JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.TECH. BIOMEDICAL ENGINEERING
IV YEAR COURSE STRUCTURE AND SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

IV YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MT701PC	Microprocessors and Microcontrollers	4	0	0	4
2	BM702PC	Medical Image Processing	4	0	0	4
3		Professional Elective- II	3	0	0	3
4		Professional Elective-III	3	0	0	3
5		Professional Elective-IV	3	0	0	3
6	MT703PC	Microprocessors and Microcontrollers Lab	0	0	3	2
7	BM704PC	Medical Image Processing Lab	0	0	3	2
8	BM705PC	Industry Oriented Mini Project	0	0	3	2
9	BM706PC	Seminar	0	0	2	1
		Total Credits	**17**	**0**	**11**	**24**

II YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective - III	3	0	0	3
2		Professional Elective-V	3	0	0	3
3		Professional Elective-VI	3	0	0	3
4	BM801PC	Major Project	0	0	30	15
		Total Credits	**9**	**0**	**30**	**24**

Professional Elective - I

BM611PE	Laser and Fiber Optic Instrumentation
BM612PE	Biological Control Systems
BM613PE	VLSI Design
BM614PE	General Surgery and Radiology

Professional Elective - II

EC721PE	Computer Networks
BM722PE	Telemedicine
BM723PE	Biomaterials
BM724PE	Virtual Instrumentation

Professional Elective – III

BM731PE	Hospital System Management
BM732PE	Artificial Neural Networks
BM733PE	Rehabilitation Engineering
BM734PE	Operating Systems

Professional Elective – IV

BM741PE	Transportation Phenomena in living systems
EI742PE	Robotics and Automation
BM743PE	Quantitative Engineering Physiology
BM744PE	Nanotechnology

Professional Elective – V

BM851PE	Medical Informatics
BM852PE	Physiological Systems Management
BM853PE	Embedded System Design
BM854PE	Internet of Things

Professional Elective - VI

BM861PE	Bio MEMS
BM862PE	Biometric Systems
EI863PE	DSP Processors and Architectures
EI864PE	Machine Learning

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR B.TECH. III AND IV YEARS

S. No.	Name of the Department Offering Open Electives	Open Elective – I (Semester – V)	Open Elective – II (Semester – VI)
1	Aeronautical Engg.	AE511OE: Introduction to Space Technology	AE621OE: Introduction to Aerospace Engineering
2	Automobile Engg.	CE511OE: Disaster Management MT512OE: Intellectual Property Rights	MT621OE: Data Structures MT622OE: Artificial Neural Networks
3	Biomedical Engg.	BM511OE: Reliability Engineering	BM621OE: Medical Electronics
4	Civil Engg.	CE511OE: Disaster Management.	CE621OE: Remote Sensing and GIS CE622OE: Geo-Informatics CE623OE: Intellectual Property Rights
5	Civil and Environmental Engg.	CE511OE: Disaster Management	CN621OE: Environmental Impact Assessment CE623OE: Intellectual Property Rights
6	Computer Science and Engg. / Information Technology	CS511OE: Operating Systems CS512OE: Database Management Systems	CS621OE: Java Programming CS622OE: Software Testing Methodologies CS623OE: Cyber Security
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC511OE: Principles of Electronic Communications	EC621OE: Principles of Computer Communications and Networks
8	Electronics and Computer Engg.	EM511OE: Scripting Languages	EM621OE: Soft Computing Techniques
9	Electrical and Electronics Engg.	EE511OE: Non-Conventional Power Generation EE512OE: Electrical Engineering Materials EE513OE: Nanotechnology	EE621OE: Design Estimation and Costing of Electrical Systems EE622OE: Energy Storage Systems EE623OE: Introduction to Mechatronics
10	Electronics and Instrumentation Engg.	EI511OE: Electronic Measurements and Instrumentation	EI621OE: Industrial Electronics
11	Mechanical Engg.	ME511OE: Optimization Techniques ME512OE: Computer Graphics ME513OE: Introduction to Mechatronics	ME621OE: World Class Manufacturing ME622OE: Fundamentals of Robotics ME623OE: Fabrication Processes

		ME514OE: Fundamentals of Mechanical Engineering	
12	Mechanical Engg. (Material Science and Nanotechnology)	NT511OE: Fabrication Processes NT512OE: Non destructive Testing Methods NT513OE: Fundamentals of Engineering Materials	NT621OE: Introduction to Material Handling NT622OE: Non-Conventional Energy Sources NT623OE: Robotics
13	Mechanical Engg. (mechatronics)	MT511OE: Analog and Digital I.C. Applications MT512OE: Intellectual Property Rights MT513OE: Computer Organization	MT621OE: Data Structures MT622OE: Artificial Neural Networks MT623OE: Industrial Management
14	Metallurgical and Materials Engg.	MM511OE: Materials Characterization Techniques	MM621OE: Science and Technology of Nano Materials MM622OE: Metallurgy of Non Metallurgists
15	Mining Engg.	MN511OE: Introduction to Mining Technology	MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas
16	Petroleum Engg.	PE511OE: Materials Science and Engineering PE512OE: Renewable Energy Sources PE513OE: Environmental Engineering	PE621OE: Energy Management and Conservation PE622OE: Optimization Techniques PE623OE: Entrepreneurship and Small Business Enterprises

S. No.	**Name of the Department Offering Open Electives**	**Open Elective –III (Semester – VIII)**
1	Aeronautical Engg.	AE831OE: Air Transportation Systems AE832OE: Rockets and Missiles
2	Automobile Engg.	AM831OE: Introduction to Mechatronics AM832OE: Microprocessors and Microcontrollers
3	Biomedical Engg.	BM831OE: Telemetry and Telecontrol BM832OE: Electromagnetic Interference and Compatibility
4	Civil Engg.	CE831OE: Environmental Impact Assessment CE832OE: Optimization Techniques in Engineering CE833OE: Entrepreneurship and Small Business Enterprises
5	Civil and Environmental Engg.	CN831OE: Remote Sensing and GIS CE833OE: Entrepreneurship and Small Business Enterprises
6	Computer Science and Engg. / Information Technology	CS831OE: Linux Programming CS832OE: R Programming CS833OE: PHP Programming

7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC831OE: Electronic Measuring Instruments
8	Electronics and Computer Engg.	EM831OE: Data Analytics
9	Electrical and Electronics Engg.	EE831OE: Entrepreneur Resource Planning EE832OE: Management Information Systems EE833OE: Organizational Behaviour
10	Electronics and Instrumentation Engg.	EI831OE: Sensors and Transducers, EI832OE: PC Based Instrumentation
11	Mechanical Engg.	ME831OE: Total Quality Management ME832OE: Industrial Safety, Health, and Environmental Engineering ME833OE: Basics of Thermodynamics ME834OE: Reliability Engineering
12	Mechanical Engg. (Material Science and Nanotechnology)	NT831OE: Concepts of Nano Science And Technology NT832OE: Synthesis of Nanomaterials NT833OE: Characterization of Nanomaterials
13	Mechanical Engg. (mechatronics)	MT831OE: Renewable Energy Sources MT832OE: Production Planning and Control CE833OE: Entrepreneurship and Small Business Enterprises
14	Metallurgical and Materials Engg.	MM831OE: Design and Selection of Engineering Materials
15	Mining Engg.	MN831OE: Solid Fuel Technology MN832OE: Health & Safety in Mines
16	Petroleum Engg.	PE831OE: Disaster Management PE832OE: Fundamentals of Liquefied Natural Gas PE833OE: Health, Safety and Environment in Petroleum Industry

***Open Elective –** Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

MICROPROCESSORS AND MICROCONTROLLERS

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT701PC	**4**	**0**	**0**	**4**

Pre-requisites: Nil.

Course Objectives:

- To develop an understanding of the operations of microprocessors and micro controllers; machine language programming and interfacing techniques.

Course Outcomes:

- Understands the internal architecture and organization of 8086, 8051 and ARM processors/controllers.
- Understands the interfacing techniques to 8086 and 8051 and can develop assembly language programming to design microprocessor/ micro controller based systems.

UNIT - I

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT - II

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

UNIT – III

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232, USB.

UNIT – IV

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions,

Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

UNIT – V

Advanced ARM Processors: Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

REFERENCE BOOKS:

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051 Microcontrollers, Architecture and Programming and Applications -K. Uma Rao, Andhe Pallavi, Pearson, 2009.

MEDICAL IMAGE PROCESSING

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM702PC	**4**	**0**	**0**	**4**

Pre-requisites: Nil.

UNIT - I

Digital Image Fundamentals: Digital Image Processing System, Applications, Digitization of an image – Spatial and Intensity Quantization, Quality of an Image – Spatial resolution, Brightness Representation, Noise Content, Color Images

Image Transforms: Unitary, 1D-DFT, 2D-DFT, Discrete Cosine Transform (DCT) and Discrete Sine Transform (DST)

UNIT - II

Image Enhancement: Spatial domain, frequency domain methods, Histogram equalization, Mask Processing: Image Smoothing, Image sharpening (filters).

Image Segmentation – Masks – Point detection – Line Detection – Edge Detection.

UNIT - III

Image Restoration: Model of the image Degradation Process, Restoration in the presence of noise only spatial filtering, periodic Noise reduction by Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Weiner) Filtering, Least Squares Filtering.

UNIT - IV

Image Compression: Fundamentals, Image compression Models, Error-free Compression, Lossy Compression, Image Compression Standards.

UNIT – V

Processing of Medical Images: Processing and Feature Extraction of CT, MRI, Ultrasound and PET Images.

TEXT BOOKS:

1. Geoff Dougherty, Digital Image Processing for medical Applications. Cambridge University Press, 2007.
2. Kayvan Nataraian and Robert Splinter, Biomedical Signal and Image Processing, CRC Press, Taylor and Francis, 2006.
3. Digital Image Processing – by R.C. Gonzalez & R.E. Woods, Addison Wesley.

REFERENCE BOOKS:

1. Pattern Recognition Principles – J.T.TOU.R.C. Gonzalez, Addison Wesley.
2. Fundamentals of Digital Image Processing – by A.K. Jain, PHI Pearson Education

COMPUTER NETWORKS
(Professional Elective – II)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: ET702PC/EC721PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.
- To have the concept of different routing techniques for data communications.

Course Outcomes:

- Students should understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and ad hoc networks.

UNIT - I

Introduction to Networks: Internet, Protocols and Standards, The OSI Model, Layers in OSI Model, TCP/IP Suite, Addressing.

Physical Layer: Multiplexing, Transmission Media, Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

UNIT - II

Data Link Layer: Introduction, Checksum, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, Random Access Controlled Access, Channelization, IEEE Standards, Ethernet, Giga-Bit Ethernet, Wireless LANs, SONET-SDH, Frame Relay and ATM.

UNIT - III

Network Layer: Logical Addressing, Internetworking, Tunneling, Address Mapping, ICMP, IGMP, Forwarding, Routing-Flooding, Bellman& Ford, Disjkstra's routing protocols, RIP, OSPF, BGP,- and Multicast Routing Protocols. Connecting Devices-Passive Hubs, Repeaters, Active Hubs, Bridges, Routers.

UNIT - IV

Transport Layer: Process to Process Delivery, UDP, TCP and SCTP Protocols, Congestion, Congestion Control, Quality of Service.

Application Layer: Domain Name Space, DNS in Internet, Electronic Mail, File Transfer Protocol, WWW, HTTP, SNMP, Multi-Media.

UNIT - V

Network Security: Security services, mechanisms and attacks, IPSec, SSL, VPN, Firewall. Bluetooth, Zigbee, IPv4, IPv6.

TEXT BOOKS:

1. Data Communications and Networking – Behrouz A. Forouzan, 4th Edition Mc Graw Hill Education, 2006.
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

REFERENCES:

1. Data communications and Networks by William Stallings
2. Data communication and Networks - Bhusan Trivedi, Oxford University press 2016.
3. An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Education.
4. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

TELEMEDICINE
(Professional Elective – II)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM722PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

History of telemedicine: Block diagram of telemedicine system, Definition of telemedicine, Tele health, Telecare, organs of telemedicine, scope, Benefits, and limitations of telemedicine. Type of information; Audio, Video, Still images, Text and data, fax, type of communications and network, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave. Different Modulation techniques. Types of antennas depending on requirements, Integration, and operational issues: - system integration, store –and - forward operation, Real-time Telemedicine.

UNIT – II

Data Exchange: Network Configuration, circuit and packet switching, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN). Video Conferencing. Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Ecryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7.

UNIT – III

Ethical and legal aspects of Telemedicine: Confidentiality, and the law, patient rights and consent, access to medical Records, Consent treatment, jurisdictional Issues, Intellectual property rights.

UNIT – IV

Tele radiology: Definition, Basic parts of Tele-radiology system: Image Acquisition system Display system, Communication network, Interpretation section. Tele pathology: multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of color, controlled sampling security and confidentiality tools.

UNIT – V

And Tele-Cardiology: Tele-Oncology, Tele-Surgery. Applications of Tele-Surgery

TEXTBOOKS:

1. Olga (EDT) Ferrer – Roca, M.Sosa (EDT) Iudicissa Hand book of Telemedicine IOS press 2002
2. A.C. Norris, Essentials of Telemedicine and Telecare John Sons & Ltd, 2002

BIOMATERIALS
(Professional Elective – II)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM723PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I: Classification of materials used in medicine, Properties of Materials.

UNIT - II

Host reactions to: Inflammation, Wound healing and the Foreign body response.
Systemic toxicity and Hypersensitivity. Blood coagulation and Blood-materials Interactions. Tumorigenesis.
Testing biomaterials: In Vitro assessment of tissue compatibility In vivo assessment of tissue compatibility. Testing of blood-materials interactions.
Degradation of materials in the biological environment: Effects of the Biological environment on metals, polymers, and ceramics.

UNIT - III

Applications of materials in medicine, Dentistry and Biology: Cardiovascular medical devices. Nonthrombogenic treatments and Strategies. Dental implantation adhesive and Sealants. Ophthalmologic applications-intraocular lens implants.

UNIT - IV

Orthopedic biomaterials, Materials for fixation screws, plates, intramedullar nails. Sutures. Burn dressings and Skin substitutes. Artificial organs and tissues: Implantable cardiac assist devices. Materials for extracorporeal devices. Cochlear implants. Artificial red blood cell substitutes.

UNIT - V

Sterilization of implants and Devices implants and Device failure. Implant retrieval and Evaluation. Standards development and regulation of medical products using biomaterials. Nano bio materials.

TEXT BOOKS:

1. Biomaterials Science: An Introduction to Materials in Medicine Buddy D. Ratner, Frederick J. Schoen, Allan S. Hoffman, Jack E. Lemons
2. Hench L L Ethridg E.C. Biomaterials, an interfacial approach, Academic press 1982

REFERENCE BOOKS:

1. Bronzino J D, The Handbook Biomedical Engineering, CRC Press.

VIRTUAL INSTRUMENTATION
(Professional Elective – II)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: BM724PE	**3**	**0**	**0**	**3**

Course Objectives: To introduce LABVIEW programming and simulation of real time applications like instrument control, Signal processing, image processing, Data acquisition etc.,

Course Outcomes: Upon completion of this course the student shall be able to develop their own GSD and interface them with real world instruments.

UNIT - I

Virtual Instrumentation: An introduction Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

UNIT - II

VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT - III

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques, and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT - IV

VI Interface requirements: Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT - V

VI toolsets: Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXTBOOKS:

1. LabVIEW Graphical Programming, Gary Johnson, Second edition, McGraw Hill, Newyork, 1997.
2. LabVIEW based Advanced Instrumentation Systems, S. Sumathi and P. Surekha, Spinger.

REFERENCE BOOKS:

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000.
2. WEB RESOURCES: www.ni.com
3. LabVIEW for everyone, Lisa K. wells & Jeffrey Travis Prentice Hall, New Jersey, 1997.

HOSPITAL SYSTEM MANAGEMENT
(Professional Elective – III)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: BM731PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

Classification of Hospital Systems: General, Specialist, Teaching and Research Hospitals, Primary Health Centre Their role, Functions. Role of Biomedical Engineers

Aspects of Hospital Services: Outpatient, Inpatient, supportive, emergency, drug and medical supply. Nursing Services, Dietry services, Transport services

UNIT - II

Hospital Planning: Location, Orientation, budgeting, communication both within and outside the hospital. Electric power supply for various Theatres and Rooms, Diesel Generator, standby power supply.

Air conditioning of important theatres and equipment housings, water supply requirements and management, lifts, fire fighting and equipments. Sanitation within the hospitals, laundry services.

UNIT - III

Computer and Information Management in Hospitals: Registration, Administration, Discharge records of patient's. Patients billing, Maintenance of patients records, Maintenance of inventory of medicines and drugs.

UNIT - IV

Electrical Factors in Hospital Design: voltage stabilizer, uninterrupted power supply for intensive care units and computerized monitoring units, safety precautions.

Electrical factors associated with equipment: interference of systems, protection, and grounding of ECG, EEG, EMG, and other therapeutic equipments.

UNIT - V

Biomedical equipment services: purchase, servicing, and maintenance, Management of condemned equipment, Training of men on medical equipments, preventive and periodical maintenance procedures.

TEXT BOOKS:

1. S. I, Goel & Ram Kumar, Hospital Administration, and Management, Deep and Deep Publications, New Delhi. 2002.
2. Principles of Hospital Administration and Management by Ravi Bindra, Adroit publishers, 2004

REFERENCE BOOKS:

1. Source book of Modern Technology for Hospitals and Health care by Ashok Sahni, ISHA, BANGALORE, 1992.
2. I. Donald Snook, Opportunities in Hospital Administration Careers, McGraw-Hill, 1997.

ARTIFICIAL NEURAL NETWORKS
(Professional Elective – III)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EM724PE/BM732PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

Course Outcomes: By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

UNIT - I

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

UNIT - II

Single Layer Perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT - III

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

UNIT - IV

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

UNIT - V

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

Hopfield Models – Hopfield Models, Computer Experiment

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

REFERENCE BOOKS:

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

REHABILITATION ENGINEERING
(Professional Elective – III)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM733PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

Engineering concepts in Rehabilitation Engineering: Anthropometry: Methods for Static and dynamic Measurements, Area Measurements, Measurement of characteristics and movement, Measurement of Muscular Strength and Capabilities. Measurement tools and processes in Rehabilitation engineering: fundamental principles, structure, function; performance and behavior. Subjective and objective measurement methods.

UNIT - II

Orthopedic Prosthetics and Orthotics in rehabilitation: Engineering Principles. Prosthesis - Amputation Types and Prescribed Prostheses, Components of Upper Limb Prosthesis – Sockets and Liners, Suspension, Control Systems (Myoelectric), Shoulder, Elbow and Wrist Components, Terminal Devices. Components of Lower Limb Prosthesis – Sockets and Liners, Suspension, Hip, Pelvic, Knee and Ankle Components.

Orthotics – Biomechanical Principles, Spinal, Upper Extremity and Lower Extremity

FES Systems - Restoration of hand function, restoration of standing and walking.

UNIT - III

Engineering concepts in sensory rehabilitation Engineering: Sensory augmentation and substitution. **Assistive Technology for visually Impaired:** General Purpose, Task Specific (Mobility, Reading, Writing, Computer Access, Communication)

Assistive Technology for Hearing: Impaired – Hearing Assistance Solutions – Medical and Surgical Approach to restore function - Hearing aids, cochlear implantation, Assistive Listening Solutions, visual and tactual Substitution.

UNIT - IV

Alternative and Augmentative Communication (AAC): User interface, Language Representation, Technology and Devices Features. Human Factors, Performance Measurement. Wheelchairs – Manual, Electric Power, Power Assisted, Multi-Functional, Standards, Wheelchairs Transportation System, Securement Systems.

UNIT - V

Rehabilitation Robotics: Intelligent Mobility Aids, Robotic Manipulation Aids, Therapeutic Robots. Environmental Control Systems. Brain computer interface.

TEXT BOOKS:

1. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hobson – An introduction to Rehabilitation Engineering – CRC Press, Taylor and Francis Group, 2007.

2. Bronzino, Joseph; Handbook of biomedical engineering. 2nd edition, CRC Press, 2000.

REFERENCE BOOKS:

1. Horia- Nocholai Teodorecu, L.C.Jain, intelligent systems and technologies in rehabilitation engineering; CRC; December 2000.
2. Robinson C.J Rehabilitation engineering. CRC press 1995

OPERATING SYSTEMS
(Professional Elective – III)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EM721PE/BM734PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

- To understand the OS role in the overall computer system
- To study the operations performed by OS as a resource manager
- To understand the scheduling policies of OS
- To understand the different memory management techniques
- To understand process concurrency and synchronization
- To understand the concepts of input/output, storage and file management
- To understand the goals and principles of protection
- Introduce system call interface for file and process management
- To study different OS and compare their features

Course Outcomes:

- Apply optimization techniques for the improvement of system performance.
- Ability to design and solve synchronization problems.
- Learn about minimization of turnaround time, waiting time and response time and also maximization of throughput by keeping CPU as busy as possible.
- Ability to change access controls to protect files.
- Ability to compare the different operating systems.

UNIT - I

Overview-Introduction-Operating system objectives, User view, System view, Operating system definition, Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.

Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT - II

Process and CPU Scheduling - Process concepts-The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(),exec(),wait(),exit(), Interprocess communication-ordinary pipes and named pipes in Unix.

Process Scheduling-Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Linux scheduling and Windows scheduling.

Process Synchronization, Background, The Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization in Linux and Windows.

UNIT - III

Memory Management and Virtual Memory – Memory Management Strategies- Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table, IA-32 Segmentation, IA-32 Paging.

Virtual Memory Management-Background, Demand Paging, Copy-on-Write, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Virtual memory in Windows..

UNIT - IV

Storage Management-File System- Concept of a File, System calls for file operations - open (), read (), write (), close (), seek (), unlink (), Access methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

File System Implementation - File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance.

Mass Storage Structure – Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management

UNIT - V

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Protection – System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

TEXT BOOKS:

1. Operating System Concepts , Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2016 India Edition
2. Operating Systems – Internals and Design Principles, W. Stallings, 7th Edition, Pearson.

REFERENCE BOOKS:

1. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2. Operating Systems A concept-based Approach, 2nd Edition, D.M. Dhamdhere, TMH.
3. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.
4. An Introduction to Operating Systems, P.C.P. Bhatt, PHI.
5. Principles of Operating systems, Naresh Chauhan, Oxford University Press.

TRANSPORTATION PHENOMENA IN LIVING SYSTEMS
(Professional Elective – IV)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM741PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

Heat Transport: Body temperature regulation modes of heat transfer, processes of Head loss and heat gain from the human body. Heat transportation in Tissues, Muscles, Skin, and other Organs in different environmental temperatures. Models of heat transfer in the body.

UNIT - II

Fundamentals and applications of mass transport: Introduction to Mass Transport. Diffusion with Convection or Electrical Potentials. Transport in Porous Media. Trans vascular Transport. Solvent and Solute Transport across the Kidney Glomerulus.

UNIT - III

Processes of mass transfer Diffusion, Osmosis, Electro Osmosis. Ultra filtration. Reverse Osmosis through natural Membrane systems, Reverse Osmosis through artificial synthetic Membranes.

UNIT - IV

Mass Transport and Biochemical Interactions, Oxygen Transport from the Lungs to the Tissues.

UNIT - V

Mass transfer: Mass transfer in Kidney, Skeletal, Nervous, G. I. system, Cardio Pulmonary system. Mass transfer in Dialyzers and Oxygenators.

TEXT BOOKS:

1. Fournier, Ronald L, Basic transport phenomena in biomedical engineering. Taylor & Francis. 1998

REFERENCE BOOKS:

1. David. O. Cooney, Biomedical engg. Principles: An introduction to fluid, Heat & Mass transport process Vol &2; Marcel Dekker Inc.
2. Medical physiology by Ganong, MGH
3. Physiology by Best and Taylor, Lippincott Williams & Wilkins

ROBOTICS AND AUTOMATION
(Professional Elective – IV)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EI742PE	**3**	**0**	**0**	**3**

Course Objectives:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.

UNIT - I

Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT - II

Power Sources and Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT – III

Manipulators, Actuators and Grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers –design considerations.

UNIT – IV

Kinematics and Path Planning: Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages.

UNIT – V

Case Studies: Multiple robots – machine interface – robots in manufacturing and non-manufacturing applications – robot cell design – selection of robot.

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCE BOOKS:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

QUANTITATIVE ENGINEERING PHYSIOLOGY
(Professional Elective – IV)

	L	T	P	C
B.Tech. IV Year I Sem.				
Course Code: BM743PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

Cellular Physiology-I: Introduction to Physiology, Introduction to Modeling and Review of Electric Circuits. Review of Cellular Physiology, Cellular Metabolism and Kinetics, Membrane Dynamics.

UNIT - II

Cellular Physiology-II: Ion Transport types of transport and Cellular Homeostasis, The Resting Potential. Regulation of Cell Function and Cell Cycle Detailed aspects of Neoplasia, Uses of DNA Micro-Arrays,

UNIT - III

Neuromuscular Physiology: Review of Nervous System, The Action Potential, and Propagation of Action Potentials measurement by Patch Clamp. Skeletal Muscle, Neuromuscular Junction, and Synaptic Transmission, Smooth Muscle, study of Demyelinating Diseases.

UNIT - IV

Cardiovascular Physiology-I: Review of Cardiovascular Physiology, The ECG, causes and classification of Arrhythmias, characteristics of Defibrillation phenomena.

UNIT - V

Cardiovascular Physiology-II: Pressure Volume Relationships, Models of Circulation, Cardiac Output, Cardiac Regulation, Physiological aspects of Myocardial infarction.

TEXT BOOKS:

1. Robert Plonsey and roger Barr, Bioelectricity, McGraw Hill,
2. Text Book of Physiology by Guyton, Elsevier
3. Text Book of Physiology by West & Todd

REFERENCE BOOKS:

1. Text Book of Physiology by Chaudhary.

NANOTECHNOLOGY
(Professional Elective – IV)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: BM744PE	**3**	**0**	**0**	**3**

Course Objectives: Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

Course Outcomes: The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

UNIT - I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

UNIT - II

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT- III

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT - IV

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

UNIT - V

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

MICROPROCESSORS AND MICROCONTROLLERS LAB

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT703PC	**0**	**0**	**3**	**2**

Note: - Minimum of 12 experiments to be conducted.
The following programs/experiments are to be written for assembler and to be executed the same with 8086 and 8051 kits.

List of Experiments:

1. Programs for 16 bit arithmetic operations 8086(using various addressing modes)
2. Programs for sorting an array for 8086.
3. Programs for searching for a number of characters in a string for 8086.
4. Programs for string manipulation for 8086.
5. Programs for digital clock design using 8086.
6. Interfacing ADC and DAC to 8086.
7. Parallel communication between two microprocessor kits using 8255.
8. Serial communication between two microprocessor kits using 8251.
9. Interfacing to 8086 and programming to control stepper motor.
10. Programming using arithmetic, logical and bit manipulation instructions of 8051.
11. Program and verify Timer/Counter in 8051.
12. Program and verify interrupt handling in 8051.
13. UART operation in 8051.
14. Communication between 8051 kit and PC
15. Interfacing LCD to 8051
16. Interfacing Matrix/Keyboard to 8051
17. Data transfer from peripheral to memory through DMA controller 8237/8257

MEDICAL IMAGE PROCESSING LAB

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: BM704PC	**0**	**0**	**3**	**2**

Any 12 programs are to be done.

1. Computation of Convolution and Correlation Sequences.
2. Analog and Digital Signal Conditioning.
3. Signal Averaging Improvement in the SNR Using Coherent Averaging.
4. Signal Averaging Improvement in the SNR Using Incoherent Averaging.
5. Exponential Averaging.
6. Data Polishing: Mean and Trend Removal.
7. Design or I I R Filter.
8. Design of F I R Filter.
9. PSD Estimation.
10. Data Compression Techniques: AZTEC. TP.
11. Data Compression Technique: CORTES.
12. Data Compression Technique: K. L. Transform.
13. Data Compression Techniques: DCT, Wavelets.
14. Noise Cancellation Techniques.
15. QRS Detections and HRV Analysis.

Using MATLAB and Signal Processing & Image Processing Toolbox.

MEDICAL INFORMATICS
(Professional Elective – V)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: BM851PE	**3**	**0**	**0**	**3**

UNIT – I

Introduction and Overview of hospital information system: Patient history taking mechanisms. Patient Data Processing, Database Management, Communication of Medical data across different hospital units. Networking and Integration of patient data.

UNIT – II

Data from Patients: Coding and Classification, The Patient Record, Biosignal Analysis, Medical Imaging, Image Processing and Analysis. Patient-Centered Information Systems, Primary Care, Clinical Departmental Systems, Clinical Support Systems, Nursing Information Systems.

UNIT – III

Medical Knowledge and Decision Support: Methods for Decision Support, Clinical Decision-Support Systems, Strategies for Medical Knowledge Acquisition, Predictive Tools for Clinical Decision Support.

UNIT – IV

Institutional Information Systems: Modeling of Health Care for Information Systems Development, Hospital Information Systems: Clinical Use, Technical Choices, Health Information Resources. Methodology for Information Processing, Logical Operations, Biostatistical Methods, Biosignal Processing Methods, Pattern Recognition, Modeling for Decision Support, Structuring the Computer-based Patient Record, Evaluation of Clinical Information Systems.

UNIT – V

Methodology for Information Systems: Human-Computer Interaction in Health Care ,Costs and Benefits of Information Systems, Security in Medical Information Systems, Standards in Health-care Informatics and Telematics, Project Management,

TEXT BOOKS:

1. Bemmel, J.Van; Musen, M.A. Handbook of Medical Informatics 1st ed. 1997.

REFERENCE BOOKS:

1. R. D. Lele, Computers in Medicine Tata McGraw Hill, 2005.
2. Davidson, P., Best Practice Series: Healthcare Information Systems, Auerbach Publications, 2000.
3. Edward B.H. Shortliffe & James J Cimino- Biomedical Informatics –Computer Application in Health Care and Biomedicine. (New Age Int. P.Ltd.), 3rd Edition Springer-2008.

PHYSIOLOGICAL SYSTEMS MANAGEMENT
(Professional Elective – V)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: BM852PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

UNIT - I

The problem of system modeling in Physiology: Types of Nonlinear models of physiological systems. Deductive and Inductive modeling.

Nonparametric modeling: Volterra models. Wiener models. Efficient volterra kernel estimation Analysis of estimation errors.

UNIT - II

Parametric modeling: Basic parametric model forms and Estimation procedures. Volterra kernels of nonlinear differential equations. Discrete-time volterra kernels of NARMAX models. From Volterra kernel measurements to parametric models. Equivalence between continuous and Discrete -parametric models.

UNIT - III

Preliminary tests and Data preparation: Model specification and Estimation. Model validation and Interpretation. Outline of step-by-step procedure.

Applications: Neurosensory systems: Cardiovascular system, Renal system, Metabolic-Endocrine system.

UNIT - IV

Modeling of multi input/multi output systems: The Two-input case. Application s of two-input modeling to physiological systems. The Multiinput case spatiotemporal and spectrotemporal modeling.

UNIT - V

Modeling of neuronal systems: A General model of membrane and Synaptic dynamics, Functional integration in the Single neuron, Neuronal systems with Point process inputs Modeling of neuronal ensembles. Modeling of Closed-loop systems: Autoregressive form of Closed-loop model, Network model form of Closed-loop systems.

TEXT BOOKS:

1. Vasilis Z. Marmarelis, Nonlinear dynamic modeling of physiological systems, Wiley-IEEE Press, 2004.

REFERENCE BOOKS:

1. David T. Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.
2. Michel C Khoo, Physiological Control Systems -Analysis, simulation and estimation, Prentice Hall of India, 2001.

EMBEDDED SYSTEM DESIGN
(Professional Elective – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: BM853PE	**3**	**0**	**0**	**3**

Pre-requisites: Nil

Course Objectives:

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware, operating systems in correlation with hardware systems.

Course Outcomes:

- Expected to understand the selection procedure of Processors in the Embedded domain.
- Design Procedure for Embedded Firmware.
- Expected to visualize the role of Real time Operating Systems in Embedded Systems.
- Expected to evaluate the Correlation between task synchronization and latency issues

UNIT - I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT - II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT - III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT - V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOK:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

INTERNET OF THINGS
(Professional Elective – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: BM854PE/EI861PE	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web based services on IoT devices.

UNIT - I

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT - II

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT - III

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.

UNIT - IV

IoT Physical Devices and Endpoints - Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT - V

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

BIO MEMS
(Professional Elective – VI)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: BM861PE	**3**	**0**	**0**	**3**

UNIT - I

Introduction: History of MEMS, market for MEMS, overview of MEMS processes properties of silicon, a sample MEMS process. Basics of Microtechnology: definitions and terminology, a sample process, lithography and etching. MEMS Biosensors: Bio Flow Sensors, MEMS Images. Introduction to MEMS Pro design software.

UNIT - II

Micromachining: Subtractive processes (wet and dry etching), additive processes (evaporation, sputtering, epitaxial growth). Fundamental Devices and Processes: basic mechanics and electrostatics for MEMS, parallel plate actuators, pull-in point, comb drives. Fundamental Devices and Processes: more electrostatic actuators; MEMS foundries, Cronos MUMPs (multi user MEMS process). MUMPs Multi User MEMS Process: JDS Uniphase MUMPs processing sequence and design rules. MUMPs and SUMMIT: design rules; applications; micro hinges and deployment actuators.

UNIT - III

CMOS MEMS: CMOS foundry processes, integrated IC/MEMS, MEMS post processing, applications. Clean room lab techniques: clean rooms, gowning procedures; safety, fire, toxicity; acids and bases; photolithography.

MicroOptoElectroMechanical Systems (MOEMS): micro scanners, digital mirror display, retinal scanning display. Grating light valve, corner cube retroreflector, optical switches, other micro-optical devices.

UNIT – IV

Thermal Transducers: Bimorphs, “heatuators”, cilia arrays. Piezoresistivity; Scanning Probe Microscopy: scanning tunneling microscope (STM), atomic force microscope (AFM). Scaling Laws. Wireless MEMS: mechanical and electrical resonators, Q-factor, switches, filters. Power for MEMS: thin film batteries, micro fuel cells, energy fields, microfliuds.

UNIT – V

MEMS Packaging and Assembly: Micro assembly: serial and parallel, deterministic and stochastic; microgrippers: HexSil process; packaging techniques. The Future of MEMS: bioMEMS – neural implants, gene chips, diagnostic chips; MEMS in space; mechanical computers; invisible and ubiquitous computing.

TEXT BOOKS:

1. HSU, Tai Ran, MEMS and Microsystems Design and Manufacture, Tata McGraw-Hill, 2002.
2. Rai-Choudhury, Prosenjit; Mems and Moems Technology and Applications SPIE 2000.

BIOMETRIC SYSTEMS
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: BM862PE	**3**	**0**	**0**	**3**

UNIT – I

Biometric Fundamentals : Key Biometric terms and Processes – Definitions-verification and identification – matching, Accuracy in Biometric Systems – False match rate – False nonmatch rate – Failure to enroll rate – Derived metrics – An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy.

UNIT – II

Fingerprint Identification Technology: History, Components, Application of Fingerprints, The Technology- Finger Scan Strengths and Weaknesses, Criminal Applications, Civil Applications, Commercial Applications, Technology Evaluation of Fingerprint Verification Algorithms.

UNIT – III

IRIS Recognition: Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions.

UNIT – IV

Face Recognition: Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition- Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

UNIT – V

Voice Scan: Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

TEXT BOOKS:

1. James Wayman & Anil Jain, Biometric Systems – Technology, Design and Performance Evaluation, Springer-verlag London Ltd, USA, 2005
2. Sanir Nanavati, Michael Thieme, Biometrics Identity Verification in a Networked world, Wiley Computer Publishing Ltd, New Delhi, 2003.

REFERENCE BOOKS:

1. John D. Woodword Jr., Biometrics, Dreamtech Press, New Delhi, 2003.

DSP PROCESSORS AND ARCHITECTURES
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EI863PE	**3**	**0**	**0**	**3**

Pre-requisites: Digital Signal Processing.

Course Objectives: The objectives of the course are:

- To recall digital transform techniques.
- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Course Outcomes: Upon completion of the course, the student

- Be able to distinguish between the architectural features of General purpose processors and DSP processors.
- Understand the architectures of TMS320C54xx and ADSP 2100 DSP devices.
- Be able to write simple assembly language programs using instruction set of TMS320C54xx.
- Can interface various devices to DSP Processors.

UNIT – I

Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT – II

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT - III

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of

TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT – IV

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT – V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCE BOOKS:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures, & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes.

MACHINE LEARNING
(Professional Elective – VI)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EC854PE/EI864PE	**3**	**0**	**0**	**3**

Prerequisites:

- Data Structures
- Knowledge on statistical methods

Course Objectives:

- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes:

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT - I

Introduction - Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning

Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias**.**

Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT - II

Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm.

Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks.

Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT - III

Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.

Computational learning theory – Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.

Instance-Based Learning- Introduction, *k*-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT - IV

Genetic Algorithms – Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.

Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.

Reinforcement Learning – Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT - V

Analytical Learning-1- Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

Analytical Learning-2-Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.

Combining Inductive and Analytical Learning – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

TEXT BOOK:

1. Machine Learning – Tom M. Mitchell, - MGH

REFERENCE:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis