of operation at the micro scale level.
- design the concepts of micro sensors and micro actuators.
- build the applications of MEMS in different fields of medicine.

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- Evolution ofMicro-fabrication, 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

- discuss various MEMS Materials and the fabrication techniques.
- discuss the concepts of mechanical,thermal sensor and actuators.
- explain different 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. Marc J. Madou, "Fundamentals of Microfabrication: the science of miniaturization'', CRC Press, 2002.
2. Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and applications", CRC Press, New York, 2007
3. Malsch, NeelinaH., ed., Biomedical Nanotechnology, Washington, DC: CRC Press, 2005.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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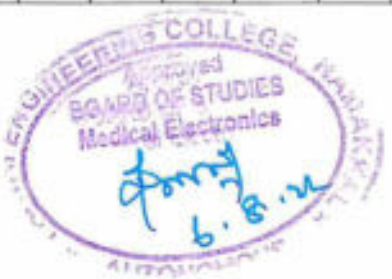
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



MD20154 **MEDICAL EXPERT SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- explain about the informed opinions about the present and past opinion leaders in the artificial intelligence debate.
- defines a simple, informal expert system by performing an effort of knowledge engineering of a real, human expert.
- develop a series of Web pages that will serve as a current "state of the art" review of the various AI application areas, areas which may be suggested by the instructor or brought to the course by participants.
- knowledge on hands-on demonstrations of ware while accomplishing the review of current applications areas in AI.
- build applications on medical expert systems

UNIT I INTRODUCTIONTO AI **9**

Introduction of AI- Definition, importance, problem solving, searching, heuristic searching.

UNIT II KNOWLEDGEREPRESENTATION **9**

Knowledge representation- Preposition Logic, Clause form, Predicate logic, Resolution, Inference Rules, Unification, Semantic networks, frames, conceptual dependency, Scripts; Knowledge representation using rules–rule based systems.

UNIT III EXPERTSYSTEMS **9**

Expert system architecture– Nonproduction systems Architecture: Associative or semantic Networks, Frame Architecture, Decision Tree Architecture, Blackboard, Neural Network Architecture – Knowledge acquisition and validation, Knowledge system building tools.

UNIT IV LEARNING&DECISIONMAKING **9**

Types of learning – general learning model, learning by induction, Generalization and specialization– inductive bios, explanation based learning

UNIT V CASESTUDY **9**

Study of medical expert systems– MYCIN, EMYCIN; Development of medical expert systems; Sample Case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the role of Artificial Intelligence, Expert Systems and Decision Models in managerial

decision-making.

- apply, build and modify decision models to solve real problems
- design and develop Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment
- explain Artificial Intelligence Technique
- build a prototype Artificial Intelligence Based Decision Support System

TEXT BOOKS

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004.

REFERENCES

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.
4. S. Shanmugam "Nanotechnology" MJP Publishers, 2011, ISBN 978-81-8094-0644.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 5			3	3	3	3	3	3	3	3	3	3	3	3	

MD20251 **VLSI DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand the MOS circuit realization and various processing technologies.
- study the transistor circuit level design and realization for digital operation.
- learn the circuit characteristics and performance estimation.
- gain the knowledge about testing of CMOS
- acquire the basics of Verilog in different types of Modeling

UNIT I MOS TRANSISTOR THEORY AND PROCESS TECHNOLOGY **9**

NMOS and PMOS transistors -Threshold voltage -Body effect -MOS device design equations- Second order effects- MOS models and small signal AC characteristics -Basic CMOS Technology.

UNIT II INVERTERS AND LOGIC GATES **9**

NMOS and CMOS inverters - Stick diagram -Inverter ratio -DC characteristics -Transmission gates - CMOS logic structures -Static CMOS design -Dynamic CMOS design.

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION **9**

Resistance estimation - Capacitance estimation- Inductance - Switching characteristics - Transistor sizing – Power dissipation and design margining -Charge sharing -Scaling.

UNIT IV CMOS TESTING **9**

Need for testing-Fault models-observability- controllability- fault coverage-Design for testability- Ad-Hoc testing Scan based test techniques-self test techniques-Boundary scan.

UNIT V VHDL AND VERILOG PROGRAMMING **9**

Overview of digital design with VHDL and Verilog HDL -Hierarchical modeling concepts-Modules and port definitions –Gate level modeling- Data flow modeling - Behavioral modeling - HDL programs for simple combinational and sequential circuits.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the basic concepts of MOS transistor logic.
- compare different CMOS designs.
- analyze the performance of CMOS circuits
- synthesize the testing methods of CMOS.

- examine the modeling concepts of hardware description language.

TEXT BOOKS

1. Neil H. E. Weste and Kamran Eshraghian- "Principles of CMOS VLSI Design"- 2nd edition-PearsonEducation.
2. Wayne Wolf- "Modern VLSI Design System on chip"- Pearson Education- 2002.

REFERENCES

1. John P. Uyemura- "Introduction to VLSI Circuits and Systems"- John Wiley and Sons- Inc.- 2002
2. Samir Palnitkar- "Verilog HDL"- 2nd Edition- Pearson Education- 2004. .
3. Pucknell- "Basic VLSI Design"- Prentice Hall of India Publication- 1995
4. Bhasker J.- "A Verilog HDL Primer"- 2nd Edition- B. S. Publications- 2001.

CO/PO MAPPING :

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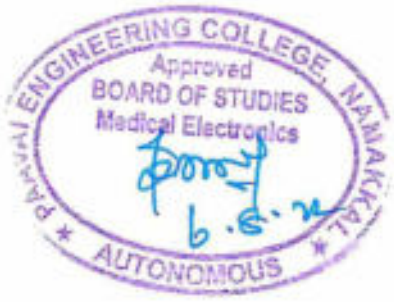
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



MD20252 **PATTERN RECOGNITION** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn about the basics of pattern recognition and bayes theory
- understand the data transformation techniques involved in the decomposition
- learns the principles of various estimation techniques based on Probability density function
- acquire knowledge on linear classifier techniques
- learn briefly about the non-linear classifier techniques

UNIT I INTRODUCTION **9**

Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions

UNIT II DATA TRANSFORMATION AND DIMENSIONALITY REDUCTION **9**

Introduction, Basis Vectors, The Karhunen Loeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA.

UNIT III ESTIMATION OF UNKNOWN PROBABILITY DENSITY FUNCTIONS **9**

Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule.

UNIT IV LINEAR CLASSIFIERS **9**

Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS and RLMS Algorithm, Sum of Error Estimate.

UNIT V NONLINEAR CLASSIFIERS **9**

The XOR Problem, The two Layer Perceptron, Three Layer Perceptron, Back propagation Algorithm, Basic Concepts of Clustering, Introduction to Clustering , Proximity Measures.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- discuss about the basics of pattern recognition and bayes theory

- comprehend the data transformation techniques involved in the decomposition
- acquire the knowledge on the principles of various estimation techniques based on Probability density function
- acquire knowledge on linear classifier techniques
- apply the knowledge on non-linear classifier techniques

TEXT BOOKS

1. Konstantinos Koutroumbas, Sergios Theodoridis,"Pattern Recognition" Elsevier India Pvt. Ltd (Paper Back), 4th edition.

REFERENCES

1. Trevor Hastie, "The Elements of Statistical Learning", Springer-Verlag New York, LLC (Paper Back), 2009
2. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification" John Wiley & Sons, 2012.
3. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, Edition- 1999.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3

MD20253 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, Origin of bioelectric signals - ECG, EEG, EMG. Electrodes for ECG, EEG, EMG, Medical surface electrodes and problems, Microelectrodes. 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 Pacemekers, Heart lung machine. Different types of Oxygenators, Pumps, Monitoring Process. Hemodialyser- Principle of Hemodialysis, Membranes, Dialyasate, Different types of heamodialysers, Wearable Artificial Kidney, Implantable Type. Defibrillators, Implantable defibrillators, Functional electrical stimulator (FES).

UNIT III RADIOLOGICAL, SURGICAL SCOPY AND DIATHERMY EQUIPMENTS 9

Digital radiography, Digital Fluroscopy, Mammography, Angiography, Bone densitometry, Endoscopy, Laparoscopy Bronchoscopy, Gastroscopy, Physiological effects of HF radiation, Depth of Penetration, 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 and 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

- familiarize with the principles of various types of biomedical signals and electrodes.
- choose appropriate assistive devices cardiac system and monitor.
- assess the radiological, surgical scopy and diathermy equipments
- assess 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 1982

REFERENCES

1. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
2. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
3. Leslie Cromwell , Fred J. Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
4. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication , New Delhi 2nd edition 2003

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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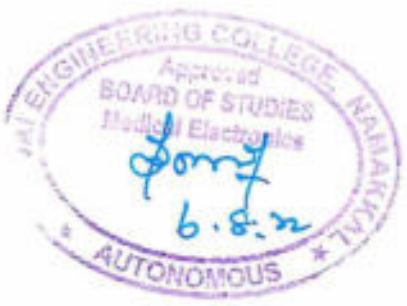
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



MD20254 **TELEHEALTH TECHNOLOGY** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- study the Series History and Evolution of telemedicine
- teach the functional diagram of telemedicine system
- teach the concept about telemedical data security and standards
- know about the Social and legal issues, Safety and regulatory issues and Advances in Telemedicine.
- gain knowledge about the health education and self care services

UNIT I TELEMEDICINE AND HEALTH **9**

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY **9**

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing.clinical data–local and centralized

UNIT III TELEMEDICAL STANDARDS **9**

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE **9**

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical

information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – health education and self care; Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- learn objectives of Tele health, Telecare and Organs of telemedicine.
- learn the Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications.
- learn Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN).
- learn Basic parts of teleradiology system.
- work on the application of robotics surgery, tele surgery, Tele cardiology and Teleoncology.

TEXT BOOKS

1. Ferrer-Roca,O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
2. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

REFERENCES

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 1	3	3			3								3		
CO 2	2	2			3								3		
CO 3	3	3			3								3		
CO 4	2	2			3								3		
CO 5	3	3			3								3		

MD20901 **BIOMEDICAL EQUIPMENTS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the basics of clinical laboratory equipments
- understand the standards and measures involved in blood gas analyzers
- acquire the knowledge on different types of audiometer
- understand the basics of instruments used in surgery
- acquire the knowledge on physiotherapy and electrotherapy equipments

UNIT I CLINICAL LABORATORY INSTRUMENTS **9**

Laboratory Instruments – Medical diagnosis with clinical tests, spectrophotometry and instruments, automated biochemical analysis system, clinical flame photometer, ion-selective electrode based analyzers.

UNIT II BLOOD GAS ANALYZERS **9**

Blood Gas Analyzer – Acid-base balance, blood pH measurement, measurement of blood Pco2, intro-arterial blood gas monitoring, complete blood gas analyzer; Blood cell counters – Types of blood cells, methods of cell counting, Coulter counter, automatic recognition and differential counting of cells.

UNIT III AUDIOMETER AND HEARING AIDS **9**

Audiometer – Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, audiometer system, Bekesy evoked response audiometer system, calibration of audiometer and hearing aids.

UNIT IV INSTRUMENTS OF SURGERY **9**

Surgery Instruments – Principles of surgical diathermy, surgical diathermy machine, safety aspects in electrosurgical units, surgical diathermy analyzer.

UNIT V PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS **9**

Electrotherapy equipments – High frequency heat therapy, short-wave diathermy, microwave diathermy, ultrasound therapy unit, electrodiagnostic therapeutic apparatus, pain relief through electrical stimulation, bladder and cerebral stimulators.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- utilize the basics of clinical laboratory equipments
- illustrate the standards and measures involved in blood gas analyzers

- apply the knowledge on different types of audiometer.
- illustrate the basics of instruments used in surgery.
- apply the knowledge on physiotherapy and electrotherapy equipments.

TEXT BOOKS

1. Handbook of Biomedical Instrumentation – by R.S. Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
2. Biomedical Instrumentation and Measurement – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.

REFERENCES

1 Josephy E.Carr, John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Publication, Fourth Edition, 2002..

2. K.N Scott, A.K. Mathur, "Textbook of biomedical Instrumentation" , First edition 2013, CBS Publishers. .

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 1			3		3	2			2			2		3	
CO 2		2	3	2	2		2		2					2	
CO 3		2	2	2	3	3		2		3			2		
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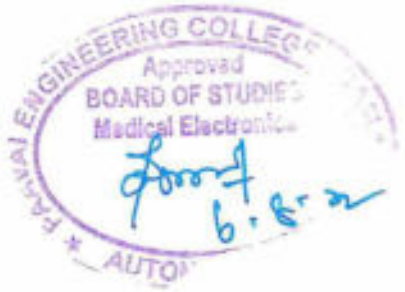
CO 5	2	3	3	2	3			2		2				2	2



MD20902 **BASICS OF BIOINFORMATICS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the basics of Biological data acquisition
- understand the formats and representation in database
- acquire the knowledge on data processing in high level data
- understand the various method of analysis on dynamic programming algorithms
- acquire the knowledge on Genome analysis and its tools

UNIT I BIOLOGICAL DATA ACQUISITION **9**

Basics of Biological data – The form of biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

UNIT II DATABASES **9**

Format and Annotation – Conventions for database indexing and specification of search terms, common sequence file formats; Annotated sequence databases – primary sequence database, protein sequence and structure databases, organism specific databases .

UNIT III DATA PROCESSING **9**

Data Access, Retrieval and submission: Standard search engines; Data retrieval tools-Entrez, DBGET and SRS; submission of data; Sequence Similarity Searches; Local versus global. Distance metrics. Similarity and homology. Scoring matrices.

UNIT IV METHODS OF ANALYSIS **9**

Dynamic programming algorithms; Needleman-wunsch and smith-waterman; Heuristic Methods of sequence alignment; FASTA and PSI BLAST; Tools for analysis – Multiple sequence Alignment and software tools for pairwise and multiple sequence alignmen

UNIT V GENOME ANALYSIS **9**

Basic of Genome analysis – Whole genome analysis, existing software tools; Genome analysis tolls – genome annotation and gene prediction, ORF finding; phylogenetic analysis – comparative genomics orthologs, paralogs; methods of phylogenetic analysis – UPGMA, WPGMA, neighbour joining method, Fitch/Margoliash method, character Based Methods.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- utilize the basics of biological data acquisition

- illustrate the formats and representation in database
- apply the knowledge on data processing in high level data
- illustrate the various method of analysis on dynamic programming algorithms
- apply the knowledge on Genome analysis and its tools

TEXT BOOKS

1. Stanely I. Letovsky, "Bioinformatics: Databases and Systems". 1999
2. Arthur K. Lesk, " Introduction to Bioinformatics ", Oxford University Press, 2015

REFERENCES

1 Dan Gusfield, "algorithms on strings, Trees and sequences", Cambridge university press.
2. Durbin, S. Eddy, A.Krough ,G.Mitchison, "Biological Sequence Analysis Probabilistic Modes of proteins and nucleic acids"
3. David W. Mount, "Bioinformatics Sequence and Genome Analysis", Cold spring Harbor Laboratory Press
4. James Tindall " Beginning Perl For Bioinformatics: An introduction to Perl for Biologists", OReilley Media

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 2		2	3						2					2	
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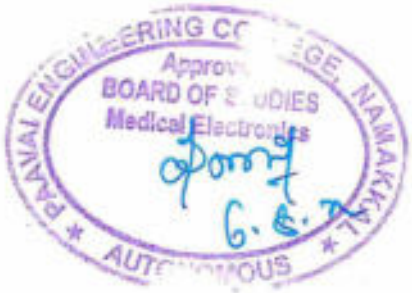
CO 4	2	2	3									3	3		2
CO 5	2	3	3					2		2				2	2



MD20701 **MEDICAL IMAGE PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the basic concept of image fundamentals.
- identify the designing concept of post processing
- familiarize medical image representation.
- acquire knowledge on medical image analysis.
- infer knowledge on image compression, recognition.

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing; Components in DIP; Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationships between pixels - Color image fundamentals - RGB, HSI models; Two-dimensional mathematical preliminaries; 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT **9**

Spatial Domain- Gray level transformations, Histogram processing; Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering; Frequency Domain- Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters, Homomorphic filtering; Color image enhancement

UNIT III IMAGE RESTORATION, THRESHOLDING AND SEGMENTATION **9**

Image Restoration - degradation model, Properties; Noise models – Mean Filters, Order Statistics; Adaptive filters – Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering. Thresholding and Segmentation: Detection methods, Optimal thresholding, multi-spectral thresholding; Edge based segmentation, Edge detection, Edge linking via Hough transform, Region based segmentation, Matching, Region growing, Region splitting and merging.

UNIT IV IMAGE COMPRESSION AND RECOGNITION **9**

Morphological processing- erosion and dilation; Segmentation by morphological watersheds – Basic concepts – Dam construction, Watershed segmentation algorithm; Need for data compression; Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG; Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors; Topological feature – Texture, Patterns and Pattern classes, Recognition based on matching

UNIT V BIOMEDICAL IMAGING **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG

standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching. Biomedical Images- Nature of Biomedical images, Objectives of biomedical image analysis, Difficulties in biomedical image acquisition and analysis.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- analyze different domain of digital images
- develop post processing techniques..
- apply image processing concepts for medical images.
- design and implement image processing applications in medical images.
- explore the possibility of applying Image processing concepts in modern hospitals.

TEXT BOOKS

1. Gonzalez R C, Woods R E, "Digital Image Processing", Third Edition, Prentice Hall, 2007
2. Sinha G. R, Patel, B. C., "Medical Image Processing: Concepts and Applications", Prentice Hall, 2014.

REFERENCES

1. Atam P.Dhawan,-Medical Image Analysis, Wiley Inter science Publication, NJ, USA 2003.
2. John L.Semmlow, Biosignal and Biomedical Image Processing Matlab Based applications Marcel Dekker Inc.,NewYork,2004
3. Kavyan Nagarian and RobertSplerstor,-Biomedical signals and Image processing,CRC–Taylor and Francis, NewYork,2006.
4. Digital Image Processing- S Jayaraman, S. Essakkirajan, T. Veerakumar-TMH,2020

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 5	3	3		3	3					1			3	3	3

MD20702 MEDICAL IMAGING TECHNIQUES AND RADIO THERAPY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn the production of x-rays and its application in medical imaging.
- apply the different types of Radio diagnostic techniques.
- infer the special imaging techniques used for visualizing the cross sections of the body.
- learn the ultrasound imaging and scanning.
- understand the Radiation therapy techniques and also Radiation safety.

UNIT I X – RAYS AND COMPUTED TOMOGRAPHY 9

Principle and production of X–Rays- Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Digital Radiography; Principles of Angiography and Fluoroscopic Techniques- Image Intensifiers, digital subtraction angiography, mammography; Dental X- ray units, Computerised Axial Tomography- Principle, Detectors, image reconstruction, Spiral CT, 3D Imaging

UNIT II EMISSION IMAGING 9

Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. and Proportional Counters, Pulse Height Analyzers, Isotopic; Scanners- Principle of PET and SPECT, PET/CT.

UNIT III MAGNETIC RESONANCE IMAGING 9

Principle of MRI- Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI instrumentation, Magnets, gradient coils, Imaging Different Sections of the Body; Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT IV ULTRASOUND IMAGING AND THERMOGRAPHY 9

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes-A, B and M; Principles and theory of image generation; Thermography- Principle, detectors and applications.

UNIT V THERAPY USING X – RAYS AND ISOTOPES 9

Direct and Indirect effects of high energy radiation, Units for radiation, Exposure, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, ICRP regulation, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, Protection Methods.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- discuss the principle and working of various radiography and tomography concept and image reconstruction techniques..
- explain the concept of nuclear imaging techniques and radiation detectors
- describe the basic principle and working of Magnetic resonance imaging technique.
- describe the basic principle involved in Ultrasound Imaging technique and Thermography.
- discuss the effects of radiation, radiation safety and the principle of Radio therapy techniques.

REFERENCES

1. Jerrold T. Bushberg, J.Anthony Seibert, Edwin M. Leidholdt, John M. Boone, The Essential Physics of Medical Imaging, Lippincott Williams and Wilkins; Third Edition, 2012.
2. D.N. Chesney and M.O. Chesney, Radio graphic imaging, CBS Publications, New Delhi, 1987.
3. Alexander, Kalender and Linke, Computed Tomography: Assessment Criteria, Ct System Technology, Clinical Applications, John Wiley, Chichster, 1986.
4. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3

MD20703 **MEDICAL 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, Bio informatics, 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 – IEEE11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records; Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation).

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 Data bases, 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, Surgical simulation, Radiation therapy and planning–Telemedicine; Virtual Hospitals– Personalized e-health services, Biometrics.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- discuss about health informatics and different ICT applications in medicine
- explain the function of Hospital Information Systems.

- appreciate and adopt medical standards.
- understand the virtual reality tools.
- summarize 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, New Delhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Computers Ltd, New Delhi, 2003.

REFERENCES

1. N.Mathivanan, "PC-Based Instrumentation'', Prentice Hall of India Pvt Ltd –New Delhi,2007.
2. YiPing Phoebe Chen, "Bioinformatics Technologies'', Springer International Edition, New Delhi, 2014.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2		3									3	2	2
CO 2	2	3		1	3				3				3	3	3
CO 3	3	3	2	3	3	3						3	3	3	3
CO 4	2	3		2							1		3	3	3
CO 5	3	3		3	3		1						3	3	3

MD20704 MEDICAL IMAGE PROCESSING LABORATORY 0 0 4 2

COURSE OBJECTIVES

To provide practice to

- analyze the basic image processing techniques.
- compute magnitude and phase representation of images.
- understand the concepts of image restoration and segmentation.
- study the various characteristics of analysis of bio-signals.

LIST OF EXPERIMENTS

1. Color Image processing.
2. Histogram Equalization.
3. Spatial filtering and non-linear filtering.
4. Edge detection using operators.
5. 2D DFT and DCT.
6. Filtering in frequency domain.
7. DWT of images.
8. Feature extraction of medical images.
9. Medical Image Compression techniques.
10. Medical Image fusion.
11. Wavelet decomposition and Reconstruction.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- use transforms and analyze the characteristics of the image.
- perform enhancing operations and segmentation operations on the image using spatial filters and frequency domain filters.
- estimate the efficiency of the compression technique on the images develop image processing algorithms for different image processing.
- apply image processing technique to solve real health care problems.

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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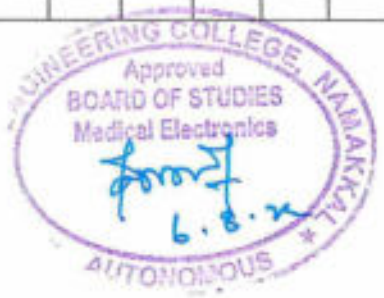
CO 1	3			3	2					1			3	2	2
CO 2	2	3			3								3	3	3
CO 3	3	3		3	3	2							3	3	3
CO 4	2	3	2	2	3								3	3	3



MD20705 **HOSPITAL INTERNSHIP** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- improve the skills by visiting the hospitals.
- understand the working principle of various biomedical equipments.
- able to work on the equipments through internship.
- able to design the equipment prototype model.

GUIDELINE FOR HOSPITAL INTERNSHIP AND TRAINING

The students may be grouped upto 4 members by internship coordinator. The students will be allowed for hospital internship training for 2 weeks. After the completion of Internship, they will have to submit the report to the Coordinator and Head of the Department. At the end of the semester examination the Hospital Training report is evaluated based on oral presentation and is examined jointly by the committee constituted by the Head of the Department.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- advocate a patient-centered approach in healthcare.
- communicate with other health professionals under various departments ina respectful and responsible manner.
- propose a patient-centered inter-professional health improvement record plan based upon the patient perceived needs.
- design the equipment prototype model.

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 1		3		3	2								3	2	2
CO 2	2		2		3								3	3	3
CO 3	3	3		3			2				2		3	3	3
CO 4	2	3		2	3								3	3	3

PANIMALAR ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Medical Electronics
AUTONOMOUS

MD20706 **PROJECT WORK (PHASE I)** **0 0 6 3**

COURSE OBJECTIVES

To enable the 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 projects.
- analyze the various procedures for validation of the product and analyze the cost effectiveness.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped up to 4 members and work under a project supervisor. The prototype/simulation may be decided in consultation with the supervisor. A Project Phase I Report to be submitted by the group and the prototype model, which 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 project work is evaluated based on oral presentation and the Project Phase I report is examined jointly by external and internal examiners constituted by the Controller of Examinations. It is highly desirable to publish their Project idea in State/ National level Conferences or Symposiums.

TOTAL PERIODS 90

COURSE OUTCOMES

At the end of the 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 project.
- analyze and validate through conformance of the developed prototype and analysis the cost effectiveness.

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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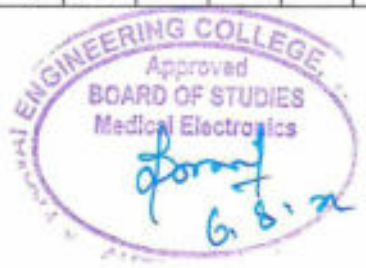
CO 2	2		2		3								3	3	3
CO 3	3	3		3			2				2		3	3	3
CO 4	2	3		2	3								3	3	3



MD20801 **PROJECT WORK (PHASE II)** **0 0 12 6**

COURSE OBJECTIVES

To enable the 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
- analyze the various procedures for validation of the product and analyze the cost effectiveness.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped up to 4 and work under a project supervisor. The device/system/component to be prototype may be decided in consultation with the supervisor. A project report to be submitted by the group and the prototype model, which 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 project work is evaluated based on oral presentation and the Project report jointly by external and internal examiners constituted by the COE. It is highly desirable to publish their project in state/ national level conferences or Symposiums.

TOTAL PERIODS: 180

COURSE OUTCOMES

At the end of the 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 project
- analyze and validate through conformance of the developed prototype and analysis the cost

CO/PO MAPPING:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 2	2		2		3								3	3	3
CO 3	3	3		3			2				2		3	3	3
CO 4	2	3		2	3								3	3	3

MD20351 FUNDAMENTALS OF BIOMEDICAL NANOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- explain the basic principles of Nanotechnology.
- learn the aspects based on bimolecular synthesis of nano materials.
- learn about the advantages of nano materials in medicine.
- familiarize about biosensors and its application in nanotechnology.
- acquire knowledge on applications of future technological advancements and increasing role of nanotechnology in biomedical industries.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Nano scale phenomena, Opportunities, Natural nanocomposite system, Types of nanostructured materials- Zero-dimensional, one-dimensional, two-dimensional and cluster of nanomaterial; Biomaterials- 1st, 2nd and 3rd generations of biomaterials; Nanoscale effects in properties - physical, mechanical, thermal, electrical and biological properties towards nano size.

UNIT II SYNTHESIS OF NANOPARTICLES 9

Top town and bottom-up nanoparticles synthesis: Physical methods - Ball milling, PVD/Sputtering, CVD, Spray pyrolysis; Chemical methods - Sol gel, Hydrothermal, Electrochemical, Sonochemical; Lithography- Electron beam and Dip pin; Biological methods - green synthesis and microbial synthesis (Bacteria, Yeast, Fungi).

UNIT III CARBON MATERIALS AND CHARACTERISATION TECHNIQUES 9

Nanoforms of carbon materials- Bucky balls, fullerene, graphene, carbon nanotubes (SWCNT and MWCNT); Characterization techniques of nano materials –UV- visible, X-ray diffraction (XRD), FTIR, Scanning and Transmission Electron Microscopy (SEM and TEM)- Energy Dispersive X-ray (EDX), Atomic Force Microscopy (AFM) and Nanoindentation.

UNIT IV NANOMATERIAL IN BIOSENSORS 9

Principles and applications nano materials- DNA and protein based nanobiosensors; Future direction in biosensor research; MEMS and NEMS; Quantum dots– Synthesis, Properties, applications and drawbacks. Biochips and In-vivo imaging - Integrated nano sensor networks.

UNIT V APPLICATIONS OF NANOTECHNOLOGY IN BIOMEDICAL 9

Biodegradable Nanomaterials in bone substitutes– Implants and Prosthesis; MCNT and other Nano materials in cancer diagnosis and targeted drug delivery; Antibacterial agents; Tissue Engineering – Nanoartificial cells; Nanorobotics– Photodynamic Therapy; Potential risks (toxicity) and remedies towards environmental impact and human health.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- relate any architecture and assembly language for a processor.
- comprehend 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. Neelina H. Malsch, "Biomedical Nanotechnology", Taylor & Francis Group, 19 Sep 2019.
2. Mauro Ferrari, Sangeeta N. Bhatia, Tejal Desai, "BioMEMS and Biomedical Nanotechnology Volume III: Therapeutic Micro/Nanotechnology · Volume 3", Springer US,1st illustrated reprint edition, 23 November 2010.

REFERENCES

1. Emily S. Day, Sarah Hurst Petrosko, "Biomedical Nanotechnology Methods and Protocols", Springer New York, 9 June 2018 .
2. Chris Binns, "Introduction to Nanoscience and Nanotechnology", Wiley,16 June 2010.
3. Amretashis Sengupta, "Introduction to Nano-Basics to Nanoscience and Nanotechnology" Springer, 2012.
4. Subbiah Balaji, "Nano biotechnology", Chennai :MJP Publishers, 2010, 228pp.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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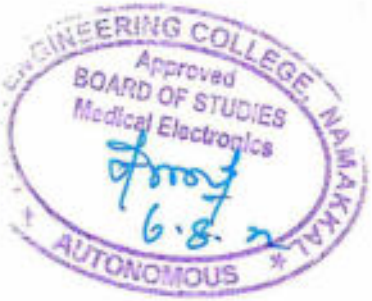
CO 3	3	3	1	3	3								3	3	3
CO 4	2	3		2	3				3				3	3	3
CO 5	3	3		3	3								3	3	3



MD20352 **SMART WEARABLE SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- learn the fundamentals of sensors.
- understand signal processing association in wearable systems.
- evaluate various energy needs in wearable.
- learn the analysis of wearable systems.
- analyze the applications of wearable.

UNIT I SENSORS **9**

Need for wearable systems; Sensors for wearable systems - Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, Pneumography; Wearable ground reaction force sensor- GSR, Radiant thermal sensor, Wearable motion sensors; CMOS Based Biosensors- E-Textiles, Bio compatibility.

UNIT II SIGNAL PROCESSING **9**

Wearability issues- Physical shape and placement of sensor; Technical challenges - Sensor design, Signal acquisition, Constraint on sampling frequency for reduced energy consumption- Light weight signal processing, Rejection of irrelevant information, Data mining.

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES **9**

Solar cell, Vibration based heat source, Thermal based heat source for power generation; Hybrid thermoelectric photovoltaic energy harvests; Thermopiles.

UNIT IV PROTOCOLS IN HEALTH YSYTEMS **9**

Need for wireless monitoring; Definition of Body area network - BAN and Healthcare, Technical Challenges, System security and reliability; BAN Architecture – Introduction, Wireless communication techniques.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS **9**

Medical Diagnostics; Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients; Multi parameter monitoring- Neural recording, Gait analysis, Sports Medicine, Smart Fabrics..

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- familiarize with the principles of various types of sensors.
- choose appropriate sensors and signal processing techniques for wearable systems.

- assess the energy requirement for a wearable system.
- evaluate the security issues related to wearable systems.
- identify the application of wearable systems.

TEXT BOOKS

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2. Sandeep. K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.

REFERENCES

1. Hang,Yuan-Ting, "wearable medical sensors and systems",Springer-2013.
2. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006.
4. Andreas Lymberis, Danilo de Rossi ,'Wearable Health systems for Personalized Health Management – State of the art and future challenges ' IOS press, The Netherlands, 2004.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 3	1	3		2	3		2						3	3	3
CO 4	2	2		2	3								3	3	3
CO 5	3	3		2	3	3				2			3	3	3

MD20353 REHABILITATION ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- explain the need for medical aids.
- understand the sensory rehabilitation systems.
- learn the use of the orthopedic prosthetics and orthotics in rehabilitation.
- handle the virtual reality in rehabilitation.
- have an understanding of rehabilitation medicine and advocacy.

UNIT I INTRODUCTION 9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities; Activities of daily living; Appropriate Technology- Residual function, Rehabilitation; Rehabilitation team – members and their functions; Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT II CONCEPTS IN SENSORY REHABILITATION ENGINEERING 9

Sensory augmentation and substitution- Visual system, Visual augmentation, Tactual vision substitution, Auditory vision substitution; Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution; Tactual system-Tactual augmentation, Tactual substitution, Computerized wheel chairs – ergonomics of wheel chair propulsion.

UNIT III PROSTHETICS AND ORTHOTICS 9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS), MARCUS intelligent hand prosthesis

UNIT IV VIRTUAL REALITY IN REHABILITATION 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Trends in the rehabilitation of the long-term ill and severely disabled, Legal aspect of Rehabilitation Amputation.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the key terminologies used by the rehabilitation team.

- devise new concepts for future development and applications.
- design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications.
- understand the need of virtual reality tools for different aids.
- appreciate the legal aspects for building rehabilitation aids for the needed people.

TEXT BOOKS

1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press, 2000.
2. Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006.

REFERENCES

1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
4. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis,1988.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 4	2	3		2									3	3	3
CO 5	3	3		3	3		2						3	3	3

MD20354 CLOUD COMPUTING FOR HEALTHCARE 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn the basics of cloud computing insight and models.
- understand the standards and security involved in cloud computing acquire
- the knowledge on different types of cloud services understand the concept of cloud.
- the concept of cloud management in the eco system demonstrate the applications in cloud computing.
- describe the cloud storage and its uses.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish- Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- learn the key and enabling technologies that help in the development of cloud
- develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- explain the core issues of cloud computing such as resource management and security..
- be able to install and use current cloud technologies.

TEXT BOOKS

1. M.N. Rao, "Cloud Computing", PHI learning private Limited 2015 edition.
2. "Cloud Computing: Concepts, Technology & Architecture"- The Pearson Service Technology Series from Thomas Erl, 1st Edition 2020.

REFERENCES

1. Dan Marinescu," Cloud Computing: Theory and Practice" 1st Edition, MK publishers (2013 edition)
2. Anthony T. Velte, Toby J. Velete, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw Hill, (2010 edition)
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computingl, Tata Mcgraw Hill, 2013.
4. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 4	2	3		2									3	3	3
CO 5	3	3		3	3		2						3	3	3

MD20451 NANOTECHNOLOGY AND ITS APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- provide a broad view of the nascent field of nanoscience and technology to undergraduates
- explore the basics of nanomaterial synthesis and characterization.
- introduce the applications of nanotechnology
- provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates
- explore the basics of nanomaterial synthesis and characterization.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Basic Structure of Nanoparticles; Kinetics in Nanostructured Materials; size and shape of nanoparticles- Zero-dimensional, one-dimensional, two-dimensional nanostructures; clusters of metals and semiconductors; bionano-particles; Natural nanocomposite systems - spider silk, bones, shells; Emergence and challenges of nanoscience and nanotechnology.

UNIT II PREPARATION AND FABRICATION TECHNIQUES 9

Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning; Bio-synthesis of nanomaterials.

UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Principle of MRI- Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI instrumentation, Magnets, gradient coils, Imaging Different Sections of the Body; Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT IV ADVANCED NANO STRUCTURES 9

Properties of nanoparticles - Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; XRD, FTIR, SEM, TEM, AFM, Confocal and TIRF imaging.

UNIT V GENERAL APPLICATIONS OF NANOTECHNOLOGY 9

Nano electronics; Nanosensors, Nanotechnology in Diagnostics and treatment - MEMS and NEMS; Environmental and Agricultural Applications of nanotechnology; Nano technology for energy systems; Nanolithography; Biochips.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- describe the basic science behind the properties of materials.
- interpret the creation, characterization, and manipulation of nanoscale materials.
- comprehend the exciting applications of nano at the leading edge of scientific research
- apply their knowledge of nano to identify how they can be exploited for new applications
- describe the basic science behind the properties of materials.

TEXT BOOKS

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004.

REFERENCES

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.
4. S. Shanmugam "Nanotechnology" MJP Publishers, 2011, ISBN 978-81-8094-0644.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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CO 3	3	2	2	2	2	2	2						3	3	3
CO 4	3	2	2	2	2								3	3	3
CO 5	3	2	2	2	2	2	2						3	3	3

MD20452 **PHYSIOLOGICAL MODELING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand the application of Physiological models and Vital organs.
- understand methods and techniques for analysis and synthesis of dynamic models
- model dynamically varying physiological system
- develop differential equations to describe the dynamic models
- simulate and visualize, dynamic responses of physiological models using software

UNIT I SYSTEM CONCEPT **9**

Introduction to Physiological control systems- Purpose of physiological modeling and signal analysis, Illustration- example of a physiological control system, Difference between engineering and physiological control systems; System variables and properties- Resistance both static and dynamic, Compliance and combination of resistance and compliance; Resistance and compliance models - Respiratory system, Aortic segments, Lumped model of physiological thermal system, step response of resistance, compliance system, dye dilution study of circulation.

UNIT II SYSTEM ANALYSIS **9**

Review of transfer function- transfer function of coupled system, Impedance based transfer function; Flexible tube feeding- a single port compliant model, development of a lung model; Periodic signals- sinusoidal analysis of second order system, analysis of respiratory system based on sinusoidal excitation, pendelluft.

UNIT III TRANSIENT AND FEEDBACK **9**

Review of transient and stability analysis- Homeostasis, representation, finger tracking; Characterization of Physiological Feedback systems- Hypophysis adrenal systems; Nonlinear systems and linearization - Transfer function analysis of pupillary control system as a closed loop, method of opening the closed loop, pupillary hippus.

UNIT IV MODELING OF CARDIOPULMONARY SYSTEM **9**

Model of cardiac output regulation - Starling's law, Physical Significance of under damped responses of post systolic operations in aortic arch, model of circadian rhythms, chemical regulation of ventilation, Cheyne-Stoke breathing, biot breathing.

UNIT V PHYSIOLOGICAL MODELS AND SIMULATION **9**

Steady state analysis of regulation of glucose; Hodgkin-Huxley model; Thermal system – Model and simulation; Modeling of eye movement- Types of eye movement, Saccade model, Model of occulomotor control.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain application of Physiological models.
- model dynamically varying physiological system.
- analyze and synthesize dynamic models of physiological system
- develop differential equations to describe the dynamic models, simulate and visualize.
- implement physiological models using software to get dynamic responses.

TEXT BOOKS

1. William B.Blesser, "A System Approach to Biomedicine", McGraw Hill Book Co., New York, 1969.
2. Micheal C.K.Khoo ,"Physiological Control System Analysis, Simulation and Estimation", Prentice Hall of India , New Delhi ,2001.

REFERENCES

1. ManfreoClynes and John H.Milsum, "Biomedical Engineering System", McGraw Hilland Co., New York ,1970
2. Richard Skalak and ShuChien, "Hand Book of Biomedical Engineering" , McGraw Hilland Co., New York, 1987
3. Douglas S.Rigg, "Control Theory and Physiological Feedback Mechanism", The Wilkliam and Wilkins Co. Baltimore, 1970.
4. Joseph D,Bronzino, "'The Biomedical Engineering Handbook'', CRC Press,3 rd Edition, 2006.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 5	3	2		3					2	2			3	3	3

MD20453 MEDICAL DEVICES REGULATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- define the basic concepts of medical device regulations
- discuss the global policies on medical device regulations
- analyze implications of the regulations
- analyze the way design concepts are imbibed in practical scenarios.
- teach the concept about medical device quality assurance

UNIT I INTRODUCTION 9

The medical device- Defining the device, the product definition process, overview of quality function deployment; The business proposal reliability- Definition, Quality vs Reliability, Reliability vs unreliability, types of reliability, optimizing reliability, reliability's effects on medical devices; Concept of failure- causes of failure, practical aspects of failure, failure rates, hardware failure, software failure, failure due to the human errors, failure from the customer point of view; Safety and risk management- effectiveness and performance of medical devices, phases in the life span of a medical device, the risk management processes, tool for risk estimation, shared responsibility for medical device safety and performance.

UNIT II GLOBAL HARMONIZATION TASK FORCE 9

Global Harmonization Task Force (GHTF)- Objectives, Scope of the four GHTF, Benefits of the GHTF, Global Medical Device Nomenclature (GMDN); The Food and Drug Administration- history of device regulation, device classification, registration and listing, the 510 (k) Process, declaration of conformance to a recognized standard; The PMA application; Investigational Device Exemptions (IDEs); Good Laboratory Practices (GLPs); Good Manufacturing Practices(GMPs); Human Factors-design Control, FDA and Software, Software classification, The FDA Inspection.

UNIT III GLOBAL POLICIES ON MEDICAL DEVICE REGULATIONS 9

The European Union- European Directives, European Standardization Bodies, European Standards Development Process, European Standards Considerations, conformity assessment and testing, European Organization for Testing and Certification, the NVCASE Program; Medical Devices Directives- Definition of a medical device, Medical Devices Directives process, choosing the appropriate directive, identifying the applicable essential requirements; Identification of corresponding harmonized standards, Essential requirements, Classification of the medical devices, identification and choice of a notified body.

UNIT IV STANDARDS AND REGULATIONS BACKGROUND 9

Standards and Regulations background- Voluntary and mandatory standards, standards development process, conformity assessment with standards, national and international of standards systems, identification of standards, current trends in the use of standards in medical device regulations; The ISO 9000 series of standards.

UNIT V SOFTWARE AND QUALITY SYSTEM REGULATION 9

Software and Quality system regulation- Software as a Technology, Domestic Software Regulations, Domestic Software Standards, International Software Regulations, International Software Standards, Software Standard

History of the quality system regulations- scope, general provisions, Quality system, Design controls, Document controls, Purchasing controls, Identification and traceability, Production and process controls, Acceptance activities, Non-conforming product, Corrective and preventive action.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- define and explain the basic concepts of medical device regulations
- illustrate the global policies on medical device regulations
- understand the design of concepts are imbibed in practical scenarios
- explain the regulations of medical devices
- construe the software and quality system regulation

TEXT BOOKS

1. Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2. Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998.

REFERENCES

1. Medical device regulations: global overview and guiding principles By Michael Cheng, World Health Organization
2. "Medical Devices: Regulations, Standards and Practices" by Seeram Ramakrishna, Lingling Tian, Charlene Wang, Susan Liao, Wee Eong Teo Woodhead Publishing.
3. Medical Device Regulations: A complete Guidebook by Aakash Deep published by Elsevier Science, 2022.
4. "The Future of Medical Device Regulation: Innovation and Protection" by Carmel Shachar, Timo Minssen, I. Glenn Cohen, W.Nicholson Price II, Christopher T. Roberson published in 2022.

CO/PO MAPPING :

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CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1		1	3	3	3

MD20454 ARTIFICIAL INTELLIGENCE IN HEALTHCARE 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basic knowledge on Neural networks
- learn the fuzzy logic control
- study the concept of Genetic algorithm
- learn the analysis of PSO and DE optimization techniques
- study the concept of AI in medicine.

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Basics of ANN – Perceptron, Delta learning rule, Back propagation algorithm, Multilayer Feed forward network-Memory models- Bi-directional associative memory- Hopfield network, Kohonen self-organizing, ART network.

UNIT II FUZZY LOGIC CONTROL 9

Classical set Vs Fuzzy set; Operation and Properties; Fuzzy Relations – Fuzzy Logic control, Fuzzification, Membership functions, Defuzzification; Rule Based System, Applications- Decision making control through fuzzy set theory.

UNIT III GENETIC ALGORITHM 9

Genetic algorithm and search space- general genetic algorithm, operators in GA - genetic programming– multilevel optimization– advances in GA.

UNIT IV PSO AND DE OPTIMIZATION TECHNIQUE 9

Introduction- Review on PSO and DE – Restoration using particle, Swarm optimization and differential evolution techniques; Formulation; Application.

UNIT V APPLICATIONS IN MEDICINE 9

Diagnosis of disease using AI; Biometrics- Face recognition and Gene matching; Automated drug delivery systems; Computer aided diagnosis; Mining of electronic health record; Computer vision.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- represent the neural network in various forms.
- elucidate the fuzzy logic operations and application of AI in decision making.
- examine the application of Genetic algorithm.
- analyze the PSO and DE techniques.
- implement the AI in medicine.

TEXT BOOKS

1. James.A.Freeman and B.M.Skapura – "Neural Networks, Algorithms Applications and Programming techniques"- Addison Wesley, 2000.
2. Zimmerman, H.J.–"Fuzzy Set Theory and its Applications", Kluwer Academic Publishers,2004.

REFERENCES

1. George Klir and Tina Folger,.A., - "Fuzzy sets, Uncertainty and Information", Prentice Hall of India Pvt.Ltd., 2002 .
2. S.Rajasekaran and G A VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall, India, 2003.
3. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
4. Carlo Combi, Yuval Shahar; "Artificial Intelligence in Medicine" – 12 th Conference – Springer

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 3	3	3	2	2	3		3						3	3	3
CO 4	2	3		2	3	3							3	3	3
CO 5	3	3		3	3							1	3	3	3

MD20551 ARTIFICIAL ORGANS AND IMPLANTS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- have an overview of artificial organs and transplants.
- familiar the principles of implant design with a case study.
- explain the implant design parameters and solution in use.
- study about various blood interfacing implants.
- study about soft tissue replacement and hard tissue replacement.

UNIT I ARTIFICIAL ORGANS AND TRANSPLANTS 9

Introduction - outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS: -Overview, Immunological considerations, Blood transfusions; Individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN 9

Principles of implant design; Clinical problems requiring implants for solution; Permanent versus absorbable devices; The missing organ and its replacement; Tissue engineering - scaffolds, cells and regulators, criteria for materials selection; Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9

Biocompatibility; Local and systemic effects of implants; Design specifications for tissue bonding and modulus matching; Degradation of devices - Natural and synthetic polymers, corrosion, wear and tear, implants for Bone; Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS 9

Neural and neuromuscular implants- Heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers; Artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS 9

Gastrointestinal system; Dentistry- Maxillofacial and craniofacial replacement; Soft tissue repair-Replacement and augmentation, recent advancement and future directions.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- gain adequate knowledge about artificial organs and transplants.
- get clear idea about implant design and its parameters and solution.
- have in-depth knowledge about blood interfacing implants.

- explain different types of soft tissue replacement and hard tissue replacement.
- undergo the applications of implantable medical devices and organs.

TEXT BOOKS

1. Nadey S. Hakim, Artificial Organs, Springer London, 28 Oct 2010.
2. Park J.B., —Biomaterials Science and Engineeringl, Springer US, 23 Jan 2014.

REFERENCES

1. J D Bronzino, Biomedical Engineering Handbook, Fourth Edition, (CRC Press), 3 Oct 2018.
2. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 16 June 2014.
3. Roderic S. Lakes, Joon B Park, Biomaterials – An Introduction, Springer US, 28 Nov 2012.
4. Yannas, I. V, —Tissue and Organ Regeneration in Adultsl, New York, NY: Springer, 2001. ISBN:9780387952147.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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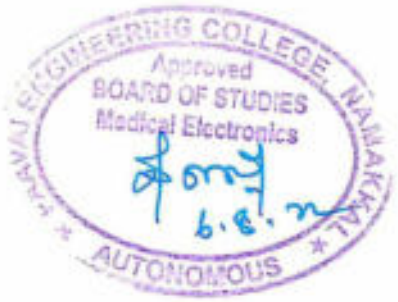
CO 3	3	3		3									3	3	3
CO 4	2	3		2	3							1	3	3	3
CO 5	3			3	3				1				3	3	3



MD20552 **BODY AREA NETWORKS** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- introduce the basic concepts of BAN
- know the hardware requirement of BAN
- understand the communication and security aspects in the BAN
- explore the coexistence issues with BAN
- know the applications of BAN in the field of medicine

UNIT I INTRODUCTION **9**

Definition- BAN and Healthcare; Technical Challenges- Sensor design, biocompatibility, Energy supply; Optimal Node placement- Number of nodes, System security and reliability, BAN Architecture Introduction.

UNIT II HARDWARE FOR BAN **9**

Processor- Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory; Antenna- Flexible PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface; Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body; Antenna design and testing- Propagation, Base Station; Network topology- Stand Alone BAN Wireless personal Area Network Technologies- IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN **9**

Interferences- Intrinsic and Extrinsic Effect on transmission; Counter measures on physical layer and data link layer; Regulatory issues; Medical Device regulation in USA and Asia; Security and Self-protection - Bacterial attacks, Virus Infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN USING IoT **9**

Monitoring patients with chronic disease - Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi Patient monitoring systems; Multichannel Neural recording - Gait analysis, Sports medicine, Electronic Pill.

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.
- design a BAN for appropriate application in medicine.

- assess the efficiency of communication and the security parameters.
- describe the need for medical device regulation and regulations followed in various regions.
- extend the concepts of BAN for medical applications.

TEXT BOOKS

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013.

REFERENCES

1. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012.
2. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006.
4. Wireless Body Area Networks: Technology, Implementation, and Applications" by Mehmet R Yuce and Jamil Khan

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 2	2	3		3	3							1		3	3
CO 3	3		1		3		1						3		3
CO 4	2	3		2	3								3	3	3
CO 5	3	2		3					1				3	3	3

MD20553 **MEDICAL ETHICS AND SAFETY** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- achieve familiarity with some basic ethical framework and understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- know about Medical Standards and Regulations
- know about the legal and ethical principles and application of these principles in health care settings
- gain knowledge about the medical standards that to be followed in hospitals.
- learn about suitable principles of medical equipment safety standards in hospitals

UNIT I INTRODUCTION TO MEDICAL ETHICS 9

Definition of Medical ethics; Scope of ethics in medicine; International code of Ethics for occupational health professionals - CMA code of ethics; Fundamental Responsibilities - The Doctor and The Patient, The Doctor and The Profession; Professional Independence - The Doctor And Society.

UNIT II CODE OF ETHICS FOR BIOMEDICAL ENGINEERS 9

Bioethics - The principle of Double effect, Code of Hammurabi, Engineering Competence; Ethical Issues in biomedical research - Cloning and stem cell research, Neuro ethic; Organ Transplantation; Hypothetic co-deductive method; Research Conflict of Interest; Medical device failure - Five failure types; Bio-terrorism; Sustainable Bioethics - Life cycles and Concurrent Engineering, Environmental Health; case studies.

UNIT III MEDICAL DEVICES STANDARDS 9

Medical Standards and Regulations - Device classification, Registration and listing, Declaration of conformance to a recognized standard, Investigational Device Exemptions; Institutional Review Boards - IDE format, Good laboratory practices, Good manufacturing practices.

UNIT IV HOSPITAL SAFETY STANDARDS 9

Life Safety Standards - Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke; Providing and Maintaining Fire Alarm Systems - Systems for Extinguishing Fires Environment of Care Standards, Minimizing EC Risks, Smoking Prohibitions; Managing Hazardous Material and Waste; Maintaining Fire Safety Equipment - Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT V HOSPITAL ACCREDITATION STANDARDS 9

Accreditation - JCI Accreditation and its Policies; Patient centered standards; Healthcare Organization management standards; Indian Perspective.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply legal and professional guidelines for the health professions.

- perform social responsibility in healthcare systems.
- categorize bioethics and engineers role.
- illustrate medical device maintenance.
- perform safety aspects.

TEXT BOOKS

1. William Charney, "Handbook of Modern Hospital Safety'', CRC Press, 2nd Edition, 2009.
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, Zijad Dzemic, "Inspection of Medical Devices: For Regulatory Purposes", Springer Nature, 2018.

REFERENCES

1. Eileen E.Morrison, "Ethics in Health Administration: A Practical Approach for Decision Makers'',Jonnes and Bartletts' Publication, 2nd Edition, 2011.
2. Robert M Veatch, "Basics of Bio Ethics'', Prentice- Hall, Inc., 2nd Edition, 2003.
3. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003.
4. Domiel A Vallero , "Biomedical Ethics for Engineers", Elsevier Pub.1st Edition, 2007.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 4	3	2	2	2	2								3	3	3
CO 5	3	2	2	2	2	2	2				2		3	3	3

MD20554	EMBEDDED SYSTEMS AND INTERNET OF THINGS IN HEALTHCARE	3	0	0	3

COURSE OBJECTIVES

To enable students to

- learn the internal architecture and programming of an embedded processor.
- introduce interfacing I/O devices to the processor.
- introduce the evolution of Internet of Things (IoT).
- build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/open platform.
- apply the concept of Internet of Things in real world scenario.

UNIT I 8-BIT EMBEDDED PROCESSOR 9

8-Bit Microcontroller-Architecture, Instruction Set and Programming, Programming Parallel Ports, Timers and Serial Port; Interrupt Handling.

UNIT II EMBEDDED C PROGRAMMING 9

Memory And I/O Devices Interfacing – Programming Embedded Systems in C; Need For RTOS – Multiple Tasks and Processes, Context Switching, Priority Based Scheduling Policies.

UNIT III IOT AND ARDUINO PROGRAMMING 9

ARM Processor – Introduction to the Concept of IoT Devices, IoT Devices Versus Computers, IoT Configurations, Basic Components; Introduction to Arduino – Types of Arduino – Arduino Tool chain – Arduino Programming Structure – Sketches – Pins – Input/Output pins using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT IV IOT COMMUNICATION AND OPEN PLATFORMS 9

IoT Communication Models and APIs – IoT Communication Protocols- Bluetooth , Wi-Fi, ZigBee; GPS – GSM modules, Open Platform (like Raspberry Pi), Architecture, Programming, Interfacing, Accessing GPIO Pins, Sending and receiving signals using GPIO Pins, Connecting to the Cloud.

UNIT V APPLICATIONS 9

Complete Design of Embedded Systems – Development of IoT Applications, Home Automation, IoT based health care, Physiological monitoring system, healthcare ECHO with IoT.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand and compare various embedded processors.
- design and deploy timers and interrupts.
- write embedded C programs.

- design simple embedded applications.
- design portable IoT using Arduino/Raspberry Pi open platform.

TEXT BOOKS

1. Muhammed Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2. Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 2014.

REFERENCES

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
4. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.

CO/PO MAPPING :

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO 5	3	3		3	3	1				1			3	3	3

MD20651 **VIRTUAL BIOINSTRUMENTATION** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- understand what Virtual instrumentation is and to 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 (VI)- Advantages, Block diagram, Architecture of a virtual instrument; Programming paradigms– Virtual Instrumentation- Lab VIEW software, Lab VIEW basics, Lab VIEW 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 VI **9**

Plug-in DAQ boards– Organization of the DAQVI 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 and IVI; Image acquisition and processing; Motion Control, ADC, DAC, DIO, DMM, Waveform generator.

UNIT V APPLICATIONS OF HEALTHCARE **9**

Design of virtual applications - Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis; Noninvasive Blood Pressure Measurement- Biofeedback, Virtual Reality and 3 D graphical modeling, 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
- understand 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, LAB VIEW Graphical Programming, 4th Edition, McGrawHill, 2006

REFERENCES

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

CO/PO MAPPING :

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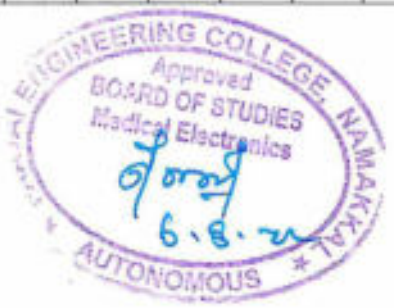
CO 2	2	3		3	3								3	3	3
CO 3	3	3		3	3		2						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3				3				3	3	3



MD20652 **DIGITAL VIDEO PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable students to

- provide an introduction to the fundamental principles and techniques in Video processing.
- offer an overview of video enhancement and restoration algorithms
- deliver details about video Tracking.
- incorporate processing with artificial intelligence.
- review latest trends and future technologies in video computing.

UNIT I FUNDAMENTALS OF VIDEO PROCESSING **9**

Video Formation- Perception and Representation, Video Capture and Display, Principles of Color Video, Video Cameras, Video Display and Composite versus Component Models and Gamma Correction; Analog Video Raster – Progressive vs Interlaced scans, Digital Video, Notation – ITU, R.BT.601; Digital Video Format and Applications.

UNIT II DIGITAL VIDEO ENHANCEMENT AND SEGMENTATION **9**

Video Sampling - Basics of the Lattice Theory, Sampling of Video Signals over Lattices, Filtering Operations in Cameras and Display Devices; Video Segmentation Algorithms – Median Cut, Graph Cut and EM Algorithms; Active Contour models.

UNIT III MOTION ESTIMATION **9**

Two-Dimensional Motion Estimation - Optical Flow; General Methodologies - Motion Representation, Motion Estimation Criteria, Optimization Methods; Pixel-Based Motion Estimation - Block-Matching Algorithm, Exhaustive Block-Matching Algorithm, Phase Correlation Method and Multiresolution Motion Estimation.

UNIT IV VIDEO ANALYSIS AND TRACKING **9**

Typical Tracker – Localization, Optical Flow - Object Tracking and analysis, Kalman Filtering; Video Tracking- Bayesian Approach, Particle Filter – Trackers, Evaluation; Video in painting – restoration; Video Mining; Video Search Engines and retrieval; Visual Event Detection; Video Surveillance and Security.

UNIT V VIDEO CLASSIFICATION AND RECOGITION **9**

Video Classification – Classification and Clustering models; Video Annotation, Video Summarization, Action Recognition; Visual Event Detection.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- implement basic algorithms related to digital video.
- familiarize with the MATLAB and its equivalent open source tools for processing video.
- design and implement some basic video related applications in domains like biometrics object .
- traction and in Industrial environment.
- critically analyze the role of video in modern technologies.

TEXT BOOKS

1. A. Murat Tekalp ,"Digital Video Processing", Pearson, 2010.
2. Oge Marques „Practical Image and Video processing using Matlab", IEEE Press, 2011.

REFERENCES

1. Maggio E., Cavallaro A., Video Tracking, Wiley, 2011.
2. Michael A. Smith, Takeo Kanade, Multimodal Video Characterization and Summarization, The Kluwer International Series in Video Computing, 2005.
3. Alan Bovik C "The Essential Guide to Video Processing", Academic Press Inc, 2009.
4. Niels Niels Haering, Niels Da Vitoria Lobo, Visual Event Detection, The International Series in Video Computing, Springer US, 2001.

CO/PO MAPPING :

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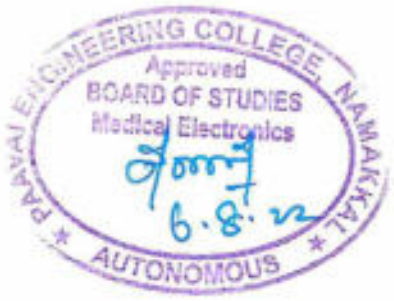
CO 2	2	3	2	3	3		2						3	3	3
CO 3	3	3	2	3	3				1				3	3	3
CO 4	2	3	2	2										3	
CO 5	3	3	3	3	3						1		3	3	3



MD20653 QUALITY CONTROL IN BIOMEDICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn overview of various methodologies used for management in health care.
- understand the various Quality standards and regulations used for health care.
- gain the knowledge about management methodologies in medical Engineering.
- achieve the various tools.
- gain knowledge in regulatory bodies.

UNIT I INTRODUCTION **9**

Philosophy of Quality Management, Customer Focus, Top Management Commitment, Team work, Quality control Tools; Problem solving methodologies; New Management Tools; work habits, strategic Quality planning.

UNIT II QUALITY DEVELOPMENT **9**

Quality policy development; quality function development; designing for Quality; Manufacturing for Quality.

UNIT III QUALITY STANDARDS **9**

Need for standardization- Regional, National, International standardization; classification of equipment, Methods of Testing standardization, Maintenance of standardization and Recalibration.

UNIT IV QUALITY REGULATION **9**

FDA Regulations; Joint Commission, Accreditation of hospitals, other Regulatory codes.

UNIT V REGULATORY BODIES **9**

Need for ISO 9000 System, Advantages, clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality Auditing, Case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- know the overview of various methodologies used for management in health care.
- gain the knowledge about management methodologies in medical Engineering.
- understand the knowledge in regulatory bodies
- know the overview of various methodologies used for management in health care.
- gain the knowledge about management methodologies in medical Engineering.

TEXT BOOKS

1. Rose, J.E., "Total Quality Management", Kogan Page Ltd., 1993.
2. Cesar A. Cacere & Albert Zana, "The Practice of clinical Engineering", Academic Press, Newyork, 1977.

REFERENCES

1. John Bank, "The Essence of Total Quality Management", Prentice Hall of India, 1999.
2. Webster J.G and Albert M.Cook, "Clinical Engineering, Principles & Practices", Prentice Hall Inc., Engle wood cliffs, NewJersy, 2011.
3. "Quality control" by Kulkarni. A.K. and Bewoor. V.A. Published by Wiley India Pvt. Ltd
4. "Handbook on Quality Assurance & Quality Control in Construction" by Jude D'Silva.

CO/PO MAPPING :

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CO 4	2	3		2									3	3	3
CO 5	3	3			3						1		3	3	

MD20654 BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basic concepts of brain computer interface
- study the various signal acquisition methods
- study the signal processing methods used in BCI
- learn the various types of feature translation methods
- learn the various applications of BCI

UNIT I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system, Classification of BCI, Invasive, Non-invasive and Partially invasive BCI; EEG signal acquisition; Signal Preprocessing; Artifacts removal.

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensori motor activity – Mu rhythm; Movement Related Potentials; Slow Cortical Potentials- P300, Visual Evoked Potential, Activity of Neural Cells, Multiple Neuro mechanisms.

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD, Wavelets; Parametric Methods – AR,MA,ARMA models,PCA;Linear and Non-Linear Features.

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis; Support Vector Machines; Regression; Vector Quantization–Gaussian Mixture Modeling, Hidden Markov Modeling; Neural Networks.

UNIT V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis; Functional Electrical Stimulation; Visual Feedback and control - External device control; Case study- Brain actuated control of mobile Robot.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- describe BCI system and its potential applications.
- analyze event related potentials and sensory motor rhythms.
- compute features suitable for BCI.
- design classifier for a BCI system.
- implement BCI for various applications.

TEXT BOOKS

1. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1999.
2. Bernhard Graimann, Brendan Allison, Gert P Furtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2011.

REFERENCES

1. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
2. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
3. "Brain-Computer Interfaces and Human-Computer Interaction" by Desney Tan and Anton Nijholt- SpringerLink.
4. Brain-Computer Interfacing: An Introduction Hardcover – 30 September 2013 by Rajesh P. N. Rao.

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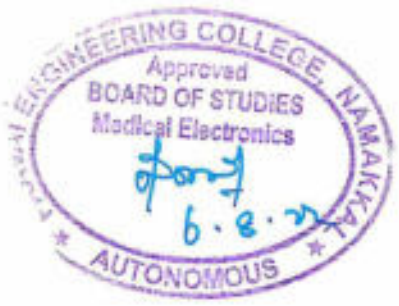

MD20903 PRODUCT DESIGN AND DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basic concepts of product design.
- infer product features and its architecture.
- apply knowledge in common features.
- incorporate the products in a specific place.
- understand the planning and principles of prototypes.

UNIT I INTRODUCTION 9

Need for IPPD; Strategic importance of Product development - integration of customer, designer, material supplier and process planner; Competitor and customer behavior analysis - Understanding customer, promoting customer, involve customer in development and managing requirement; Organization process-management and improvement.

UNIT II CONCEPT GENERATION, SELECTION AND TESTING 9

Plan and establish product specifications task; Structured approaches – clarification, search-externally and internally, explore systematically; reflect on the solutions and processes - concept selection, methodology, benefits; Implications - Product change, variety, component standardization, product performance, manufacturability; Concept Testing Methodologies.

UNIT III PRODUCT ARCHITECTURE 9

Product development management - establishing the architecture, creation, clustering, geometric layout development; Fundamental and incidental interactions; Related system level design issues - secondary systems, architecture of the chunks, creating detailed interface specifications; Portfolio Architecture

UNIT IV INDUSTRIAL DESIGN 9

Integrate process design - managing costs, robust design, integrating CAE, CAD, CAM tools; Simulating product performance and manufacturing processes electronically; Need for industrial design impact; Design process, investigation of customer needs, conceptualization, refinement, management of the industrial design process; Technology driven products – user, driven products, assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition - Estimation of Manufacturing cost, reducing the component costs and assembly costs, Minimize system complexity; Prototype basics - principles of prototyping, planning for prototypes; Economic Analysis - understanding and representing tasks, baseline project planning, accelerating the project, project execution.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the integration of customer requirements in product design
- apply structural approach to concept generation, selection and testing
- understand various aspects of design such as industrial design, design for manufacture, economic analysis and product architecture.
- know the design and function of product architecture.
- basics of project planning and analysis.

TEXT BOOKS

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999.

REFERENCES

1. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377.
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewoo 1992,ISBN, 1-55623-603-4.
3. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing, Newyork NY,1991, ISBN 0-202-41639-5 4. www.me.mit/2.7444.

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MD20904	ELECTRICAL SAFETY AND QUALITY ASSURANCE IN HEALTHCARE	3	0	0	3

COURSE OBJECTIVES

To enable students to

- provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care.
- learn and understand regulatory requirements for healthcare
- aware of the role of biomedical engineer in hospitals.
- educate the management of electrical supply, maintenance of electrical safety.
- access the quality of healthcare and the hospital services

UNIT I STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 9

Definition of Medical ethics; Scope of ethics in medicine; International code of Ethics for occupational health professionals; CMA code of ethics; Fundamental Responsibilities- The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society.

UNIT II REGULATORY REQUIREMENT FOR HEALTHCARE 9

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, regulatory Codes.

UNIT III HOSPITAL SAFETY 9

Security and Safety of Hospital -Property, Staff and Patients, Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation; ICRP regulations for radiation safety; Disposal of Biological waste.

UNIT IV ELECTRICAL AND FIRE SAFETY 9

Sources of shocks; Macro and Micro shocks - hazards, monitoring and interrupting the operation from leakage current- Elements of fire, causes of fire, Action to be taken in case of fire in a Hospital.

UNIT V ASSESSING QUALITY HEALTHCARE 9

Patient Safety Organization- Governmental and Independent, Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction. 5S techniques

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the scope of need and significance of quality practices in healthcare industry.
- discuss the system of regulatory measures and accreditation.
- differentiate the level of safety and security measures and significance.

- understand the concepts of Electrical and Fire Safety Hazards Mitigations
- understand the assessing quality practices using tools.

TEXT BOOKS

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 24.
2. T2: K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert.

REFERENCES

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Englewood Cliffs, New Jersy, 1979.
2. Joint Commission International Accreditation Standards for Hospitals, 6th edition, july2017.
3. Sharon Myers —Patient Safety & Hospital Accreditation - A Model for Ensuring SuccesslSpringer Publishers 2012 7. Joseph F Dyro —Clinical Engineering Handbook— Elsevier Publishers,2004.
4. Zana, The Practice of Clinical Engg. Academic press, New York, 1977.

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