SEMESTER V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	CH16501	Environmental Science and Engineering	3	0	0	3
2	PC	MD16501	Medical Informatics	3	0	0	3
3	PC	MD16502	Microprocessor and Microcontroller	3	0	0	3
4	PC	MD16503	Biomedical Signal Processing	3	2	0	4
5	PC	MD16504	Biomechanics	3	0	0	3
6	PE	MD161**	Professional Elective-I	3	0	0	3
Practicals							
7	PC	MD16505	Biomedical signal processing Laboratory	0	0	4	2
8	PC	MD16506	Microprocessor and Microcontroller Laboratory	0	0	4	2
9	EE	EN16501	Carrier Development Laboratory I	0	0	2	1
			Total	**18**	**2**	**10**	**24**

SEMESTER VI

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	BA16151	Professional Ethics and Human Values	3	0	0	3
2	PC	MD16601	Diagnostic and Therapeutic Equipment	3	0	0	3
3	PC	MD16602	Biomaterials and Artificial Organs	3	0	0	3
4	PC	MD16603	Medical Imaging Techniques	3	0	0	3
5	PE	MD162**	Professional Elective-II	3	0	0	3
6	OE	MD16***	Open Elective-I	3	0	0	3
Practicals							
7	PC	MD16604	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
8	EE	MD16605	Mini Project	0	0	4	2
9	EE	EN16601	Career Development Laboratory II	0	0	2	1
			Total	**18**	**0**	**10**	**23**

PROFESSIONAL ELECTIVE COURSES (PE)

S.No.	Category	Course Code	Course Title	L	T	P	C
Professional Elective-I							
1	PE	MD16151	Robotics and Automation	3	0	0	3
2	PE	MD16152	Neural Networks and its applications	3	0	0	3
3	PE	MD16153	Bio MEMS	3	0	0	3
4	PE	MD16154	Nano Technology and its applications	3	0	0	3
Professional Elective-II							
5	PE	MD16251	VLSI Design	3	0	0	3
6	PE	MD16252	Pattern Recognition	3	0	0	3
7	PE	MD16253	Medical Expert Systems	3	0	0	3
8	PE	MD16254	Introduction to Cloud Computing	3	0	0	3
Professional Elective-III							
9	PE	MD16351	Medical Devices Regulations	3	0	0	3
10	PE	MD16352	Rehabilitation Engineering	3	0	0	3
11	PE	MD16353	Fundamentals of Nano science	3	0	0	3
12	PE	MD16354	Medical Ethics and Safety	3	0	0	3
Professional Elective-IV							
13	PE	MD16451	Smart Wearable Systems	3	0	0	3
14	PE	MD16452	Fundamentals of Biomedical Nanotechnology	3	0	0	3
15	PE	MD16453	Advanced Medical Instrumentation Technology	3	0	0	3
16	PE	IT16454	Introduction to Mobile App Development	3	0	0	3
Professional Elective-V							
17	PE	MD16551	Artificial Organs and Implants	3	0	0	3
18	PE	MD16552	Embedded Systems and IOT in Healthcare	3	0	0	3
19	PE	MD16553	Body Area Networks	3	0	0	3
20	PE	MD16554	Telehealth Technology	3	0	0	3
Professional Elective-VI							
21	PE	MD16651	Virtual Bio Instrumentation	3	0	0	3
22	PE	MD16652	Digital Video Processing	3	0	0	3
23	PE	MD16653	Quality Control in Biomedical Engineering	3	0	0	3
24	PE	MD16654	Brain Computer Interface and its Applications	3	0	0	3
			Total	**18**	**0**	**0**	**18**

OPEN ELECTIVE COURSES (OE)

S.No.	Category	Course Code	Course Title	L	T	P	C
OPEN ELECTIVE COURSE -I							
1	OE	MD16901	Biomedical Equipments	3	0	0	3
2	OE	MD16902	Basics of Bioinformatics	3	0	0	3
OPEN ELECTIVE COURSE –II							
3	OE	MD16903	Product design and development	3	0	0	3
4	OE	MD16904	Analytical Methods and Instrumentation	3	0	0	3
			Total	**12**	**0**	**0**	**12**

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	EE	EN16501	Carrier Development Laboratory I	0	0	2	1
2	EE	EN16601	Career Development Laboratory II	0	0	2	1
3	EE	MD16606	Mini Project	0	0	4	2
4	EE	MD16705	Project Work Phase I	0	0	4	2
5	EE	MD16706	Hospital Internship Training	0	0	0	1
6	EE	MD16801	Project Work Phase II	0	0	12	6
			Total	**0**	**0**	**24**	**13**

ONE CREDIT COURSES

S.No.	Category	Course Code	Course Title	L	T	P	C
1	OCC	MD16951	Embedded Programming using ARDUINO	0	0	2	1
2	OCC	MD16952	PC Hardware Assembling and Troubleshooting	0	0	2	1
3	OCC	MD16953	Basic Electronic Circuit Design using Multisim	0	0	1	1
4	OCC	MD16954	MATLAB Programming	0	0	2	1
5	OCC	MD16955	Labview Programming	0	0	2	1
6	OCC	MD16956	Open source programming using Linux	0	0	1	1
7	OCC	MD16957	PCB Design using KICAD EDA Tool	0	0	2	1
8	OCC	MD16958	VHDL Programming	0	0	1	1

SYLLABI
SEMESTER V

MD16501 **MEDICAL INFORMATICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the basics of medical informatics
- understand the need of computers in medical imaging and automation in clinical laboratory.
- learn the various medical standards and functionality of CPR
- acquire the knowledge on health informatics based on medical standards
- build ICT application based on medical informatics

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Medical Informatics, Structure of Medical Informatics, Computer based medical information retrieval, Functional capabilities of a computerized Hospital Information System; Health Informatics – Medical Informatics, Bioinformatics, Clinical informatics, Nursing informatics, Public health informatics.

UNIT II MEDICAL DATA STORAGE AND AUTOMATION 9

Representation of health Data - Relational, Hierarchical and network Approach, Data modeling for patient database development; Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System; Computer assisted medical imaging- Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III MEDICAL STANDARDS AND COMPUTERISED PATIENTRECORD 9

Evolution of Medical Standards – IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA; Computer based Patient Records-History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology, Clinical information system, Computerized prescriptions for patients.

UNIT IV HEALTH INFORMATICS 9

Bioinformatics - Databases, Bio-information technologies, Genome Analysis, Semantic web and Bioinformatics, Genome projects; Clinical information system- data for decision making, Medical diagnostic and decision support systems, Decision analysis in health informatics.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine; Computer assisted surgical techniques-Virtual endoscopy, Computer assisted surgery, Surgical simulation, Computer assisted medical education, Computer assisted patient education and health; Telemedicine -Virtual Hospitals, Smart Medical Homes, Personalized e-health services.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze the structure of medical Informatics and functional capabilities of hospital information system.
- describe the need of computers in medical imaging and automation in clinical laboratory.
- apply the medical standards in the various CPR applications
- interpret the knowledge on health informatics based on medical standards
- build recent trends and different ICT applications in medical Informatics

TEXT BOOKS:

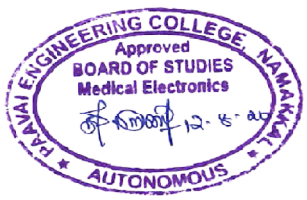
1. Mohan Bansal, —Medical informatics‖, Tata McGraw Hill Publishing Ltd, 2003
2. R.D.Lele, —Computers in medicine progress in medical informatics‖, Tata Mcgraw Hill, 2005

REFERENCES

1. R.D.Lele, —Computers in medicine progress in medical informatics‖, Tata Mcgraw Hill, 2005
2. Edward H. Shortliffe, James J. Cimino, —Biomedical Informatics: Computer Applications in Health Care and Biomedicine‖, Springer Science & Business Media, 2013
3. OrpitaBosu and Simminder Kaur Thukral, —Bioinformatics Databases, Tools and Algorithms‖, Oxford University press, 2007.
4. Shui Qing Ye, —Bioinformatics: A Practical Approach‖ , CRC Press, 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													
	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	PO11	PO12	PSO 1	PSO 2
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	
CO 5	2	3	3	2	3			2		2				2



MD16502 MICROPROCESSOR AND MICROCONTROLLER 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- explainthe architecture of 8086microprocessor.
- learnthe design aspects of I/O and memory interfacing circuits.
- interfacemicroprocessors with supporting chips.
- familiarize about ARM microcontroller
- acquireknowledge on applications of microprocessor and microcontroller in biomedical domain.

UNIT I OVERVIEW OF 8086 MICROPROCESSOR 9

8086 Microprocessor-Evolution of Microprocessor, Importance in biomedical domain; Architecture and signal description - 8086 Minimum and maximum mode, addressing modes, Instruction set, Programs

UNIT II 8051 MICROCONTROLLERS 9

8051 Microcontroller - Introduction to 8 bit microcontroller, signal descriptions of 8051, Architecture of 8051, Register set of 8051,Instruction set, Addressing mode

UNIT III INTERFACING MACHINES 9

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

UNIT IV ARM MICROCONTROLLER 9

Fundamentals - registers, current program status register, pipeline, exceptions, interrupts, vector table; ARM Basics - Architecture, ARM instruction set, thumb instruction set.

UNIT V APPLICATIONS IN MEDICINE 9

Bio signal recording using Mobile phone; 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

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

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

TEXT BOOKS

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.

2. Douglas V. Hall, "Microprocessor and Interfacing:Programming and Hardware",Glencoe, 2nd edition, 2006.

REFERENCES

1. Andrew N.Sloss,DonimicSymes, Chris Wright, "ARM System Developer's Guide", Elsevier, 1st edition, 2007.
2. Muhammad Ali Mazidi and JanicaGilliMazidi, 'The 8051 microcontroller and embedded systems', Pearson Education, 5th Indian reprint, 2003.
3. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3rd edition, 2013.

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	PO11	PO12	PSO 1	PSO 2
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	
CO 5	2	3	3	2	3			2		2				2

MD16503 BIOMEDICAL SIGNAL PROCESSING 3 2 0 4

COURSE OBJECTIVES

To enable students to

- understand the concept of DIF and DIT for the analysis of bio signal and system
- choose the IIR Filter in frequency domain
- learn to design the FIR filter in frequency domain
- utilize the concepts acquired through cardiovascular applications
- utilize the concepts acquired through Neurological applications and signal classification

UNIT I FUNDAMENTALS OF SIGNAL PROCESSING 15

Basics- Sampling and aliasing, simple signal conversion systems, spectral analysis; FFT - Decimation In Time algorithm, Decimation in Frequency algorithm; Bioelectric signals and its basic characteristics-Bio signal Characteristics of Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal; Objectives of Biomedical signal analysis; Difficulties in Biomedical signal analysis.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 15

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 15

Design of FIR filters; symmetric and Anti-symmetric FIR filters; design of linear phase FIR filters using Fourier series method; FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method; FIR filter structures - linear phase structure, direct form realizations

UNIT IV CARDIOVASCULAR APPLICATIONS 15

Noise &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 15

EEG rhythms & waveforms; EEG applications- Epilepsy, sleep disorders, brain computer interface;ModellingEEG- linear, stochastic models, Nonlinear modeling of EEG; Artifacts in EEG & their characteristics and processing; Spectral Analysis - Nonparametric spectral analysis, Model based spectral analysis; EEG segmentation; Joint Time-Frequency analysis; correlation analysis of EEG

channels; coherence analysis of EEG channels; Evoked potentials- noise characteristics, Noise reduction by linear filtering; Statistical signal classification- linear discriminant function, direct feature selection and ordering, Back propagation neural network; Analysis of EEG using Empirical mode decomposition (EMD).

TOTAL PERIODS 75

COURSE OUTCOMES

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

- apply DIF and DIT for the analysis of bio signal and system
- applythe 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. John G. Proakis&DimitrisG.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007 (UNIT I - III).
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis, A Case-Study Approach", John Wiley & Sons, Reprint 2016.(UNIT 1)
3. Semmlow, —Biosignal and Biomedical Image Processing‖, Marcel Dekker, 2004(UNIT IV-V)
4. Sergio Cerutti Carlo Marchesi, "Advanced Methods of Biomedical Signal Processing" Wiley, 2011

REFERENCES

1. Reddy D.C, "Biomedical signal processing: Principles and techniques", Tata McGraw-Hill, New Delhi, 2nd edition, 2005.
2. 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
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	
CO 5	2	3	3	2	3			2		2				2

MD16504 **BIOMECHANICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- explain the basic principles of mechanics in various applications
- discussthe mechanics of physiological systems.
- elaborateabout biosolid mechanics.
- describethe 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, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modelling 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 &Voight models, anisotropy, fatigue analysis; Hard Tissues – Definition of stress & strain, Deformation mechanics, Bone structure & composition, mechanical properties of bone, cortical and Cancellous Bone, blood circulation, elasticity and strength, 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, mathematical modeling, 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

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

- describethe use of mechanics in medicine.
- summarizethe mechanics of physiological systems.
- designand develop the models specific to orthopedic applications.
- explainthe structure, movements of Hard and Soft tissues.
- analyzethe biomechanical systems using mathematical models.

TEXT BOOKS

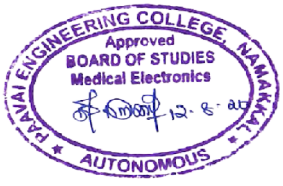
1. Y. G. Fung, Biomechanics, Springer-Verlag New York Inc, 2010
2. Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor& Francis, 2017.

REFERENCES

1. Susan J Hall, "Basics of Biomechanics'', McGraw Hill Publishing.co. New York, 8th Edition, 2019.
2. C. Ross Ether and Craig A.Simmons, "Introductory Biomechanics from cells to organisms",Cambridge University Press, New Delhi, 2013.
3. Paul Brinckmann, Wolfgang Frobin; Gunnar Leivseth; BurkhardDrerup, "OrthopaedicBioMechanics", 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	PO 10	PO 11	PO 12	PSO 1	PSO 2
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	
CO 5	2	3	3	2	3			2		2				2



CH16501 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the constituents of the environment and theprecious resources in the environment
- conserve all biological resources
- understand the role of human being in maintaining a clean environment and useful environment forthe future generations
- maintain the ecological balance and preserve bio-diversity.
- The role of government and non-government organizations in environment management.

UNIT I UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Environment: Definition-scope -importance -need for public awareness. Forest resources: Use -over exploitation-deforestation -case studies-mining -effects on forests and tribal people. Water resources -Use -over utilization of surface and ground water-floods -drought -conflicts over water. Mineral resources Use -exploitation -environmental effects of extracting and using mineral resources -Food resources: World food problems -changes caused by agriculture and overgrazing-effects of modern agriculture -fertilizer-pesticide problems -water logging -salinity. Energy resources: Growing energy needs -renewable and non-renewable energy sources-Role of an individual in conservation of natural resources

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concept of an ecosystem: Structure and function of an ecosystem -producers -consumers -decomposers -energy flow in ecosystem--ecological succession -food chains -food webs and ecological pyramids. Types of ecosystem: Introduction-characteristic features -forest ecosystem -grassland ecosystem -desert ecosystem -aquatic ecosystems (lakes-rivers-oceans-estuaries). Biodiversity: Introduction-definition (genetic -species -ecosystem) diversity. Value of biodiversity: Consumptive use -productive use -social values -ethical values -aesthetic values. Biodiversity level: Global -national -local levels-India as a mega diversity nation-hotspots of biodiversity. Threats to biodiversity: Habitat loss -poaching of wildlife -man wildlife conflicts -endangered and endemic species of India. Conservation of biodiversity

UNIT III POLLUTION 9

Pollution: Définition -air pollution -water pollution -soil pollution -marine pollution -noise pollution -thermal pollution -nuclear hazards. Solid waste management: Causes -effects -control measures of urban and industrial wastes. Role of an individual in prevention of pollution -pollution. Disaster management: Floods -earthquake -cyclone -landslides. Electronic waste-Sources-Causes and its effects.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

Water Sustainable development : Unsustainable to sustainable development -urban problems related to energy. Water conservation -rain water harvesting -watershed management-Resettlement and rehabilitation of people. Environmental ethics: Issues -possible solutions -climate change -global warming and its effects on flora and fauna -acid rain -ozone layer depletion -nuclear accidents -nuclear holocaust -Environment protection act: Air (Prevention and Control of Pollution) act -water (Prevention and control of Pollution) act -wildlife protection act -forest conservation act -issues involved in enforcement of environmental legislation.

UNIT V HUMAN POPULATION AND ENVIRONMENT 9

Human population: Population growth -variation among nations -population explosion -family welfare programme and family planning -environment and human health -Human rights -value education -HIV/AIDS Swine flu -women and child welfare. Role of information technology in environment and human health.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- know the relationship between the human population and environment.
- understand the basic concepts of environment studies and natural resources
- gain the knowledge about ecosystem and biodiversity.
- have knowledge about causes-effects and control measures of various types of pollution.
- understand the social issues and various environmental acts.

TEXT BOOKS

1. Raman Sivakumar, Introduction to Environmental Science and Engineering, 2ndEdn, Tata McGraw Hill Education Private Limited, New Delhi,(2010).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, (2010).

REFERENCES

1. S. Divan, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2001.
2. A.K.De, Environmental Chemistry, VI edition,2015 NewAge International (P) ltd Publication, New Delhi.
3. C.S.Rao, Environmental Pollution and Control engineering, Vedition, New Age International (P) ltd Publication, NewDelhi 110002
4. Clair Nathan Sawyer, Perry L. McCarty, Gene F. Parkin, "Chemistry for Environmental Engineering

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	PO11	PO12	PSO 1	PSO 2
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	
CO 5	2	3	3	2	3			2		2				2

MD16505 BIOMEDICAL SIGNAL PROCESSING LABORATORY 0 0 4 2

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

TOTAL PERIODS 60

COURSE OUTCOMES:

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)	
	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
CO 1			3						2			2		3
CO 2		2	3				2		2					2
CO 3		2	2					2		3			2	
CO 4	2	2	3				1					3	3	

MD16506 **MICROPROCESSOR AND MICROCONTROLLER LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- learn to write programs for sorting, and string manipulation using 8086
- acquire the programming knowledge for arithmetic and logical operations in 8086 & 8051
- learn how the devices interfaced with processor
- acquire the 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 Logical operations
3. Programming using Bit Manipulation instructions of the 8051microcontroller.
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 Launchpad to control the DC motor using external analog input.
10. Implement Pulse Width Modulation to control the brightness of the on-board, green LED using ARM Microcontroller

TOTAL PERIODS 60

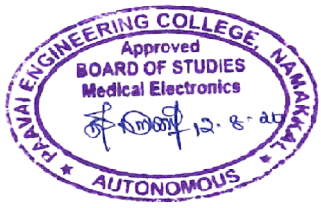
COURSE OUTCOMES:

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

- enumerate the programs for sorting, and string manipulation using 8086
- apply the programming knowledge for arithmetic and logical operations in 8086 & 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
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	



EN16501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

To enable students to

- understand their capabilities and enhance their grooming and showcasing his/ her capabilities to a prospectiveemployer
- provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- articulate their thoughts on a given topic in English and also to make decent write ups in English on any giventopic
- practice and score well in Aptitude tests conducted by corporate / prospectiveemployers
- prepare for any group discussion evaluation or presenting their credentials during a face - to - face interview leading to selection andemployment

UNIT I BASIC SELF ANALYSIS 6

Introduction; Self Explorations -Who Am I, Personal Attributes, Self Confidence and Self Esteem; Communication Skills - Introduction to communication, Flow of communication, Listening, Barriers of communications, How to overcome the barriers of communications; Leadership Qualities - Skills for a good Leader, Leadership styles, SWOT Analysis; Time Management- Time is a resource, Identify Time wasters, Time Management Styles, Techniques for better time management; Group Dynamics/ Team Building - Importance of group in organizations, Team Building, Interaction with the team, How to build the good team

UNIT II PERSONALITY DEVELOPMENT 6

Motivation - Introduction, Relevance and types of motivation, Analysis of motivation ; Attitude - Factors, Influencing Attitude, Challenges and lessons from attitude; Creativity -Out of box thinking, Lateral thinking; Goal Setting - Wish list, Blue print for success; Short, long, life time goals

UNIT III QUANTITATIVE APTITUDE 6

Number System , LCM & HCF, Square root & Cube root, Percentage, Time speed & Distance

UNIT IV QUANTITATIVE APTITUDE 6

Trains, Boats & Streams, Average, Ages, Area

UNIT V LOGICAL AND VERBAL REASONING 6

Series Completion - Number Series, Letter series, Symbol Series; Verbal Reasoning - Blood Relation, Coding and decoding, Logical Sequence, Analogy, Character Puzzles, Classification, Data sufficiency

TOTAL PERIODS 30

COURSE OUTCOMES

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

- demonstrate aptitude and reasoningskills
- enhanceverbal and writtenability.
- improvehis/her grooming and presentationskills.
- interacteffectively on any recent event/happenings/ currentaffairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same withConfidence.

TEXT BOOKS

1. Agarwal, R.S." A Modern Approach to Verbal & Non Verbal reasoning", S.Chand& co ltd, New Delhi.
2. Abhijitguha, "Quantitative Aptitude ", Tata - Mcgraw hill.
3. Word power made easy by normanlewis ,W.R.Goyal publications.
4. Johnson, D.W. Boston: Allyn and Bacon" reaching out – interpersonal effectiveness and self - actualization.
5. Agarwal, R.S." objective general English", S.Chand& co
6. "Infosys campus connect program – students" guide for soft skills.

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

PROFESSIONAL ELECTIVE I

MD16151 **ROBOTICS AND AUTOMATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the basic concepts associated with the design, functioning, applications and social aspects of robots
- understand 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
- learn the various motion planning techniques and the associated control architecture
- inference the application of 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 & 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 & 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 & 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 learning - AI, Expert systems; Telerobotics and Virtual Reality, Micro &Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the 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 & automation
- examine different sensors and actuators for applications like maze solving and self-driving cars.
- design a 2R robot & 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. Robert J. Schilling, "Fundamentals of Robotics: Analysis and Control", Pearson; 2 January 1990

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													
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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	
CO 5	2	3	3	2	3			2		2				2

MD16152 NEURAL NETWORKS AND ITS APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable the 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 FROM BIOLOGY TO ARTIFICIAL NEURAL NETWORKS – 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 back propagation – Single Layer Perceptron, Convergence theorem, delta rule, Linear Separability, Multilayer Perceptron, Back propagation algorithm, variation and extension to back propagation. 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 OTHER 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

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

Upon the completion of the 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:

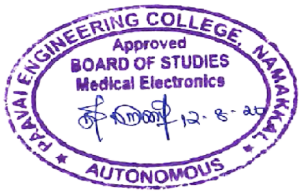
1. David Kriesel, —A Brief Introduction to neural networks, 2007
2. Martin T.H, "Neural Network design" ,2018

REFERENCES

1. LaureneFausett, —Fundamentals of neural networks- Architectures, algorithms and applications‖, 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. Simon O. Haykins, Neural Networks: A Comprehensive Foundation, 2nd Edition, Pearson 1994
4. 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													
	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	PO11	PO12	PSO 1	PSO 2
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	
CO 5	2	3	3	2	3			2		2				2



MD16153 **BIO MEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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-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.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the 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

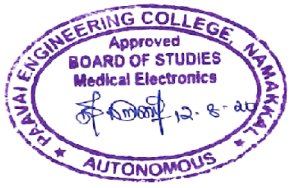
1. Marc J. Madou, "Fundamentals of Microfabrication: the science of miniaturization'', CRC Press, 2002.
2. Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and applications", CRC Press, New York, 2007
3. Malsch, NeelinaH., ed., Biomedical Nanotechnology, Washington, DC: CRC Press, 2005

CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

Course Outcomes (Cos)	Programme Outcomes(POs)														
	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**
CO1	3	3			3								3	3	3
CO2	2	2			3								3	2	3
CO3	3	3			3								3	3	
CO4	2	2			3								3	2	
CO5	3	3			3								3	3	



MD16154 **NANO TECHNOLOGY AND ITS APPLICATIONS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the basic structure of nanoparticles
- understand the basic science behind the properties of material
- analyse the creation, characterization, and manipulation of nanoscale materials
- utilize the exciting applications of nanotechnology at the leading edge of scientific research
- analyze their knowledge of nanotechnology to identify how they can be exploited for new applications.

UNIT I INTRODUCTION TO NANOTECHNOLOGY **9**

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials, Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures; clusters of metals and semiconductors, bio nanoparticles.

UNIT II FABRICATION AND CHARACTERIZATION OF NANOMATERIALS **9**

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs,Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques(Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electro spinning. Bio-synthesis of nanomaterials.

UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS **9**

Optical Properties- Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements - SEM, TEM, AFM and STM; Confocal and TIRF imaging.

UNIT IV NANO STRUCTURES **9**

Nanostructures- Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots, Applications of nanostructures, Reinforcement in Ceramics, Drug delivery, Giant magneto resistance, Cells response to Nanostructures.

UNIT V APPLICATIONS OF NANOTECHNOLOGY **9**

Nano electronics, Nanosensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems

TOTAL PERIODS **45**

COURSE OUTCOMES

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

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

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-YuenTseng and Hari Singh Nalwa, American Scientific 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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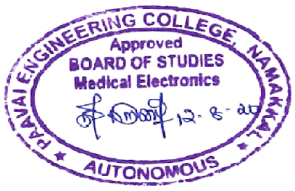
CO 2		2	3	2	2		2		2					2
CO 3		2	2	2	3	3		2		3			2	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2



SEMESTER VI

BA16151 PROFESSIONAL ETHICS AND HUMAN VALUES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic human values for a professional
- discuss the significance of ethics in engineering and the theories related to it
- familiarize oneself with the role of engineer as responsible experimenters
- expose the students to their roles and responsibilities in assessing safety and reducing risks
- describe the global issues in ethics and role of engineers as manager and consultants

UNIT I HUMAN VALUES 9

Morals, values and ethics-Integrity-Work Ethic-Service Learning-Civic virtue-Respect for others-Living peacefully – caring – sharing – Honesty – Courage – Valuingtime-cooperation-Commitment-Empathy-Self-confidence-Character-Spiruality

UNIT II ENGINEERING ETHICS 9

Senses of "Engineering Ethics"-variety of moral issues-types of inquiry-moral dilemmas-moral autonomy-Kohlberg's theory-Gilligan's theory-consensus and controversy-Models of Professional Roles-theories about right action-Self -interest-Customs and religion-uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation-engineers as responsible experimenters-codes of ethics-a balanced outlook on law-the challenger case study

UNIT IV SAFETY, RESPONSIBILTIES AND RIGHTS 9

Safety and risk-assessment of safety and risk-risk benefit analysis and reducing risk-the Three Mile Island and Chernobyl case studies. Collegiality and loyalty-respect for authority-collective bargaining-confidentiality-conflicts of interest-occupational crime-professional rights-employee rights-Intellectual property rights(IPR)-discrimination

UNIT V GLOBAL ISSUES 9

Multinational corporations-Environmental ethics-computer ethics-weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors-moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of materials Management, Institution of electronics and telecommunication engineers(IETE), India,etc.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the basic human values for a professional
- understandthe significance of ethics in engineering and the theories related to it.
- be familiar with the role of engineer as responsible experimenters
- acquire knowledge about their roles and responsibilities in assessing safety and reducing risks
- discuss the global issues in ethics and role of engineers as manager and consultants

TEXT BOOKS

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics -Concepts and Cases", Thompson Learning, (2000).
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003).
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001).
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics - An Indian Perspective",Biztantra, NewDelhi, (2004).
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes:

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CO2	3		3		3								3	3
CO3	3		3		3								3	3
CO4	3		3		2								3	3
CO5	3		3		2								3	3

MD16601 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- applydifferent medical devices in the measurement of parameters related to cardiology, neurology.
- measureand analyze signals generated by muscles.
- gain knowledge about measurements of parameters related to respiratory system
- understandthe various sensory measurements that hold clinical importance.
- interpretBiomedical Laser principles and applications.

UNIT I CARDIAC AND NEUROLOGICAL EQUIPMENT **9**

Cardiac Equipment - Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Defibrillator Protection Circuit, Cardiac ablation catheter; Neurological Equipment - Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto EncephaloGraph). EEG Bio Feedback Instrumentation.

UNIT II MUSCULAR AND BIOMECHANICAL MEASUREMENTS **9**

Muscular Measurements - Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation; Static Measurement – Load Cell, Pedobarograph; Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.

UNIT III RESPIRATORY MEASUREMENT SYSTEM **9**

Measuring Instruments - Instrumentation for measuring the mechanics of breathing, Lung Volume and vital capacity, Airway resistance measurement, Whole body, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor; Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT IV SENSORY MEASUREMENT **9**

Psychophysiological Measurements **–** polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR); Sensory responses **–** Audiometer, Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

UNIT V LASER BASED EQUIPMENTS **9**

Lasers in Medicine **–** Types, Tissue reactions. Lasers in ophthalmology, Flow Cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser Micro irradiation, Laser Doppler Velocimetry, Neurosurgical Laser Techniques. Biomedical laser safety.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describethe working and recording setup of all basic cardiac and neurological equipment.
- discuss the recording of diagnostic and therapeutic equipment‘s related to EMG.
- explainabout measurements of parameters related to respiratory system.

- summarizeabout the measurement techniques of sensory responses.
- appreciatethe use of advanced laser technology in diagnosis and minimally invasive therapies.

TEXT BOOKS

1. R.S.Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 3rd edition, 2014.
2. Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology, Pearson education, 2012.
3. Albert M.Cook and Webster.J.G, *"Therapeutic Medical Devices"*, Prentice Hall Inc., New Jersey, 1st edition, 1982.

REFERENCES

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", Pearson Education, PHI Learning Private limited, India, 2nd edition, 2007.
2. John G.Webster, "Specifications of Medical Instrumentation Application and Design",Wiley India Pvt Ltd, India, 4th edition, 2015.
3. Cotton.P. B, and Williams. C. B., "Endoscopic Equipment, in Practical Gastrointestinal Endoscopy: TheFundamentals", Wiley-Blackwell, Oxford, UK, 6th edition, 2008.
4. Marc. Safran, Bobby. Chhabra. A., Mark. Miller.D., "Primer of Arthroscopy",Elsevier Health Sciences, 2nd edition, 2010.
5. Ventura.,Risegari., "The Art of Cryogenics Low-Temperature Experimental Techniques", Elsevier Science,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													
	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	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2

MD16602 BIOMATERIALS AND ARTIFICIAL ORGANS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- choosethe characteristics and classification of biomaterials.
- understand the materials used to implant
- demonstratethe response of biomaterials in living system.
- analyzeabout the polymeric materials and composites in tissue replacements.
- makeuse of the compatibility and functioning of artificial organs inside the living system.

UNIT I STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY 9

Structure of Biomaterials - Definition and classification of bio-materials, mechanical properties, visco elasticity, wound- healing process, body response to implants, blood compatibility, HLA compatibility.

UNIT II IMPLANT 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 materials, bioactivity, bioactive ceramics, nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization - polyamides, Acryrilic polymers, Hydrogels, rubbers, high strength, thermoplastics, medical applications; Bio polymers - collagen and elastin; Medical Textiles- silica, chitosan, PLA, composites, Sutures, wound dressings; Materials for ophthalmology - contact lens, Intra ocular lens. Membranes for plasma separation and blood oxygenation.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair; Tissue Replacements- Soft tissue replacements, Types of transplant - stem cell, sutures, surgical tapes, Tissue adhesive/glue. Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Pancreas replacement. Scaffolds for tissue engineering.

UNIT V ARTIFICIAL HEART, LUNG AND KIDNEY DEVICES 9

Fundamentals of implants and medical devices-Use of patients lung for gas exchange, the ideal heart lung device; Comparisons of natural and artificial lungs; Basic types of oxygenators, temperature maintenance, and gas flow rate requirements for artificial lungs-Drug delivery carriers; Basic methods of artificial waste removal; Hemodialysis; modeling of the patient; artificial kidney system.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyzedifferent types of materials and its application in biomedical field.
- choosematerials for design of implants in tissue replacement.

- evaluateresponse of biomaterials in living system.
- assesscompatibility and functioning of artificial organs inside the living system.
- designand develop biomaterial based scaffold for biomedical application.

TEXT BOOKS

1. Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, 3rdEdition, 2017.
2. JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003.

REFERENCES

1. H.H.Willard,D.L.Merrit, " "Instrumental Methods of Analysis",CBS Publishers, 7th edition, 2012.
2. ParkJ.B., "Biomaterials Science and Engineering'', Plenum Press,2014.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2nd edition, 2010.
4. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, ""Introduction to Biomedical Engineering", Elsevier, 4th edition, 2019.
5. AC Anand, JF Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Health Care'', Woodhead Publishing Limited, 2010.
6. D F Williams, "Medical and Dental Materials: A comprehensive Treatment-Volume 14", VCH Publishers, 1999.
7. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine", Academic Press, 3rd edition, 2013.
8. Joseph D.Bronzino, "Tissue Engineering and artificial Organs", Boca Raton: CRC Press, 2016.

CO-PO Mapping:

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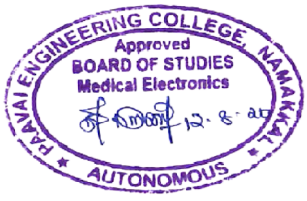
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2



MD16603 **MEDICAL IMAGING TECHNIQUES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- summarizeabout the production of x-rays and its application in medical imaging.
- identifydifferent types of Radio diagnostic techniques.
- inferknowledge in special imaging techniques used for visualizing the cross sections of the body.
- outlinethe imaging techniques of Ultrasound and Thermography.
- concludeRadiation 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. Computerized 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. & 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**

Diagnostic Ultrasound, Physics of Ultrasonic waves, Basic pulse-echo apparatus. Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes-A, B & M, Principles and theory of image generation. Digital scan converters 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, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the production, principles of X-rays and CT imaging techniques.
- explain about different types of Radio diagnostic techniques

- analyze special imaging techniques used for visualizing the cross sections of the body
- makeuse of Ultrasound and Thermography techniques for diagnose.
- discovernew in Radiation therapy techniques.

TEXT BOOKS

1. Khandpur R.S, "Hand-book of Biomedical Instrumentation", Tata McGraw Hill, 3rd Edition, 2015.

REFERENCES

1. Steve Webb, "The Physics of Medical Imaging", Adam Hilger, Philadelpia, 2nd edition, 2016.
2. Donald Graham, Paul Cloke, Martin Vosper –"Principles of Radiological physics", Churchill Livingston, 5th Edition, 2008.
3. Jerry L.Prince and JnathanM.Links,"Medical Imaging Signals and Systems"- Pearson Education Inc. 2nd edition, 2015.

CO-PO Mapping:

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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	
CO 5	2	3	3	2	3			2		2				2

MD16604	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.

TOTAL PERIODS60

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
- analyzethe different bio signals using suitable tools.
- analyzethe 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													
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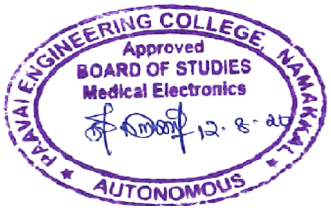
CO 3		2	2	2	3	3		2		3			2	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2



MD16605 **MINI PROJECT** **0 0 4 2**

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
- examine the technical report of the project

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. Thedevice/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 Head of the Department. It is highly desirable to publish their project in state/ national level conferences or Symposiums.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of the course, 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.
- explain the acquired knowledge through preparation of report and oral presentations.

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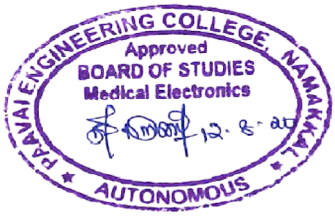
CO 3		2	2	2	3	3		2		3			2	2
CO 4	2	2	3	2	3	3	1					3	3	3
CO 5	2	3	3	2	3			2		2			3	2



EN16601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

To enable students to

- enhance career competency and employability skills
- demonstrate effective leadership and interpersonal skills
- improve professional capabilities through advanced study and researching current market strategy.
- develop problem solving and decision making capabilities
- prepare for any group discussion evaluation or presenting their credentials during a face -to - face interview leading to selection and employment

UNIT I CORPORATE READINESS 6

Business communication - Email, Paragraph, Letter Writing Skills; Public speaking skills - Rules of Public speaking skills, Extempore, JAM; Inter and intra personal skills – Introduction, Need for Inter and Intra personal skills in organizations; Stress management - Causes of stress and its impact, How to manage and distress, Circle of control, stress busters; Emotional Intelligence - What is emotional Intelligence, Why Emotional Intelligence Matters, Managing Emotions

UNIT II INTERVIEW SKILLS 6

Interview Basics - General Selection process, Grooming, Dress code, Supporting Documents to carry; Resume Building - Impact of Powerful CV, Do‟s and don‟ts in CV; Group Discussion - Introduction to GD, Important of Listening and Speaking skills, Do‟s and Don‟ts in GD ; Face to face interview / Hire me- Rules for face to face interview, body language; Self-Introduction ; Psychometric Assessment - Importance of Psychometric assessment, Why psychometric assessment

UNIT III QUANTITATIVE APTITUDE 6

Simplification ; Time and work; Pipes and cisterns; Ratio and Proportion; Partnership

UNIT IV QUANTITATIVE APTITUDE 6

Simple interest and Compound interest ; Profit and loss ; Permutation and combination Probability ; Calendar

UNIT V LOGICAL AND VERBAL REASONING 6

Seating arrangement; Direction; Arithmetic reasoning; Verbal reasoning – Syllogisms, Making Judgments, Statements and conclusions, Matching definition, Cause and effect

TOTAL PERIODS 30

COURSE OUTCOMES

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

- develop team work capabilities
- demonstrate aptitude and reasoning skills

- boost their problem solving skills.
- enhancethe transformation from college to corporate.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same withConfidence.

TEXT BOOKS

1. Agarwal, R.S." A Modern Approach to Verbal & Non Verbal reasoning", S.Chand& co ltd, New Delhi.
2. Abhijitguha, "Quantitative Aptitude ", Tata - Mcgraw hill.
3. Word power made easy by normanlewis ,W.R.Goyal publications.
4. Johnson, D.W. Boston: Allyn and Bacon" reaching out – interpersonal effectiveness and self - actualization.
5. Mitra ,barun.K, " Personalaity Development &Softskills " , OxfordUniversity.
6. "Infosys campus connect program – students" guide for soft skills.

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	
CO 5	2	3	3	2	3			2		2				2

PROFESSIONAL ELECTIVE- II

MD16251 VLSI DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the 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

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

UNIT II INVERTERS 9

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

UNIT III CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATIO 9

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

UNIT IV CMOS TESTING 9

CMOS Testing - 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 VERILOG HARDWARE DESCRIPTION LANGUAGE 9

Overview of digital design with Verilog HDL -Hierarchical modeling concepts, Modules and port definitions, Gate level modeling, Data flow modeling, Behavioral modelling; HDL programs - Combinational Circuits, 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 3		2	2	2	3	3		2		3			2	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2

MD16252 **PATTERN RECOGNITION** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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 KarhunenLoeve (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 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

Upon the completion of the 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. KonstantinosKoutroumbas, SergiosTheodoridis,"Pattern Recognition" Elsevier India Pvt. Ltd (Paper Back), 4th edition.
2. Christopher M.Bishop, "Pattern Recognition and Machine Learning", Springer books

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 Johnson baugh, Steve Jost, "Pattern Recognition and ImageAnalysis", Prentice Hall of India Pvt. Ltd., New Delhi, Edition- 1999.

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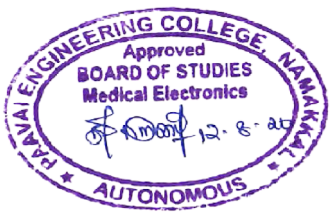

MD16253 **MEDICAL EXPERT SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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 demonstration software while accomplishing the review of current applications areas in AI.
- build applications on medical expert systems

UNIT I **INTRODUCTION TO AI** **9**

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

UNIT II **KNOWLEDGE REPRESENTATION** **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 **EXPERT SYSTEMS** **9**

Expert system architecture –Nonproduction systems architecture, Knowledge acquisition and validation, Knowledge system building tools.

UNIT IV **LEARNING & DECISION MAKING** **9**

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

UNIT V **CASE STUDY** **9**

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

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the 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. Dan W. Patterson, —Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, Delhi, 2001.
2. Watterman. —Expert Systems, Mc-Graw Hill, New York, 1991

REFERENCES

1. George F Luger, —Artificial Intelligence, structures and strategies for complex problem solving, Pearson Education Delhi, 2001.
2. Elain Rich and Kevin Knight, —Artificial Intelligence‖, 2nd edition, Tata McGraw Hill, 1993.
3. R.D.Lele, —Computers in Medicine,‖ Tata McGraw Hill, NewDelhi-1989.

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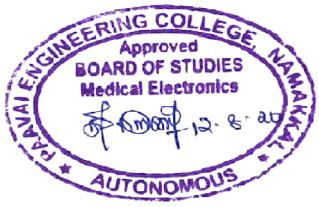
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2



MD16254 **INTRODUCTION TO CLOUD COMPUTING** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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 management in the ecosystem
- demonstrate applications on cloud computing

UNIT I CLOUD COMPUTING – AN INSIGHT AND MODELS **9**

Introduction to cloud computing - Cloud essentials, business& IT perspective, benefits & challenges, applications; Business models and cloud adoption Cloud models - Introduction, from collaboration to cloud, cloud models and architecture, value of cloud computing and infrastructure models, scaling a cloud infrastructure

UNIT II STANDARDS AND SECURITY **9**

Standards and Security- Introduction, legal and regulatory issues, security challenges, cloud data security, network security, host security, Database management, risk tolerance; Cloud licensing and major players - Introduction, cloud data centre, moving into cloud,issues in cloud computing, major players in cloud computing, eucalyptus, nimbus, open nebula, cloud-sim

UNIT III CLOUD SERVICES **9**

Introduction to services - Storage, database, information, process, application, management, platform, security, testing, integration; Infrastructure Software plus services - Introduction, mobile device integration, Microsoft online, intuit quick base, cast iron cloud, bungee connect, map reduce, google file system, Hadoop framework, HDFS

UNIT IV CLOUD MANAGEMENT **9**

Introduction and cloud ecosystem -Business process management, stack, sourcing, analytics, asset management, resiliency, provisioning, governing, charging models, metering; Billing Virtualization for cloud - Introduction, pros and cons, architecture, virtual machine and types, virtualization in cluster / grid, network, types, machine monitor, desktop infrastructure

UNIT V CLOUD STORAGE AND APPLICATIONS OF CLOUD COMPUTING **9**

Cloud Storage - Introduction, storage providers, disaster recovery planning, disaster management; Applications of cloud computing-Cloud comparing approaches; ANEKA - private and public cloud, resource provisioning; COMET CLOUD - architecture, autonomic behavior, applications, implementation

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- utilize the basics of cloud computing insight and models
- illustrate the standards and security involved in cloud computing

- apply the knowledge on different types of cloud services
- illustrate the concept of cloud management in the ecosystem
- develop applications based on cloud computing by utilizing the cloud storage

TEXT BOOKS:

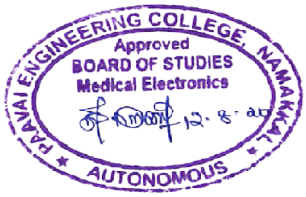
1. M N Rao, "Cloud Computing", PHI learning private limited (2015 edition)
2. Cloud Computing: Concepts, Technology & Architecture (The Pearson Service Technology Series from Thomas Erl) 1st Edition, 2020

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)

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
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	
CO 5	2	3	3	2	3			2		2				2



OPEN ELECTIVE-I

MD16901 **BIOMEDICAL EQUIPMENTS** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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 & 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 pCO_2, intra-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

Upon the completion 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. Introduction to Biomedical Equipment technology – JosephyE.Carr, John M.Brown- Pearson Publication, Fourth Edition, 2002
2. Textbook of Biomedical Instrumentation, K.N Scott, A.K.Mathur, First edition 2013, CBS Publishers.

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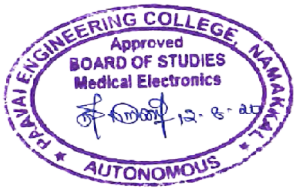
CO 1			3		3	2			2			2		3
CO 2		2	3	2	2		2		2					2
CO 3		2	2	2	3	3		2		3			2	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2



MD16902 **BASICS OF BIOINFORMATICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the 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 databases, 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 alignment

UNIT V GENOME ANALYSIS 9

Basic of Genome analysis - Whole genome analysis, existing software tools; Genome Analysis tools - 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

Upon the completion 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. Stanley I. Letovsky, "Bioinformatics: Databases and Systems", 1999
2. Arthur K. Lesk, "Introduction to Bioinformatics", Oxford University Press

REFERENCES

1. Dan Gusfield, "Algorithms on Strings, Trees and Sequences" , Cambridge University Press.
2. Durbin, S.Eddy, A.Krogh, G.Mitchison, "Biological Sequence Analysis Probabilistic Models 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

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