STUDY & EVALUATION SCHEME
B. TECH. Biomedical Engineering
(with effect from 2021-2022)

4thYear **7thSemester**

S. No.	Course Category	Subject Code	Name of Subject	Periods and Credits				Evaluation Scheme				Subject Total
								Sessional (CA)			ESE	
				L	T	P	C	CT	TA	Total		
1	DC	BE452	Biotelemetry & Telemedicine	2	1	0	3	25	15	40	60	100
2	DC	BE453	Medical Image Processing	2	1	0	3	25	15	40	60	100
3	DC	BE454	Medical Informatics	2	1	0	3	25	15	40	60	100
4	DE		Departmental Elective 3	3	1	0	4	25	15	40	60	100
5	DE		Departmental Elective 4	3	1	0	4	25	15	40	60	100
6	DC	BE455	Design Concept & Maintenance of Biomedical Instruments	3	1	0	4	25	15	40	60	100
Practicals												
7		BE456	Image processing Lab	0	0	2	1	30	30	60	40	100
8	DC	*BE300	Industrial Training	0	0	0	0	0	0	0	50*	S/U*
			Total	**15**	**6**	**2**	**22**	**180**	**120**	**300**	**400**	**700**
*** A zero-credit industrial training. Candidate has to score an S (satisfactory) grade.**												
* An inter-disciplinary program offered by the Department of Bioengineering in association with the Department of Electronics and Communication Engineering.												

L: Lecture **T**: Tutorial **P**: Practical **C**: Credit
CA: Continuous Assessment **CT**: Class Test **TA**: Teacher's Assessment
ESE: End Semester Examination **DC**: Departmental Core
DE: Departmental Elective
ESA – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

Departmental Elective 3

1. Communication Systems (EC441)
2. Control Engineering (EC442)

Departmental Elective 4

1. Electrical & Electronic Measurement and Instrumentation (EC443)
2. VLSI & Embedded System (EC444)

BIOTELEMETRY & TELEMEDICINE
BE452

Pre-requisite	Co-requisite	L	T	P	C
None	None	**2**	**1**	**0**	**3**

Course Objective

1. To familiarize students with basic concepts of Biotelemetry &Telemedicine
2. To teach students the application of Biotelemetry &Telemedicine

Course Outcome

After completion of the course the students will be able to

1. Describe basic Telemetry, Biotelemetry & Telemedicine system/subsystems
2. Explain the application of Biotelemetry & Telemedicine in modern healthcare technology
3. Identify and describe modern telemedical technologies.

UNIT I	**BASICS OF TELEMETRY** Introduction, fundamental of RF telemetry, basic telemetry, system components of coding resolution, pulse code modulation, PCM multiplexing and conversion, PCM data transmission, PCM PSD system. Theoretical comparison of telemetry systems, sub modulation methods, power efficiency of combined systems, practical constraint of telemetry methods optimized power efficiency.	**8**
UNIT II	**BIOTELEMETRY** Measurement of Blood pressure – Direct Methods and Indirect Methods - Temperature - Respiration rate - Heart rate measurement - Apnea detectors - Oximetry -Pulse oximeter, Ear oximeter - Computerized patient monitoring system– Bedside, Central Monitoring system – Biotelemetry: Basics components, and its different types.	**8**
UNIT III	**TELEMEDICINE AND HEALTH** History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.	**8**
UNIT IV	**TELEMEDICAL APPLICATIONS** Telemedicine access to health care services – health education and self-care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self-care, Business aspects-Project planning and costing, Usage of telemedicine.	**8**

Text Books & References

1. Fundamentals of Remote Sensing – by George Joseph, second Edition, Universities press,2005
2. Khandpur R.S, “Hand-book of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition,2003.
3. Rajarao C and Guha S.K. “Principles of Medical Electronics and Bio-medicalInstrumentation”, Universities press (India) Ltd, First Edition, Orient LongmanLtd,2001.
4. Wootton,R.,Craig,J.,Patterson,V.(Eds.),“Introductionto Telemedicine. RoyalSocietyofMedicine”PressLtd, Taylor & Francis2006.
5. O'Carroll,P.W.,Yasnoff,W.A.,Ward,E.,Ripp,L.H.,Martin,E.L.(Eds),“PublicHealthInformaticsand

Information Systems", Springer,2003.
6. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in HealthTechnology and Informatics, Volume 54, 2002.
7. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier,2006.
8. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer,1997.
9. Mohan Bansal, "Medical Informatics", Tata McGraw-Hill,2004.

MEDICAL IMAGE PROCESSING

BE453

Pre-requisite	Co-requisite	L	T	P	C
None	None	**2**	**1**	**0**	**3**

CourseObjectives:

1. To introduce the learners the basic theory of digital imageprocessing.
2. To expose learners to various available techniques and possibilities of thisfield.
3. To understand the basic image enhancement, transforms, segmentation,compression, morphology, representation, description techniques &algorithms.
4. To prepare learners to formulate solutions to general image processing problems.
5. To develop hands-on experience in using computers to processimages.
6. To familiarize with MATLAB / C/ Labview/ similar software for processingdigital images.

Course Outcomes:

A learner will be able to

1. Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation anddescription.
2. Analyze images in the spatialdomain.
3. Analyze images in the frequency domain through the Fouriertransform.
4. Design and implement with MATLAB/C/Labview algorithms for digital image processing operations such as point processing, histogram processing, spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.

UNIT I	**Digital image fundamentals:** Image digitization, sampling and quantization, neighbour of pixels, connectivity, relations, equivalence and transitive closure, distance measures, arithmetic / logic operations, discrete transform, fast Fourier transform, 2-D Fourier transform, inverse Fourier transform.	**8**
UNIT II	**Image enhancement fundamentals:** Spatial domain method, frequency domain method, contrast enhancement, histogram processing, image smoothing, image averaging, masking, image sharpening, removing of blur caused by uniform linear motion, enhancement in the frequency domain — low pass, high pass, mean and band-pass filtering.	**8**
UNIT III	**Image restoration fundamentals:** Degradation model, discrete formulation, algebraic approach to restoration — unconstrained & constrained.	**8**
UNIT IV	**Image compression and segmentation fundamentals:** Fidelity criteria, image compression models, lossy and lossless compression technique. Image segmentation: point detection, line detection, edge detection, edge linking and boundary detection.	**8**

Text Books:

1. Digital image processing by Gonzalez and Woods. r^{d} ed.. Pearson
2. Digital image processing and analysis by Chanda & Majumdar, PHI
3. Fundamental of digital image processing by Jain, PHI
4. Pattern recognition by Tou and Gonzalez

MEDICAL INFORMATICS
BE454

Pre-requisite	Co-requisite	L	T	P	C
None	None	**2**	**1**	**0**	**3**

Course objectives:

The student should be made to:

1. Expose to the need for Bioinformatics tools
2. Be familiar with the modelling techniques
3. Learn microarrayanalysis
4. Expose to Pattern Matching andVisualization

Course outcome:

Upon Completion of the course, the students will be ableto

1. Develop models for biologicaldata
2. Apply pattern matching techniques to bioinformatics data – protein data genomicdata.
3. Apply micro array technology for genomic expressionstudy

UNIT I	**INTRODUCTION** Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role ofStructural bioinformatics - Biological Data Integration System.	**8**
UNIT II	**DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS** Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics	**8**
UNIT III	**MODELING FOR BIOINFORMATICS** Hidden markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecularmodeling – Computer programs for molecular modeling.	**8**
UNIT IV	**MICROARRAY ANALYSIS** Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark – Tradeoffs	**8**

TEXT BOOK:

1. Yi-Ping Phoebe Chen Edition, “BioInformatics Technologies”, First Indian Reprint, Springer Verlag, 2007.

REFERENCES:

1. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education,2003.
2. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press,2005

DESIGN CONCEPT & MAINTENANCE OF BIOMEDICAL INSTRUMENTS

BE455

Pre-requisite	Co-requisite	L	T	P	C
None	None	**3**	**1**	**0**	**4**

Course objectives:

1. To introduce students with fundamentals instrumentation of the equipments used in health caresystems
2. To familiarize students with the application and troubleshooting, maintenance and repairing aspects of versatile medicalequipments

Course outcome:
After completion of the course the students will be able to

1. Identify various medical equipments used in medical institute/research centres
2. Explain the working theories of medicalinstruments
3. Show the skills in the view points of maintenance, repairing and troubleshooting of medicalequipments

UNIT I	**Fundamentals of Medical Instrumentation:** Bioelectric Signals and Physiological Transducers. Related Anatomy and Physiology. **Operation, functional circuit details**: Patient Safety, Repair, Service and Maintenance of a range of medical equipment	**8**
UNIT II	**Mechanical Equipment:** BP Apparatus, Suction Machine and Microscope. Recording and Monitoring Equipment: ECG and EEG Machines, Pulse Oximeter, Cardiac Monitor and Audiometer.	**8**
UNIT III	**Clinical Lab Equipment:** Colorimeter, Spectrophotometer, Semi-Auto Analyzer, Centrifuge and Oven. Imaging Systems: X-Ray and Ultrasound Machines.	**8**
UNIT IV	**Therapeutic Equipment:** Cardiac Defibrillator, Short wave and Ultrasonic Diathermy. Anesthesia Machine.	**8**
UNIT V	**Maintenance of pc based medical equipment:** Introduction to - System configuration and BIOS, Identification & Troubleshooting of PC components viz-Motherboard, HDD, FDD, CD ROM, Monitor, Printers, Modems, Ports etc. Installation and operation of - Windows Operating System, Antivirus Software, Internetworking.	**8**

TEXT BOOKS:

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004 (UNIT I, II)
2. Raja Rao, C; Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000) (UNIT III, IV &V)

REFERENCE BOOKS:

1. R.Anandanatarajan, "Biomedical Instrumentation", PHI Learning,2009.
2. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.

CONTROL ENGINEERING

EC442

Pre-requisite	Co-requisite	L	T	P	C
None	None	**3**	**1**	**0**	**4**

Course Objectives:

This course is objected to impart knowledge on the fundamentals of Control systems engineering, its components and applications.

Course Outcomes:

After completion of the course the students will be able to

1. To teach the fundamental concepts of Control systems and mathematical modelling of thesystem
2. To study the concept of time response and frequency response of thesystem
3. To teach the basics of stability analysis of thesystem
4. To study the state variableanalysis
5. To teach the problem solving technique and designing aspect of controlsystem.

UNIT I	**Introduction to Control Systems:** Classification of control systems with examples. Properties of Control Systems: Stability, disturbance rejection, insensitivity and robustness. **Control system components:** Position and velocity sensors and encoders, servomotors and voice coil actuators.	**8**
UNIT II	**Basic Control actions:** Proportional, integral, derivative, and their combinations. **Review of Matrix Algebra:** Rank of matrix, Generalised matrix inverse, eigenvalues, eigenvector, computation of function of matrix.	**8**
UNIT III	**State variable analysis:** Concept of state, state variable, state model. State variable formulation of control system, diagonalization, Relating transfer function with state model. Time response of state model of lineartime-invariant system. Alternative representations in state space (cascade form, parallel form, controllable canonical form, observable canonical form). Elementary concept of controllability & observability.	**8**
UNIT IV	**Stability of linear systems:** Routh-Hurwitz criterion, Nyquist criterion. Stability margins. Root locus analysis. Effects of system gain and additional pole-zeros on stability. **Design and compensation of control systems in frequency domain:** Lag compensator, lead compensator, lead-lag compensator and lag-lead compensator.	**8**

UNIT V	**Block diagram representation of control systems:** block diagram reduction and signal flow graph analysis. **Review of frequency domain methods:** Nichols plots. Frequency Domain Specifications in open loop andclosed loop and their significance, Concept of Bandwidth (3 dB BW & 90 degree BW) and Cut-off frequency, Effect of addition of poles and zeros on Bandwidth.	**8**

Text Books:

1. Nagrath I. J. and Gopal M.,"Control Systems Engineering", New Age International (P) Ltd.
2. Ogata K, "Modern Control Systems", Prentice Hall, Englewood Cliffs.
3. Benjamin C. Kuo, "Automatic Control Systems", PHI
4. Gopal: Modern Control System, New Age International

COMMUNICATION SYSTEMS

EC441

Pre-requisite	Co-requisite	L	T	P	C
None	None	**3**	**1**	**0**	**4**

Pre-Requisite: Mathematics, Signal Theory.

Course Objective: This curriculum is designed for enabling the students to assimilate the principles of electronic communication. Theory of traditional communication systems, digital communication, wireless communication, information theory, Source coding, error correction strategies and their working methodology would be stressed.

Course Outcome: On course completion, the students would be exposed to the methods of modulating amplitude and phase/frequency of the electromagnetic wave, transmission and receptions of binary streams and voice signals, constraints of designing communication systems namely noise, power. Also idea of information as measurable quantity. Methods of probabilistic source coding and error correction techniques are ingrained quantitatively.

UNIT I	**ANALOG COMMUNICATION** **Noise:** Source of Noise - External Noise- Internal Noise - Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).	**8**
UNIT II	**DIGITAL COMMUNICATION** Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital CommunicationSystem (ASK– FSK – PSK – QAM).	**8**
UNIT III	**DATA AND PULSE COMMUNICATION** **Data Communication:** History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. **Pulse Communication:** Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse codeModulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM)	**8**
UNIT IV	**SOURCE AND ERROR CONTROL CODING** Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.	**8**

UNIT V	**MULTI-USER RADIO COMMUNICATION** Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Codedivision multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.	**8**

TEXT BOOK:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons,2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education,2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education,2007.
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press,2007.
5. Blake, "Electronic Communication Systems", Thomson Delmar Publications,2002.
6. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, Prentice Hall of India,2002.
7. B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education,2007.

VLSI & EMBEDDED SYSTEM
EC444

Pre-requisite	Co-requisite	L	T	P	C
None	None	**3**	**1**	**0**	**4**

Course Objective:

1. Describe MOS transistor structure and operation 2 . State VLSI design flow and design hierarchy
2. Design NAND, NOR, half adder, full adder transmission gate
3. describe different inverters(Resistive load,CMOSetc.)
4. Design MOS based sequentialcircuit
5. Design dynamic logiccircuits
6. Understand the fundamentals of the embeddedsystems
7. Basic programming concepts of for embeddedsystems
8. Describe the Basic OS fundamentals and the RTOS for embeddedsystems

Learning Outcome:
Outcome of this course is:

Students will be able to apply the theoretical VLSI circuits knowledge and embedded systems fundamentals for designing circuits in the domain of VLSI and can have a basic platform for embedded systems. Getting a strong foundation on the theoretical knowledge on VLSI as well as embedded systems will help them to get into the field of VLSI circuits design and the embedded systems and RTOS fields which in turn helps the society to have chips for simplifying /helping everyday life either in form of knowledge sharing or in the form of productdevelopment.

UNIT I	**Introduction to MOSFETs**: MOS-transistor structure,operation,characteristics.VLSI design flow and design hierarchy. Brief overview of circuit design techniques (Hierarchical design, Design abstraction, computer aided design). **MOS Inverter:** Simple inverter structure, VTC, Critical voltages, different types of inverter, Noise margin. **CMOS combinational circuit::**NAND gate, NOR gate, Half adder, Full adder, Other complex logic circuits, CMOS transmission gates, Simplecircuits design with CMOS transmission gate.	**8**
UNIT II	**Sequential MOS Logic Circuits:** SR Latch, JK Latch,Dlatch,Edge triggered Flipflops. **Dynamic Logic Circuits:** Dynamic logic circuits basics, Pre-charge and evaluate logic,cascading problem, Domino Logic.	**8**
UNIT III	**Introduction to Embedded systems:** Embedded Systems –Definition, Difference between Embedded system and General Computing Systems, Importance of Embedded Systems,Hardware architecture of the real time systems,Different hardware units & processor overview for embedded systems.	**8**

UNIT IV	**Programming Concepts for Embedded systems:** ALP and High level language, Macros, functions, data types, data structures, modifiers, statements ,loops, pointers Queue, stack, Lists and ordered lists, compilers and cross-compilers.	**8**
UNIT V	**Real Time Operating Systems :**Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, Multiple tasks scheduling in real time systems by RTOS.	**8**

Text books:

1. NeilH.EWeste,KimHaase,DavidHarris,A.Banerjee,"CMOSVLSIDesign:Acircuits&Systems Perspective", PearsonEducation
2. Wayne Wolf," Modern VLSI Design – System-on-chip Design", Prentice Hall India/PearsonEducation
3. Sung-MoKang&YusufLablebici,"CMOSDigitalIntegratedCircuits,Analysis&Design",Tata McGraw-HillEdition
4. Introduction to Embedded System: Shibu K. V. (TMH)
5. Embedded System Design – A unified hardware and software introduction: F.Vahid (JohnWiley)
6. Embedded Systems: Rajkamal(TMH)

References:

1. David Hodges, Horace G Jackson, &Resve A Saleh, " Analysis & Design of Digital Integrated Circuits", Tata McGraw- HillEdition
2. Ken Martin," Digital Integrated Circuits", Oxford University Press
3. Embedded Systems : L. B. Das(Pearson)
4. Embedded System design: S. Heath(Elsevier)
5. Embedded microcontroller and processor design: G. Osborn(Pearson)

ELECTRICAL & ELECTRONIC MEASUREMENT AND INSTRUMENTATION

EC443

Pre-requisite	Co-requisite	L	T	P	C
None	None	**3**	**1**	**0**	**4**

Prerequisite:

Knowledge of analog & digital electronics

Course Objective:

1. To familiarize students with basic measurement system & itscomponents
2. To introduce students with characteristics of measuring instruments & errors inmeasurement
3. To familiarize students with basic electrical measuring instruments
4. To familiarize students basic and advanced electronic measuring instruments
5. To introduce students with PC based instrumentation system and data acquisitionsystem
6. To introduce students with basic optical power measurementsystem

Course Outcome:

Upon successful completion of this course, the student will be able to:

1. Understand & describe basic measurement systems and theircomponents.
2. Describe the characteristics of instruments and different measurementerrors.
3. Describe construction & operation of basic electrical instruments &analyze AC bridgecircuits.
4. Understand and describe the configuration & working principle of different electronic instruments for the used in laboratories.
5. Distinguish between analog and digitalinstruments.
6. Understand and describe the working theory of basic data acquisition system & PC based instrumentationsystem.
7. Realize the construction & working principle of Optical PowerMeasurement.

UNIT I	**General Features:** Measurement systems – Static and Dynamic Characteristics – Units and Standards of measurements, –errors analysis, – moving iron meters, dynamometer, wattmeter– multimeter,–Truermsmeters– Bridgemeasurements,WheatstoneBridge,Kelvin,Wein,Maxwell,Hay, Schering and Anderson Bridges.	**8**
UNIT II	**Basic Measurement Concepts:** Electronic Multimeter Current measurement with analog electronic instruments. Chopper stabilized amplifier for measurement of very low voltage and currents. Cathode Ray Oscilloscopes-Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, Digital Storage Oscilloscopes.	**8**
UNIT III	**Signal Generator and Analysis:** Function Generators- RF Signal Generators- Sweep Generators – Frequency Synthesizer-Wave Analyzer-Harmonic Distortion Analyzer – Spectrum Analyzer.	**8**
UNIT IV	**Digital Instruments:** Comparison of analog & digital techniques- digital voltmeter- mutlimeter–frequency counters-measurement of frequency and time interval – extension of frequency range- measurement errors.	**8**
UNIT V	**Data Acquisition Systems:** Elements of digital data acquisition system-interfacing of transducers – multiplexing – computer controlled instrumentation: IEEE 488 BUS. Optical Power Measurement, Optical Time Domain Reflectometer.	**8**

Text Books:

1. Electronic Instrumentation by H. S. Kalsi. 3rd Ed. Tata McGraw-HillEducation
2. A Course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, PuneetSawhney. Dhanpat RaiPublications.
3. Modern Electronic Instrumentation & Measurement Techniques – Albert D. Helfrick& William D. Copper,Prentice Hall of India,2003
4. Elements of Electronics Instrumentation & Measurement, Pearson Education2003
5. Measurement System- Application & Design – Ernest O.Doeblin, Tata McGraw Hill2004

MEDICAL IMAGE PROCESSING LAB

BE456

Pre-requisite	Co-requisite	L	T	P	C
None	None	**0**	**0**	**2**	**1**

Course Objectives:

To gain the practical knowledge about the processing of medical images, understand the fundamentals of digital image and its properties. To enhance the medical images by applying various filters and segment the region of interest using various image processing Algorithms.

Course Outcome

After completion of the course the students will gain

1. Knowledge in the science of medical images and image processing, including mathematicaltransforms.
2. Knowledge in the techniques of Digital Image Processing, including Image Enhancement in the Spatial and Frequency Domain, Compression, Morphology andSegmentation.
3. Knowledge Current science and technological practice in industry and advanced research topics in thisarea.

List of experiments:

[Students are required to perform at least EIGHT experiments]

1. Image enhancement — Histogram
2. Image smoothing
3. Image sharpening
4. Point detection
5. Line detection
6. Edge detection
7. Image data compression
8. Image Characterization
9. Vector & Matrix Indexing
10. Fourier Transform
11. Image Transformation
12. Morphological Image Processing

STUDY & EVALUATION SCHEME
B.Tech. Biomedical Engineering
(with effect from 2020-2021)

4thYear **8thSem**

S. No.	Course Category	Sub. Code	Name of Subject	Periods and Credits				Evaluation Scheme				Sub. Total
								Sessional (CA)			ESE	
				L	T	P	C	CT	TA	Total		
1	DC	BE-451	Seminar	0	0	0	3	0	100	100	0	100
2	DC	BE-499	B.Tech. Project	0	0	0	4	0	60	60	40	100
3	DC	BE-499	B.Tech. Project	0	0	0	4	0	60	60	40	100
4	DC	BE-499	B.Tech. Project	0	0	0	4	0	60	60	40	100
5	DC	BE-412	Educational Tour	0	0	0	2	0	60	60	40	100
6	OE		Open Elective-2	-	-	-	4	25	15	40	60	100
Total				0	0	0	21	25	355	380	220	600
* An inter-disciplinary program offered by the Department of Bioengineering in association with the Department of Electronics and Communication Engineering.												

L: Lecture **T**: Tutorial **P**: Practical **C**: Credit **CA**: Continuous Assessment

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DC: Departmental Core **OE**: Open Elective