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)

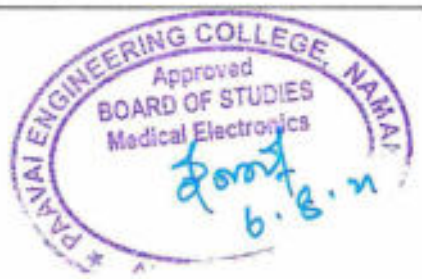
S.No.	Category	Course Code	Course Title	L	T	P	C
1	HS	EN20101	English Communication Skills I	3	0	0	3
2	HS	EN20201	English Communication Skills II	3	0	0	3
			Total				**6**

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

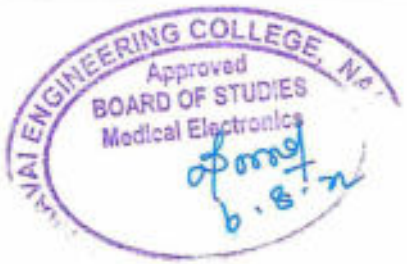
S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD20601	Human Assist Devices	3	0	0	3
2	PC	MD20602	Biomaterials	3	0	0	3
3	PC	MD20603	Biomedical Signal Processing	3	0	0	3
4	PE	MD2025*	Professional Elective II .	3	0	0	3
5	OE	MD2090*	Open Elective I	3	0	0	3
Practicals							
7	PC	MD20604	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)		
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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		

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

Fundamentals: registers, current program status register, Pipeline, exceptions, Barrel Shifter, Interrupts and vector table, ARM architecture, ARM instruction set, thumb instruction set.

UNIT V APPLICATIONS IN MEDICINE 9

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

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- 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 :

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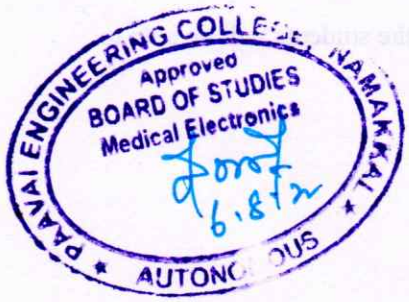
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



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

IR and UV lamp – applications; Diathermy types- short wave, ultrasonic, Microwave, electro surgery machine-current waveforms, Tissue Responses, Hazards and safety procedures; Lasers in medicine- Types, Tissue reactions, flow cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser micro irradiation, Laser Doppler velocimetry, Neurosurgical Laser Techniques.

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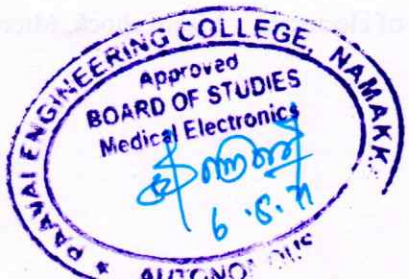
CO 2	2			3						2			3	3	3
CO 3		3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3						1			3	3	3



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)		
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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)													
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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 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 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

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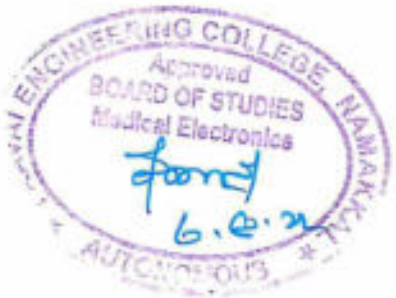
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



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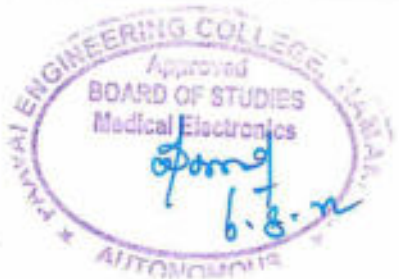
CO 3	3	3			3								3		
CO 4	2	2			3								3		
CO 5	3	3			3								3		



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 :

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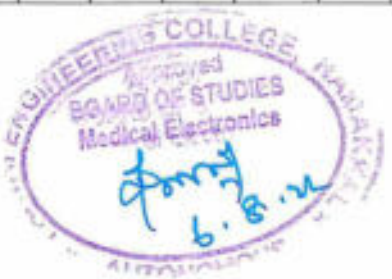
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



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 2	2	3		3	3								3	3	2
CO 3	3	3		3	3								3	3	3
CO 4	2	3		2	3								3	3	3
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 :

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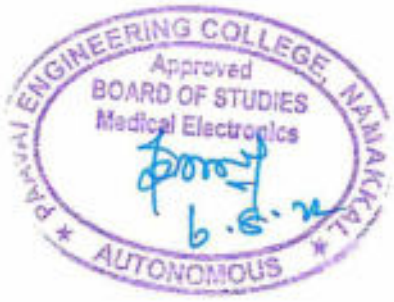
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



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)		
	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

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														
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)		
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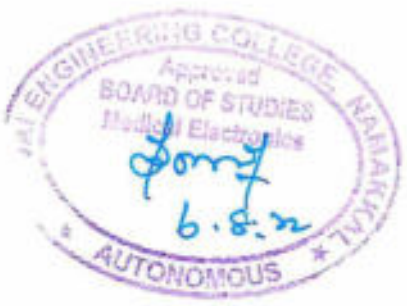
CO 1	3	3		3	2								3	2	2
CO 2	2	3		3	3					2			3	3	3
CO 3	3	3			3		3						3	3	3
CO 4	2	3		2	3								3	3	3
CO 5	3	3		3	3					1			3	3	3



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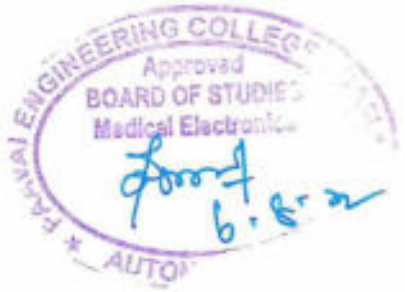
CO 1			3		3	2			2			2		3	
CO 2		2	3	2	2		2		2					2	
CO 3		2	2	2	3	3		2		3			2		
CO 4	2	2	3	2	3	3	1					3	3		2
CO 5	2	3	3	2	3			2		2				2	2



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