CURRICULUM & SYLLABI

B.TECH DEGREE PROGRAMME

BIOMEDICAL ENGINEERING

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

KARUNYA UNIVERSITY,

COIMBATORE
INDIA

Table BM-1

B.Tech. (Biomedical Engineering)–2014 batch

COURSE COMPONENTS
Excluding PEP subjects(First Year)

Table 1

Sl. No.	Sub.Code	General – 2 credits Course	Credits
1	14VE2001 /14VE2002	Value Education I / II	2:0:0
		Course Total	2

Table 2

Sl. No.	Sub.Code	Basic Sciences – 12 credits Course	Credits
1	14MA2003	Mathematical Transforms	3:1:0
2	14MA2015	Probability, Random Process and Numerical Methods	3:1:0
3	15BT2001	Medical Biochemistry	3:0:0
4	15BT2002	Medical Biochemistry Laboratory	0:0:1
		Course Total	12

Table 3

Sl. No.	Sub.Code	Engineering Sciences & Technical Arts – 6 credits Course	Credits
1	14MS2002	Managerial Skills	3:0:0
2	15EI2001	Health and Hospital Management	3:0:0
		Course Total	6

Table 4

Sl.No	Sub.Code	Program Core – 75 credits & a full / part semester project NameoftheCourse	 Credits
1	14EE2001	Electric Circuits and Networks	3:1:0
2	14EC2001	Digital Electronics	3:1:0
3	15EI2002	Medical Electronics	3:0:0
4	15EI2003	Biomedical Sensors and Transducers	3:0:0
5	14EC2005	Electron Devices and Circuits Lab	0:0:2

6	15EI2004	Biomedical Sensors and Transducers Laboratory	0:0:2
7	15BT2003	Human Anatomy and Physiology	3:0:0
8	14EC2003	Signals and Systems	3:1:0
9	15EI2005	Biosignal Conditioning Circuits	3:0:0
10	15EI2006	Biocontrol systems	3:1:0
11	15EI2007	Medical Diagnostic Equipment	3:0:0
12	14EC2014	Digital Signal Processing	3:1:0
13	15EI2008	Biosignal Processing Laboratory	0:0:2
14	14EC2079	Microprocessors and Microcontrollers	3:1:0
15	15EI2009	Intelligent Instrumentation Systems Laboratory	0:0:2
16	15EI2010	Fundamentals of Biomechanics	3:0:0
17	15EI2011	Telemedicine	3:0:0
18	15EI2012	Radiological Imaging Techniques	3:0:0
19	15EI2013	Medical Image Computing	3:0:0
20	15BT2004	Biomaterials and Artificial Organs	3:0:0
21	15EI2014	Biosignal Conditioning Circuits Laboratory	0:0:2
22	15EI2015	Biomedical Instrumentation laboratory	0:0:2
23	15EI2016	Medical Therapeutic Equipment	3:0:0
24	15EI2017	Modelling of Physiological systems	3:0:0
25	15EI2018	Biovirtual Instrumentation Laboratory	0:0:2
26	SIP2995	In-Plant Training	0:0:1
		Total Subject Credits	75
		Full / Part Semester project	20/12
		Total	95 / 87

S.No.	Subject Code	Soft CORE SUBJECTS (Bio Mechanical)	Credits
1	15EI2019	Finite Element Modeling in Biomedical Engineering	3:0:0
2	15EI2020	Ambulatory Services	3:0:0
3	15EI2021	Ergonomics in Hospitals	3:0:0
4	15EI2022	Surgical Assist Systems	3:0:0
5	15BT2005	Occupational Safety Management	3:0:0
6	15EI2023	Sensory and Motor Rehabilitation	3:0:0
7	15EI2024	Hospital Automation	3:0:0
8	15BT2006	Medical Waste Treatment	3:0:0
9	15EI2025	Medical Equipment, Maintenance and Troubleshooting	3:0:0
10	15EI2026	Bio Fluid and Solid Mechanics	3:0:0
11	15EE20XX	Alternate Energy Sources for Hospitals	3:0:0
12	15EI2027	Computer Applications in Modeling of Physiological Systems	3:0:0

S.No.	Subject Code	Soft CORE SUBJECTS (Bio Chemical)	Credits
1.	14BT2011	Molecular Biology	3:0:0
2.	15BT2007	Cell Biology and Immunology	3:0:0
3.	15BT2008	Tissue Engineering	3:0:0
4.	14BI2002	Instrumental Methods of Analysis	3:0:0
5.	15EI2031	Medical Ethics	3:0:0
6.	15CH2001	Polymer science and Technology in medicine	3:0:0
7.	15BI2005	Medical Informatics	3:0:0
8.	14EC2075	Nano Electronics	3:0:0
9.	15CH2002	Bio Ceramic Materials in Medicine	3:0:0
10.	15BT2009	Instrumentation in Pathology and Microbiology	3:0:0

S.No.	Subject Code	Soft CORE SUBJECTS (Bio Electrical)	Credits
1	15EI2028	Biomedical Optics	3:0:0
2	15EI2029	Patient and Device Safety	3:0:0
3	15EI2030	ICU and Operation Theatre Equipment	3:0:0
4	14EC2061	Soft Computing	3:0:0
5	15EI2031	Medical Ethics	3:0:0
6	14EC2075	Nano Electronics	3:0:0
7	15EI2032	Bioelectric Phenomena	3:0:0
8	15EI2033	MEMS Sensor Technology	3:0:0
9	15EI2034	Biometric systems	3:0:0
10	15EI2035	Ionizing and Non-Ionizing Radiations	3:0:0
11	15EI2036	Radiation and Nuclear Medicine	3:0:0
12	15EI2037	Intelligent Instrumentation Systems	3:0:0

S.No.	Subject Code	Subject	Credits
1	15EI2001	Health and Hospital Management	3:0:0
2	15EI2002	Medical Electronics	3:0:0
3	15EI2003	Biomedical Sensors and Transducers	3:0:0
4	15EI2004	Biomedical Sensors and Transducers Laboratory	0:0:2
5	15EI2005	Biosignal Conditioning Circuits	3:0:0
6	15EI2006	Biocontrol systems	3:1:0
7	15EI2007	Medical Diagnostic Equipment	3:0:0
8	15EI2008	Biosignal Processing Laboratory	0:0:2
9	15EI2009	Intelligent Instrumentation Systems Laboratory	0:0:2
10	15EI2010	Fundamentals of Biomechanics	3:0:0
11	15EI2011	Telemedicine	3:0:0
12	15EI2012	Radiological Imaging Techniques	3:0:0
13	15EI2013	Medical Image Computing	3:0:0
14	15EI2014	Biosignal conditioning circuits Laboratory	0:0:2
15	15EI2015	Biomedical Instrumentation Laboratory	0:0:2
16	15EI2016	Medical Therapeutic Equipment	3:0:0
17	15EI2017	Modelling of Physiological systems	3:0:0
18	15EI2018	BioVirtual Instrumentation Laboratory	0:0:2
19	15EI2019	Finite Element Modeling in Biomedical Engineering	3:0:0
20	15EI2020	Ambulatory Services	3:0:0
21	15EI2021	Ergonomics in Hospitals	3:0:0
22	15EI2022	Surgical Assist Systems	3:0:0
23	15EI2023	Sensory and Motor Rehabilitation	3:0:0
24	15EI2024	Hospital Automation	3:0:0
25	15EI2025	Medical Equipment, Maintenance and Troubleshooting	3:0:0
26	15EI2026	Bio Fluid and Solid Mechanics	3:0:0
27	15EI2027	Computer Application in Modeling of Physiological Systems	3:0:0
28	15EI2028	Biomedical Optics	3:0:0
29	15EI2029	Patient and Device Safety	3:0:0
30	15EI2030	ICU and Operation Theatre Equipment	3:0:0
31	15EI2031	Medical Ethics	3:0:0
32	15EI2032	Bioelectric Phenomena	3:0:0
33	15EI2033	MEMS Sensor Technology	3:0:0
34	15EI2034	Biometric systems	3:0:0
35	15EI2035	Ionizing and Non-Ionizing Radiation	3:0:0
36	15EI2036	Radiation and Nuclear Medicine	3:0:0
37	15EI2037	Intelligent Instrumentation Systems	3:0:0
38	15EI2038	Modern Automotive and Intelligent Systems	3:0:0
39	15EI2039	Automotive Control and HIL Simulation	3:0:0
40	15EI2040	Automobile Electric and Electronics Systems	3:0:0
41	15EI2041	Automotive In-Vehicle Communication System	3:0:0
42	15EI2042	Automotive Telematics and Infotainment	3:0:0
43	15EI2043	Automotive Fault Diagnostics	3:0:0

15EI2001 HEALTH AND HOSPITAL MANAGEMENT

Credits: 3:0:0

Course Objective:

- To understand the need and significance of clinical engineering and health policies.
- To familiarize the training strategies, quality management policies and information technology used in health care.
- To know the needs of managerial training to hospital staffs.

Course Outcome:

- Appreciate the need for standard health policies and quality management in hospitals.
- Apply the knowledge of computer and information technology in health care.
- Relate the training needs at various level of organization.

Health Organization of the country, National Health Policies, Health Financing System, Organization of Technical Section. Management of Hospital Organization, Nursing section Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human relation in Hospital, Importance to Team Work, Legal aspect in Hospital Management. FDA Regulation, Joint Commission Of Accreditation for Hospitals, National Fire Protection Association, Standard, IRPC. Organizing Maintenance Operations, Paper Work Control, Maintenance Job, Planning Maintenance Work. Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance, Training, Contract Mainframe, Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

References:

1. R.C. Goyal, "Handbook of Hospital Personal Management", Prentice Hall of India, 2008.
2. Joseph. F. Dyro, " Clinical Engineering Management", Academic Press Series in Biomedical Engineering, 2004
3. Antony Kelly, "Strategic Maintenance planning", Butterworths London, 2006.
4. Cesar A. Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, 1977.
5. Webster, J.G. and Albert M. Cook, "Clinical Engineering Principles and Practices", PrenticeHallInc.Englewood Cliffs, 1979.

15EI2002MEDICAL ELECTRONICS

Credits: 3:0:0

Course Objective:

- To furnish information on the mechanisms of current flow in semi-conductors.
- To yield understanding about the basic operations of diode, transistor and their medical applications.
- To provide knowledge about advanced semiconductor devices and their significant practical applications in medical field.

Course Outcome:

- Apply the concepts of electronic circuits to biomedical applications.

- Design practical circuits for acquisition and analysis of biomedical signals.
- Build simple circuits for biomedical signal and analysis.

Overview of medical electronic equipments, transduction of bioelectric potentials, concepts of bio-impedence. PN junction diodes-VI characteristics, rectifiers, Zener diodes, Regulators, LED, LCD, Laser diodes, Special purpose diodes and their medical applications

BJT and its medical applications: Construction, Characteristics, Hybrid model. Transistor as amplifier, Transistor as a switch, Opto-coupler & its medical application.

Junction field effect transistor and its medical applications: JFET, MOSFET and its classification, Power MOSFET, MOS as a charge transferring Device – CCD, Uni-junction transistor. Medical application of MOSFET.

Differential amplifiers: CM and DM, feedback amplifiers, Oscillators – LC, RC, crystal and their medical application, Pulse circuits for medical devices.

References:

1. Khandpur. R.S.,"Handbook of Biomedical Instrumentation", Tata McGraw-Hill, Second edition, 2003.
2. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall, Sixth edition, 2009.
3. David ABell, "Electron Devices and Circuits", Prentice Hall Of India, Fifth edition, 2007.
4. Millman and Halkias, "Electronic devices and Circuits", Tata McGraw Hill, First edition, 1994.
5. Thomas L. Floyd, "Electron Devices", Charles &Messil Publications, Tenth edition 2009.

15EI2003BIOMEDICAL SENSORS AND TRANSDUCERS

Credits: 3:0:0

Course Objective:

- To provide introduction to the field of medical sensors and an indepth and quantitative view of device design and performance analysis.
- To provide knowledge on the principle and operation of different medical transducers.
- To introduce the application of sensors and transducers in the physiological parameter measuring system.

Course Outcome:

- Identify the key design criteria and suggest an appropriate wearable sensor approach which is most likely to meet a specific biosensor application.
- Use the principle of transducers to design medical instrumentation systems.
- Suggest suitable sensors for a particular application.

Studyofbiologicalsensorsinthehumanbodyandtheirbasicmechanismofaction,Studyofvariouscorpuscleslikepacinian, functionsandmodeling,Chemoreceptor,hotandcoldreceptors,baro-receptors,sensorsforsmell,sound, vision,osmolalityandtaste.
Temperaturetransducers,Displacementtransducers,potentiometric,resistivestraingauges,inductivedisplacement, capacitivedisplacementtransducer. Pressuretransducer, Blood pressure measurement,measurementofintracranialpressure, LVDTtransducers,capacitiveandpiezo-electric type.Biosensors,Biocatalystsbased biosensors,bio-affinitybasedbiosensors&microorganismsbasedbiosensors,biologicallyactivematerial andanalyte.Typesofmembranesusedinbiosensorconstructions.Ionexchangemembrane, electrodes, Electrolyticsensors,opticalsensor,fiberopticsensors.Biosensorsinclinical chemistry,medicineandhealthcare,Commercialprospectsfor biomolecular computingsystems.

References:

1. Michael. R.Newman,David. G.Flemming"PhysicalSensorsforBiomedical Applications", CRCPressInc.,Florida. 2004.
2. Pearson,J.E.Gill,A.,andVadgama,P. "AnalyticalAspectsofBiosensors".AnnClin.Biochem,2002.
3. R.S.C.Cobbold, "TransducersforBiomedicalInstruments", PrenticeHall. 2003.
4. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.
5. John.G.Webster. "MedicalInstrumentation,ApplicationandDesign".Fourth Edition. Wiley &sons,Inc.,NewYork.2009.

15EI2004 BIOMEDICAL SENSORS AND TRANSDUCERS LABORATORY

Co-Requisite: 15EI2003 Biomedical Sensors and Transducers
Credits: 0:0:2
Course Objective:

- To introduce the practical aspects of various medical transducers and their characteristics.
- To impart knowledge in measurement of Resistance, Inductance and Capacitance using bridges.
- To improve the skills in calibrating analog meters.

Description:

This laboratory introduces the different biomedical transducers, their working and determination of their characteristics.

Course Outcome:

- Analyze the performance characteristics of various transducers and infer the reasons for the behavior.
- Critically analyze any measurement application and suggest suitable measurement methods.
- Calibrate basic instruments.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

15EI2005 BIOSIGNAL CONDITIONING CIRCUITS

Pre requisite: 15EI2002 Medical Electronics

Credits: 3:0:0

Course Objective:

- To understand bioelectric amplifiers
- To discuss filters and circuits
- To introduce application of signal conditioning in biomedical field

Course Outcome:

- Identify the method to apply various signal conditioning circuits
- Interface bioelectric signals with embedded systems.
- Identify the application of signal condition circuits for biomedical field.

Nature of Bio Electricity: Bioelectric Currents, Nernst Potential, Diffusion Potential, Action potential, Detection of Bio electric events, bio-electrode and electrode-skin interface.
Operational Amplifiers and Comparators. Instrumentation and Medical Isolation Amplifiers: Instrumentation Amplifier, Medical Isolation amplifiers.
Digital Interfaces: Analog to Digital , Digital to Analog conversion, Special analog circuits and systems used in biomedical Instrumentation, Phase Detectors-Analog and Digital, Voltage Controlled Oscillators, Phase locked loops.Electrical Interface problems and Safety Standards in Bio Potential Measurements.

References:

1. Robert B. Northrop, " Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, II Edition, NewYork,2004
2. Myer Kutz, "Biomedical Engineering and Design Handbook", II Edition, Volume 1, McGraw Hill Professional,2009
3. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & Linear Integrated Circuits",Prentice-Hall, 6th Edition,2001.
4. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", TMH, 3rd Edition,2002.
5. Milman&Hallkias, "Integrated Electronics-Analog and Digital Circuit", McGraw Hill, II Edition,2011.

15EI2006 BIOCONTROL SYSTEMS

Pre requisite: 14MA2003 Mathematical Transforms

Credits: 3:0:0

Course Objective:

To study various

- Bio control systems modeling technique.
- Time response analysis and frequency response analysis.
- Analyze biological control systems.

Course Outcome:

- Model any physiological systems.
- Perform the analysis of given system in time domain and frequency domain.
- Perform Stability analysis and to design any physiological control systems.

Basic structure of control system, Positive and Negative Feedback, transfer functions, modeling of electrical systems, block diagram and signal flow graph representation of systems, difference between engineering and physiological control systems, generalized system properties , models with combination of system elements.Physiological system modeling, Linear model of respiratory mechanics, model of chemical regulation of ventilation, linearmodel of muscle mechanics, model of regulation of cardiac output, model ofNeuromuscular reflex motion, Introduction to simulation. Step response of first order and second order systems, determination oftime domain specifications of first and second order systems. Definition of steady state error constants and its computation, definition of stability, Routh-Hurwitz criteria of stability, construction of root locus.Frequency response, Nyquist stability criterion, Nyquistplotand determinationofclosedloop stability, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute resonant frequency and band width.

References:

1. Michael. C. K.Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2001.
2. M. Gopal "Control Systems Principles and design", Tata McGraw Hill ,2002
3. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India,7th edition, 1995
4. John Enderle, Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering" second edition, Academic Press, 2005.
5. Richard C. Dorf, Robert H. Bishop," Modern control systems",Pearson, 2004

15EI2007MEDICAL DIAGNOSTIC EQUIPMENT

Pre requisite: 15EI2003 Biomedical sensors and Transducers

Credits: 3:0:0

Course objective:

- To know the various biopotential recordings and operating procedure of ICCU equipment.
- To develop an understanding of the physiotherapy and diathermy equipment.
- To learn the safety standards of the diagnostic equipment.

Course outcome:

- Develop measurement systems for biosignals and its signal conditioning circuits
- Know the safe operating procedure of Cardiac care monitoring instruments.
- Get clear domain knowledge about various types of wearable and implantable devices.

ECG-continuousmonitoringsystemsforpulserate,temperature,B.P, Respiration,Arrhythmiamonitor;
B.P.monitor,Bloodflowandcardiacoutput,Measurement,Plethysmography,Oximetry,Treadmill (StressECG).EMG,EEG,EOG,ERG.Audiometer,Differentmodesandassessments.

UV,VisibleandIRSpectrophotometers,FlamePhotometers,Electrolyteanalysisusingsensitive electrodes,pHmeter,principleandapplications.DensitometerandElectrophoresisapparatus. Principlesandapplicationsofoil,gasandliquidchromatographs,MassSpectrometry,Flow Cytometry,RadioimmunoassayandELISAtechniques,Bloodgasanalyzers,Bloodcellcounters.Var ioustypesofEndoscopes,Fiberoptic,Fluidoptic,IntegralCameraElectronMicroscope, TransmissionandReflection.

References:

1. Khandpur. R.S. "HandbookofBiomedicalInstrumentation".Second Edition, McGrawHill2003.
2. Geddas,L.A.&Baker,L.E."PrinciplesofAppliedBiomedicalInstrumentation".Third Edition. JohnWiley& Sons. 2008.
3. John.G.Webster. "MedicalInstrumentation,ApplicationandDesign".Fourth Edition. Wiley &sons,Inc.,NewYork.2009.
4. LeslieCromwell,Fred. J.Weibell&Erich. A.Pfeiffer. "Biomedical InstrumentationandMeasurements". Second Edition. PrenticeHallInc.2000.
5. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

15EI2008 BIOSIGNAL PROCESSING LABORATORY

Co-Requisite:14EC2014 Digital Signal Processing
Credits: 0:0:2
Course Objective:

- To record the biosignals and analyze it.
- To study the different preamplifiers used for amplifying the biosignals.
- To impart knowledge about the measurements and recordings of bioelectric and biochemical signals.

Description:

This laboratory introduces the different signal processing techniques used for analysing and recording biosignals.

Course Outcome:

- Analyze the performance of various biomedical equipments and infer their safety aspects.
- Critically analyze any measurement application and suggest suitable measurement methods.
- Calibrate medical instruments.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

15EI2009INTELLIGENT INSTRUMENTATION SYSTEMS LABORATORY

Credits: 0:0:2

Course Objective:

- To impart knowledge on the integration of hardware circuits with software.
- To introduce the concepts of programming in an IDE and download it into a processor.
- To learn about the practical aspects of data acquisition and analysis.

Description:

This laboratory introduces the basics of sensor data acquisition and interfacing issues related to it.

Course Outcome:

- Design interfacing circuits to acquire real time data and process it using software.
- Develop intelligent instrumentation systems for biomedical applications.
- Use communication protocols for data transmission.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester

15EI2010FUNDAMENTALS OF BIOMECHANICS

Credits: 3:0:0

Course Objective:

- To introduce the Fundamental terms and concepts of human factors.
- To discuss anthropometric, biomechanical and physiological principles and how they are used to optimize human well-being and overall performance.
- To Identify, Analyze, Setup and implement solutions to a human factors problem.

Course Outcomes:

- Acquire biosignals and perform the quantification.
- Apply biomechanical and physiological principles to optimize human well-being and overall performance.
- Analyze and implement solutions to human factors problem.

Introduction: Newton's laws, Stress, Strain, Non Viscous fluid, Newtonian Viscous fluid, Viscoelasticity, Blood Characteristics, Mechanical Interaction of Red blood cells with solid wall, Thrombous formation and dissolution, Medical applications of blood rheology.

Bone & its properties.Bone structure and Composition, Blood Circulation in Bone, Viscoelastic properties of Bone, ElectricalProperties of Bone, Fracture Mechanism and Crack Propagation in bones, Kinetics and Kinematics of Joints.Cardio vascular system, Mechanical properties of blood vessels- Arteries, Arterioles, Capillaries, Veins, Bloodflow- Laminar & turbulent , Prosthetic Heart Valves & replacement.

Biomechanics of Spine- Structure, Movements, Loads on Spine, Exo-skeletal system for Paraplegics, Structureof Hip- Movements, Loads on Hip, Total Hip Prosthesis , Structure of Knee- Movements , loads on knee, Kneeprosthesis , Powered wheel chair, Crutches and canes.

Human Locomotion- Gait Analysis, Foot Pressure measurements- Pedo-barograph , Mechanics of Foot-Arthritis, Biomechanical treatment.

References:

1. Özkaya, N., Nordin, M., Goldsheyder, D., Leger, D., "Fundamentals of Biomechanics'', Equilibrium, Motion, and Deformation 3rd ed., Springer Science plus Business Media, 2012.
2. Duane Knudson, "Fundamentals of Biomechanics", Second Edition, Springer Science plus Business Media, 2007.
3. Iwan W. Griffiths, Lippincott Williams & Wilkins, "Principles of Biomechanics & Motion Analysis", Medical publication, 2006.
4. Donald R. Peterson, Joseph D. Bronzino, "Biomechanics Principles and Applications", CRC Press, 2008.
5. DhanjooN.Ghista, "Applied Biomedical Engineering Mechanics", CRC Press, 2008.
6. Lucas, Cooke, "A Primer of Biomechanics", Springer –Verlag, 1999.

15EI2011 TELEMEDICINE

Credits: 3:0:0

Course Objective:

- To introduce the key principles of telemedicine and health.
- To understand telemedical technology.
- To learn telemedical standards, mobile telemedicine and its application.

Course Outcomes:

- Apply multimedia technologies in telemedicine.
- Use protocols behind encryption techniques for secure transmission of data.
- Applytelehealth in healthcare.

Telemedicine and Health: History and Evolution of telemedicine, Functional diagram of telemedicine system, Ethical and legal aspects of Telemedicine – Telemedical technology: Principles of Multimedia - PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Satellite communication, mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing.Clinical data – local and centralized.Telemedical standards: Data Security and Standards: Encryption, Cryptography. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Cyber laws related to telemedicine.Mobile telemedicine and telemedical applications.

References:

1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002
2. Wootton, R., Craig, J., Patterson, V., "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006.
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L., "Public Health Informatics and Information Systems", Springer, 2003.
4. Ferrer-Roca, O., Sosa - Iudicissa, M. , Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.

5. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.

15EI2012RADIOLOGICAL IMAGING TECHNIQUES

Credits: 3:0:0

Course Objective:

- To provide knowledge of the principle of operation and design of radiological equipment.
- To learn the preferred medical imaging methods for routine clinical applications.
- To understand the engineering models used to describe and analyze medical image.

Course Outcomes:

- Apply the tools for different problems in medical imaging.
- Implement various techniques to analyze the medical images.
- Suggest suitable imaging methodology for a specific ailment.

Ultrasonics- Principles of image formation, display, scanning modes, types of display. X-Ray-principles and production of hard and soft x-rays, fluoroscopy-image intensifiers, Generations of X-ray imaging. CT-evolution, image formation, mathematical details of algorithms used, types-spiral, transverse. Angiography. MRI-image acquisition, density weighted images-T1 and T2, spin-echo and spin relaxation techniques, types of pulse sequences for fast acquisition, NMR spectroscopy. Other imaging techniques- PET,SPECT,DS Angiography, IR imaging, Thermography-clinical application, LCD, thermography.

References:

1. JohnBall andTonyPrice.Chesney's, "RadiographicImaging".Blackwell ScienceLimited,U.K. 2006
2. Khandpur.R.S. "Handbookof BiomedicalInstrumentation". SecondeditionTataMcGrawHillPub.Co.,Ltd. 2003.
3. Farr, "ThePhysicsofMedicalImaging".AdemHilger,Bristol&Philadelphia, 2007.
4. JosephBronzino. "ThePhysicsofMedicalImaging".Secondedition.2005.

15EI2013 MEDICAL IMAGE COMPUTING

Credits: 3:0:0

Course Objective:

- To understand digital image processing and reconstruction techniques.
- To introduce the basic concepts and methodologies for processing the CT, MRI and Ultrasound images.
- To acquire knowledge in the basic geometric transforms used in digital image processing.

Course Outcome:

- Analyse the physiological events associated with the entire human system.
- Extraction of features that helps in easy diagnosis of various arrhythmias.
- Put forth new algorithms for processing the images for better results.

Elementsofvisualperception, Imagesamplingandquantization.Basicrelationshipbetweenpixels,basic geometrictransformations, IntroductiontoFourierTransformandDFT, Propertiesof2DFourierTransform, FFT, SeparableImageTransforms, Walsh, Hadamard, DiscreteCosineTransform,Haar,Slant,Karhunen, Loevetransforms.

SpatialDomainmethods:Basicgreyleveltransformation, Histogramequalization, Imagesubtraction, Image averaging,Spatialfiltering:Smoothing,Sharpeningfilters, Laplacianfilters, Frequencydomainfilters:Smoothing,Sharpeningfilters, Homomorphicfiltering. ModelofImageDegradation/restorationprocess, Noisemodels, Inversefiltering, Leastmeansquarefiltering, Constrainedleastmeansquarefiltering, Blindimagerestoration, Pseudoinverse, Singularvaluedecomposition.Losslesscompression:Variablelengthcoding, LZWcoding, Bitplanecoding,predictivecoding, DPCM. LossyCompression:Transformcoding,Waveletcoding, BasicsofImagecompressionstandards:JPEG,MPEG, Basicsofvectorquantization.Edgedetection, Thresholding, Regionbasedsegmentation, Boundaryrepresentation:chaircodes, Polygonal approximation, Boundarysegments, Boundarydescriptors:Simpledescriptors, Fourierdescriptors, Regionaldescriptors.

References:

1. RafaelC.Gonzalez, RichardEWoods,"DigitalImageProcessing",PearsonEducation2010.
2. William. K.Pratt,"DigitalImageProcessing",JohnWiley, 2001.
3. JayaramanS,Veerakumar.T,Esakkirajan.S, "DigitalImageProcessing,"TataMcGrawHill Pub.Co. Ltd.,2009
4. Najarain Splinter, "Biomedical Signal and Image Processing", Taylor and Francis, 2012.
5. ChandaDuttaMagundar,"DigitalImageProcessingandApplications",Prentice Hall of India,

15EI2014 BIOSIGNAL CONDITIONING CIRCUITS LABORATORY

Co-Requisite: 15EI2005 Biosignal Conditioning Circuits.
Credits: 0:0:2
Course Objective:

- To understand the design of filters and circuits for bioelectric amplifiers.
- To impart knowledge of the different preamplifiers used for amplifying the biosignals.
- To impart knowledge about the application of signal conditioning in biomedical field.

Description:

This laboratory introduces the filter design and circuit design for bioelectric amplifiers.

Course Outcome:

- Apply and analyze the front end analogue circuit design for ECG, EMG, EEG, etc.
- Identify the method to apply various signal conditioning circuits.
- Identify the amplifiers for a variety of biomedical sensors.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester

15EI2015 BIOMEDICAL INSTRUMENTATION LABORATORY

Credits: 0:0:2
Course Objective:

- To record the biosignals and analyze it.
- To study the different preamplifiers used for amplifying the biosignals.
- To impart knowledge about the measurements and recordings of bioelectric and biochemical signals.

Description:

This laboratory introduces the different diagnostic and therapeuticequipment, their working and the methodologies used for analysing and recording biosignals.

Course Outcome:

- Analyze the performance of various biomedical equipment and infer their safety aspects.
- Critically analyze any measurement application and suggest suitable measurement methods.
- Calibrate medical instruments.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester

15EI2016 MEDICAL THERAPEUTIC EQUIPMENT

Credit 3:0:0
Course Objective:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

Course Outcomes:

- Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc.
- Analyze the different types of therapies for suitable applications.
- Appreciate the application of lasers in biomedical applications.

Externalandimplantablepacemakers,Programmablepacemakers,CardiacDefibrillators,Energyrequirements,Implantable
Defibrillators,Defibrillatoranalyzers.Principlesofconstantpressureandconstantvolumeventilators,
Basicprinciplesofelectromechanical,
Pneumaticandelectronicventilators,Nebulizer,Ventilatortesting.

Electrodiagnosis,Electrotherapy,Electrodes,StimulatorsforNerveandMuscle,FunctionalElectricalStimulation.Highfrequencyheattherapy,Principle,Shortwavediathermy,Microwavediathermy,Ultrasonictherapy,Lithotripsy,Therapeuticradiation,TherapeuticUVLamps.BasicprinciplesofBiomedicalLASERS:Applicationsoflasersinmedicine,CO_2laser,He-Nelaser, Nd-YAGandRubylaser.

References:

1. Khandpur. R.S.,"Handbook ofBiomedicalInstrumentation".Second Edition.TataMcGrawHill Pub. Co.,Ltd. 2003.
2. John.G.Webster. "MedicalInstrumentation,ApplicationandDesign".Fourth Edition. Wiley &sons,Inc.,NewYork.2009.
3. LeslieCromwell,Fred. J.Weibell&Erich. A.Pfeiffer. "Biomedical InstrumentationandMeasurements". Second Edition. PrenticeHallInc.2000.
4. JohnLow&AnnReed. "ElectrotherapyExplained,PrinciplesandPractice". Second Edition. ButterworthHeinemannLtd. 2000.
5. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

15EI2017 MODELLING OF PHYSIOLOGICAL SYSTEMS

Prerequisite: 15EI2006Biocontrol Systems
Credits: 3:0:0
Course Objective:

- To understand the basic ideas related to modeling and different modeling techniques of certain physiological systems.
- To analyze physiological system in time and frequency domain.
- To understand the physical and chemical properties of blood.

Course Outcomes:

- Develop mathematical model of physiological system.
- Simulate the physiological system and analyze in time and frequency domain.
- Apply system identification and optimization concepts in modeling.

Systems, Analysis, examplesofphysiologicalcontrolsystems,differencesbetweenengineeringandphysiologicalcontrolsystems.Generalizedsystemproperties,mathematicalapproach,electrical analog,linearmodels,lung mechanics,musclemechanics,distributedparameterversuslumpedparametermodels,staticanalysis,regulation ofcardiacoutput,bloodglucoseregulation,chemicalregulationofventilation,electricalmodelofneuralcontrol mechanism

Physical,chemicalandrheologicalpropertiesofblood,Dynamicsofcirculatorysystem.Biochemistryofdigestion,typesofheatlossfrombody,models ofheattransferbetweensubsystemofhumanbodylikeskincore,etc.andsystemslikewithinbody,body environment,Transportthroughcellsandtubules,diffusion,facilitateddiffusionandactivetransport,methodsofwaste removal,countercurrentmodelofurineformationinnephron,ModelingHenle'sloop.

ModelingoxygenuptakebyRBCandpulmonarycapillaries,Massbalancingbylungs,Gastransportmechanismoflungs,oxygenandcarbondioxidetransportinbloodandtissues.

References:

1. David.O.Cooney,"BiomedicalEngineeringPrinciples".MarcelDeckerPub.Co.2000
2. MichaelC.K.Khoo."PhysiologicalControlSystems".PrenticeHallofIndia. 2000
3. JohnEnderly,SusanBlanchard,JosephBronzino."Introductionto BiomedicalEngineering", Second Edition,AcademicPressSeriesinBiomedicalE ngineering, 2005.

15EI2018 BIOVIRTUAL INSTRUMENTATION LABORATORY

Credit 0:0:2

Course Objective:

- To provide knowledge about data acquisition and control an external measuring device by interfacing to a computer.
- To familiarize in signal conditioning and various processing tools.
- To become competent in designing virtual instruments for various biomedical measurements and applications.

Description:

This laboratory introduces the various applications of virtual instruments in biomedical engineering.

Course Outcome:

- Identify salient traits of a virtual instrument and incorporate these traits in projects.
- Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.
- Recognize the application of Vis in medical instrumentation in developing medical instruments.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

15EI2019 FINITE ELEMENT MODELLING IN BIOMEDICAL ENGINEERING

Credit 3:0:0

Course Objectives:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

Course Outcome:

- Identify mathematical model for solution of biomedical engineering problems.
- Formulate simple problems into finite elements and develop 3D models .
- Use professional-level finite element software to solve problems in dynamics of blood flow, cardiovascular system, etc.

Introduction: Basic concepts- Historical Background -finite element packages- Boundary Value and Initial Value Problem-Weighted Residual Methods-General Procedure of FEA-Element Types and its Characteristics-Concept of Element Assembly-Bandwidth and its effects- Boundary conditions-Aspect Ratio- Pascal's Triangle- Stiffnessmatrix -beam element-Shape Function for Spar element, Beam element-Convergence and Continuous criteria- Structural Problems:Equations of elasticity- plane elasticity problems - Bending of elastic plates .Heat Transfer Problems. One Dimensional Basic equation of heat transfer derivation of finiteelement equation- Fluid Mechanics Problems: incompressible fluid flow-Biomedical Applications:Case studies: FE modeling of blood flow channel, lungs, cardiovascular system, analysis using mechanical solver, electrical solver, electromechanical solver, Vibration analysis using software tools.

References:

1. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003.
2. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elements in Engineering', Prentice Hall of India, 2004.
3. Rao. S.S. "The Finite Element Method in Engineering", Second Edition, PergamonPress,Oxford, 2001.

15EI2020 AMBULATORY SERVICES

Pre requisite: 15EI2003 Biomedical Sensors and Transducers
Credits:3:0:0
Course objectives:

- to understand the need for ambulance services
- to learn the wireless measuring instruments for vital parameter monitoring
- to understand computer based technology in ambulatory services

Course outcomes:

- Appreciate the purpose of ambulatory services to save human life.
- Apply software and hardware required to develop wireless monitoring system
- Design the patient transport and networked services

Patient monitoring systems- artifacts-denoising techniques- Advancements in Wireless patient monitoring-design of ambulance- ambulance train- disaster relief squad- regulation for patient transportation-Lift mechanism- design of mobile services- diagnostic equipments with battery backup-mobile X-ray unit-nursing-medical gas handling-regulations-GPS in ambulance-networked services-accident care- automated alert system- smart systems-fire protection-maintenance and regulation-Arreditation for ambulatory services-Telehealth technology.

References:

1. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Andreas F. Molisch, “Wireless Communications, 2nd Edition, John Wiley &sons,USA, 2010.
3. Jochen Schiller, “Mobile Communications”, Addison Wesley Publishers, 2000.
4. Yi-Bing Lin and ImrichChlamtac, “Wireless and Mobile Network Architecture”, John Wiley and Sons, New Delhi, 2nd Edition, 2001.
5. Feher K., “Wireless Digital Communications”, Prentice Hall of India, New Delhi, 1995.

15EI2021 ERGONOMICS IN HOSPITALS

Pre requisite:15EI2003 Biomedical sensors and Transducers
Credit 3:0:0
Course Objective:

- To introduce the Fundamental terms and concepts of human factors
- To discuss anthropometric, biomechanical and physiological principles and how they are used to optimize human well-being and overall performance.
- To learn signal acquisition, recording and processing of the physiological signals related tohumanstress problem

Course Outcomes:

- Quantify the anthropometric, biomechanical and physiological principles.
- Apply instrumentation techniques for the disability and
- Apply signal processing techniques for analysis and find solutions.

Definition, human technological system, human–machine system, manual, mechanical, automated system, human system reliability, human system modeling, Human Output And Control, material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices, Workplace Design: Applied anthropometry, workspace design and seating, design of computer worktable, case studies. Environmental Conditions Illumination, climate, noise, motion, sound, vibration. Musculoskeletal anatomy, Quantitative models,Measurement of muscle stress,fatigue using EMG, EEG, Modeling of pain. Human body kinematicsand Instrumentation - Instrumentation for the Measurement human body kinematics.Case studies: computer based evaluation of recovery process caused due to limb fractures, cognitive stress to patients.

References:

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Karl Kroemer, HenrikeKroemer, KatrinKroemer-Elbert, “Ergonomics” How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, NewYork, 1993.
4. Martin Helander, A Guide to Ergonomics of Manufacturing, Tata McGrawHill, 1996.
5. Mccormic.E.J., and Sanders.M.S, “Human factors in Engineering and Design”, McGraw Hill, 1992.

15EI2022 SURGICAL ASSIST SYSTEMS

Credits:3:0:0

Course objectives:

- To understand the need for assistive devices
- To understand robot kinematics
- To understand embedded system applications in controlling robot motion

Course Outcomes:

- Write robotic equations of motion
- Design path planning algorithms
- Develop assist devices for surgery

Introduction to Robotics, degree of freedom, path planning, Lagrange equation of motion, kinetics, payload sensors, actuators, gripper- lift mechanism for surgery, special lighting controls, ventillator, heart lung machine, proximity switches, controllers, artificial intelligence, machine vision, design of controllers based on embedded system, human machine interface, case studies.

References:

1. Jacob Rosen, Blake Hannaford, Richard.M.Satava, "Surgical Robotics", Systems Applications and Visions", Springer, 2010.

2. FaridGharagozloo, FarzadNajam,"Robotic surgery", McGrawHill Publishers, US, 2009.First edition.

3. Bruno Siciliano and Lorenzo Sciavicco, "Robotics: Modelling, Planning and Control, Springer, 2010.

4. Bruno Siciliano, OussamaKhatib, "Springer Handbook of Robotics", Springer, 2008.

5. Sebastian Thrun, Wolfram Burgard," Probabilistic Robotics" ,Intelligent Robotics and Autonomous Agents series, 2005

15EI2023 SENSORY AND MOTOR REHABILITATION

Credit: 3:0:0

Course Objective:

- Tofamiliarizewiththetechnologycurrentlyusedtoimprovethequalityoflifeofindividualswith disabilities.
- Know new rehabilitation concepts for future development and applications.
- Understand orthopedic prosthetics and orthotics in rehabilitation.

Course Outcome:

- Choose the appropriate assist device suitable for specific disorder.
- Develop new assist devices for the needy.
- Use limb and prosthetic devices.

Rehabilitationconcepts,Engineeringconceptsinsensoryrehabilitation,motorrehabilitation,communication disorders.Wheeledmobility,Categoriesofwheelchairs,wheelchairstructure&componentdesign,Ergonomicsofwheelchairpropulsion,Powerwheelchairelectricalsystem,Personaltransportation.

Sensoryaidsfortheblind,Rehabilitationofauditorydisorders,treatmentofhearingimpairment,Hearing aids andotherassistivedevices. LanguagedisordersassociatedwithDementia,assessmentandtreatmentofApraxiaandDysarthia. OrthopedicprostheticsandorthoticsinRehabilitation:Fundamentals.Applications:Computer AidedEngineeringincustomizedcomponentdesign,intelligentprostheticknee.Ahierarchically controlledprosthetichand,Aself,aligningorthotickneejoint.Externallypoweredandcontrolled orthoticsandprosthetics.ActiveAboveKneeProstheses, Myo-electrichandandarmprostheses.TheMARCUSIntelligentHandProstheses.

Reference books:

1. BronzinoJ.D.,"TheBiomedicalEngineeringhandbook". Second Edition.Vol. II,CRCpress,Bocaraton, 2000
2. CooperDouglas,A. Hobson." AnIntroductiontoRehabilitation Engineering", CRCPress, 2007
3. Horia,Hicholi,TeodorescuL.,LakmeCJain."IntelligentSystemsand Technologiesin RehabilitationEngineering".First Edition.CRCPress. 2000

15EI2024 HOSPITAL AUTOMATION

Credits:3:0:0

Course Objectives

- To know the need for acquisition and processing of multiple data types
- To learn about power generation, utility and protection system
- To know about distributed and central monitoring functions

Course outcomes:

- Apply the data processing techniques and digital storage and transmit data
- Analyse the need of power generator, its maintenance and energy conservation, fire protection in hospitals
- Use digital computer for central monitoring of parameters

Medical data handling and automation-RFID in record retrival-surveillance system in hospital-building automation-power generator, maintenance, battery-maintenance and troubleshooting, energy conservation-Medical gas production and automation-boiler, blower, compressor, air conditioning, lighting, heating systems, piping, leakage test- fire prevention and safety automation-control room, limit switches, sensors, controllers, alarm system –regulation and standards.

References:

1. Khandpur. R. S., "Handbook of Biomedical Instrumentation", Prentice Hall of India, New Delhi, 2003.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education India, Delhi, 2008.
3. Curtis Johnson, D., "Process Control Instrumentation Technology", Prentice Hall of India,2006.
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989.

5. N.V. Krishnan, Safety in Industry, JaicoPublishery House, 1996.

15EI2025 MEDICAL EQUIPMENT TROUBLESHOOTING AND MAINTENANCE

Pre requisite: 15EI2002 Medical Electronics
Credits:3:0:0
Course Objectives:

- To know about power supply operation and troubleshooting
- To design electrical equipments with safety standards
- To know the principle of medical equipments.

Course Outcomes:

- Identify the reasons for equipment failure.
- Appreciate the need for grounding aspects , maintenance and troubleshooting.
- Design advanced equipments to solve critical problems.

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Testing of electronic components, Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, Safe electrical practice, Cables and standard, Fuse, Transformer testing, CT and PT, Panel wiring, Troubleshooting of X-ray machines, Troubleshooting of ECG recorders, ultrasound machine, patient monitor, ventilator, dialyser, heart lung machine, surgical lights, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

References:

1. Medical Equipment Maintenance Manuel, Ministry of Health and Family Welfare, New Delhi, 2010.
2. Shakti Chatterjee,Aubert Miller, “Biomedical Equipment Repair”, Cengage Learning Technology& Engineering, 2010.
3. David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGrawHill ,Professional edition, 2013.
4. L.Nokes.B.Turton, D.Jennings, T. Flint,”Introduction to Medical Electronics Applications”, A Butterworth Heinemann Title. 1995
5. Joseph F. Dyro, “Clinical engineering handbook, Elsevier Academic Press, 2004.

15EI2026 BIOFLUID AND SOLID MECHANICS

Credits: 3:0:0
Course Objective:

- To learn the laws governing the mechanics & materials used in medicine.
- To introduce the mechanics involved in the blood flow to various vessels and valves.
- To study the breathing mechanism, airway resistance and lung diseases.

Course Outcome:

- Analyze the problems in physiological systems and relate to its characteristic phenomenon

- Apply the mechanical principles in acquiring data,transduction and useful representation for clinical diagnosis.
- Identify the mechanical properties of the human body

Mechanical Properties of Materials used in Medicine, Newton's laws, stress, strain, elasticity, viscoelasticity, Tissue Reactions and Blood Compatibility. BiofluidMechanics**:**Hook's law, Newtonian Fluid, Non Newtonian fluid , Biomechanics of Degenerative Disorders, Hematology & Blood Rheology, Relationship between diameter, Instrumentation for velocity & pressure of blood flow, Cardiac And Respiratory Mechanics: Mechanical properties of blood vessels, Instrumentation for respiratory mechanics. Soft Tissue Mechanics, Orthopedic mechanics, Mechanical properties of cartilages, Mechanical properties of bone, Bio mechanics in orthopedics: Prosthetic design, GAIT, goniometer, accelerometer, sensors and instrumentation techniques for orthopedic mechanics, evaluation and design of manual activities in various occupations.

References:

1. Fung .Y. C., "Biomechanics: Mechanical properties of living tissues", Springer-Verlag, 2nd Edition,2004.
2. NihatOzkaya, Margareta Nordin, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", Springer, 3rd Edition, Verlag, 2012.
3. Duane Knudson, "Fundamentals of Biomechanics", Springer, 2nd Edition, US, 2007.
4. Sahay and Saxena, "Biomechanics", Tata McGraw Hill, New Delhi, 1998.
5. J.B.Park, "Bio-materials - Science and Engineering", Plenum Press, New York, 1984.

15EI2027COMPUTER APPLICATIONS IN MODELLING OF PHYSIOLOGICAL SYSTEM

Pre requisite: 15EI2017 Modeling of physiological systems
Credits: 3:0:0
Course Objectives:

- To understand the modeling of physiological system
- To know the simulation tools and techniques
- To use software tools for simulation and analysis

Course Outcomes:

- To learn the modeling tools in softwares
- To analyse the characteristics of physiological system
- To develop graphic user interface which helps as a tool for diagnosis.

Modeling of physiological system, electrical equivalent network-simulation, modeling of fluid flow characteristics of cardiovascular system – simulation, microsensor design and analysis, modeling and simulation of cardiac system, glucose regulation system, modeling and simulation of anesthesia, modeling of bones using finite element techniques and analysis.

References:

1. Myer Kutz, “Biomedical engineering and design Hand book”, CRC press, UK, 2004.
2. Sanjay Gupta, Joseph John, “Virtual Instrumentation using LabVIEW”, Tata McGraw Hill publishing, New Delhi, 2005**.**
3. MiChael.C.Khoo, “Physiological control systems -Analysis, simulation and estimation”,Prentice Hall of India Pvt Ltd, New Delhi, 2001.
4. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, PHI Learning Pvt. Ltd., 2010.

15EI2028 BIOMEDICAL OPTICS

Credit 3:0:0

Course Objective:

- To offer clear understanding of tissue characteristics when it is exposed to optical energy.
- To know about various optical sources and applications of lasers.
- To learnabout Holography and its medical applications.

Course Outcome:

- Analyze the optical properties of tissues and light interactions with tissues.
- Use optical sources for instrumentation and measurement.
- Apply photo dynamic therapy and optical holography for biomedical applications.

Optical properties of the tissues: Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction withtissues, optothermal interaction, fluorescence, speckles. Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressurearc lamp, solid state LEDs, LASERs, optical filters, polarisers, solid state detectors, time resolved and phase, resolved detectors, Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.Wave fronts, Interference patterns, principle of hologram, optical hologram, applications, Near field imaging of biological structures, in vitro clinical diagnostic, fluorescent spectroscopy, photodynamictherapy.

References:

1. Tuan Vo Dirh, Biomedical photonics – Handbook , CRC Press, Bocaraton, 2003.
2. Leon Goldman, M.D., &R.James Rockwell, Jr., Lasers in Medicine , Gordon and Breach, SciencePublishers Inc., New York, 1971.

15EI2029 PATIENT AND DEVICE SAFETY

Credits: 3:0:0

Course Objective:

- To provide a source of useful ideas, concepts, and techniques that could be selectively applied to reduce an intolerable rate of unacceptable errors, mistakes, goofs, or shortcomings in expected Medical Device performance.
- To avoid patient injury, achieving efficacious treatment, and controlling health care costs.
- Medical error has proved to be a difficult and recalcitrant phenomenon.

Course Outcome:

- Develop medical equipment that conforms to safety standards.

- Suggest reasonable, acceptable, and more effective remedies and countermeasures in medical device errors.
- Apply appropriate safety regulations to medical devices.

Reliability, Types of reliability, The concept of failure, Causes of failure, Types of Failures in Medical devices, Safety testing, Failure assessment and Documentation, Visual inspection: External & Internal visual inspection. Measurement, Safety parameters, Safety and risk management, Manufacturer's and physician's responsibilities. Safe medical devices, operation – Medical Application safety. Environmental safety, Interference with the environment,Ecological safety. Electrical Safety, Limitation of Voltages ,Macroshock and Microshock, Earth and Protection, Leakage currents, Magnetic fields and compatibility.
Medical Standards and Regulations – Device classification – Registration and listing – Declaration of conformance to a recognized standard – Investigational Device Exemptions (IDEs) – Institutional Review Boards (IRBs) – IDE format – Good laboratory practices (GLPs) – Good manufacturing practices (GMPs) – Human factors – Design control – The Medical Devices Directives (MDD) – Definition, Process and choosing the appropriate directive – Active Implantable Medical Devices Directive (AIMDD) – In Vitro Diagnostic Medical Devices Directive (IVDMDD).

References:

1. Bertil Jacobson and Alan Murray, "Medical Devices Use and Safety", Elsvier Limited,2007.
2. Richard Fries,"Reliable Design of Medical Devices – Second Edition", CRC Press,Taylor& Francis Group, 2006.
3. Norbert Leitgeb "SafetyofElectromedicalDevicesLaw – Risks – Opportunities",SpringerVerlog/Wein, 2010.
4. Gordon R Higson, "Medical Device Safety – The regulation of Medical Devices forPublic Health and Safety", IOP Publishing Limited, Bristol and Philadelphia, 2002.

15EI2030 ICU AND OPERATION THEATRE EQUIPMENTS

Credit: 3:0:0
Course Objective:

- To offer clear understanding of various intensive care equipment and their working.
- To understand the necessity of different operation theatre equipment.
- To know about different dialyzers and ventilators.

Course Outcome:

- Apply the knowledge acquired, in designing new monitoring devices for ICU.
- Suggest suitable surgical instruments and operational devices.
- Assist the medical personnel's during emergency situations in the ICU.

Suctionapparatus,Differenttypes;Sterilizers, Chemical,Radiation,Steamforsmallandlargerunits.Automateddrugdeliverysystems,Infusionpumps,closedloopcontrolinfusionsystem,implantableinfusion system.HemodialysisMachine,DifferenttypesofDialyzers,Membranes,Machinecontrolsandmeas

urements.HeartLungMachine,differenttypesofoxygenators,peristalticpumps,Incubators.
OperationTheatreEquipment**:**
Surgicaldiathermy,Instrumentsforoperation.AnesthesiaEquipment,Humidification,Sterilization aspects,Boylesapparatus.CentralizedOxygen,Nitrogen,Airsupply&Suction.CentralizedAirConditioning,OperationTheatretable&Lighting.Patientelectricalsafety,
Typesofhazards,Naturalprotectivemechanismsagainstelectricity,Leakagecurrent,Inspectionofgroundingandpatientisolation,Hazardsinoperationrooms,ICCUandIMCUs,
OptocouplersandPulsetransformers.

References:

1. Khandpur,R.S,"HandbookofBiomedicalInstrumentation ",Second Edition. TataMcGrawHillPub.Co., Ltd. 2003
2. John, G. Webster. MedicalInstrumentation,ApplicationandDesign. Second Edition. JohnWiley&sons, Inc.,NewYork.2008.
3. JosephDubovy, IntroductiontoBiomedical.McGrawHillCo.1978
4. TerryBahil.A, BiomedicalandClinicalEngineering.PrenticeHallInc.1981

15EI2031 MEDICAL ETHICS

Credit: 3:0:0

Course Objective:

- Achieve familiarity with some basic ethical framework& understand how these ethical frame works can help us to think through contemporary questions in medical ethics.
- To know about the legal and ethical principles and application of these in medical field.
- Gain knowledge about the medical standards that to befollowed in hospitals.

Course Outcome:

- Apply the moral values and ethics in their work environment
- Maintain the confidentiality issues in medical practice.
- Suggest standards that are patient centered.

Introduction to medical ethics: Definition of Medical ethics, Scope of ethics in medicine, American medical Association code ofethics, CMA code of ethics- Fundamental Responsibilities,The Doctor and the Patient, The Doctorand the Profession, Professional Independence, The Doctor and Society.Ethical theories & moral principles:Theories-Deontology& Utilitarianism,Casuist theory, Virtue theory, The Right Theory. Principles - Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medicalpractice, Ethical Issues in biomedical research,Bioethical issues in Human Genetics & ReproductiveMedicine. Hospital accreditation standards,Accrediation- JCI Accreditation & its Policies. Patient centered standards, Healthcare Organizationmanagement standards.Hospital safety standards: Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat,Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systemsfor Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions,Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing,Maintaining, and Inspecting Medical Equipment.

References:

1. Domiel A Vallero "Biomedical Ethics for Engineers", Elsevier Pub.1st edition, 2007
2. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada. 2009
3. Robert M Veatch" Basics of Bio Ethics", Second Edition. Prentice- Hall,Inc. 2003

15EI2032BIOELECTRIC PHENOMENA

Credits: 3:0:0

Course Objective:

- To offer clear understanding of ionic activity in cells and generation of action potential.
- To know about generation and conduction of cardiac, nervous and muscular action potentials.
- To impart knowledge on the measurement and recording of the various biopotentials.

Course Outcome:

- Analyze the ionic activity in cells and generation of action potential.
- Interpret the cardiac, nervous and muscular action potentials for diagnostic purpose.
- Measure and recordthe various biopotentials.

Cell membrane: Structure, Excitable cells, Nernst potential, Resting membrane potential, Polarized state, Goldman Hodgkin Katz equation, Action potential , Propagation of nerve impulses, Refractory period,Hodgkin Huxley model of squid gait axon membranes, Modes of transport of substances across the cell membranes. Electrical activity of the heart: Cardiac muscle, Action potentials in cardiac muscle, SA node, Origin and propagation of rhythmical excitation & contraction, refractoriness, regular and ectopic pace makers, Electrocardiogram, Arrhythmias, Electrical activity of brain – Sleep stages, Brain waves, waveforms & measurements, 10-20 electrode system , Evoked potentials , Magnetoencephalogram, Electrogastrogram, Electroretinogram, Electroocculogram. Electrical activity of muscles – neuromuscular junction, synaptic potentials, motor unit, motor unit action potentials, Electromyogram ,Electrodes for measurement of biopotentials, electrode tissue interfaces , Polarizable and non polarizable electrodes , skin contact impedance. Electroneurogram – nerve conduction studies.

References:

1. Arthur C. Guyton : Textbook of Medical Physiology, Prism Books (Pvt) Ltd & W.B. Saunders Company, 12th edition, 2012
2. D.J. Aidley: The Physiology of Excitable cells, 3rd Ed., Cambridge University Press, 4th edition, 1998
3. John G. Webster: Medical Instrumentation - Application and Design; Houghton Mifflin Co., Boston, 3rd edition, 2009.
4. Richard Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1st edition, 1990.
5. Khandpur R S: Handbook of Medical Instrumentation, Tata McGraw Hill, New Delhi.2004.

15EI2033 MEMS SENSOR TECHNOLOGY

Credits: 3:0:0

Course Objective:

- To introduce the theories and concepts of microelectromechanical systems.
- To know about the materials used and the manufacture of MEMS
- To impart knowledge on the various types of Microsystems and their applications in medical field.

Course Outcome:

- Analyze the theories and concepts of microelectromechanical systems.
- Apply the fundamentals in the manufacture of MEMS
- Analyze the various types of Microsystems and their applications in medical field.

IntroductiontoMEMS:HistoricalBackground,SmartMaterialsandStructures.Microsystemsandtheiradvantages.Materialsused.TechnologyinvolvedinMEMS.GeneralapplicationsinAerospace,automotiveindustryandhealthcare.Marketsizeandworldscenario.
Micromachiningtechnology:lithography,etching,ionimplantation,waferbonding,integratedprocessing,bulkmicromachining,surfacemicro,
machining,coatingtechnologyandCVD,LIGAprocess.PrinciplesofMicrosystems:generalprinciples,microsensors,pressuresensors,actuators,electrostaticforces,piezo-electriccrystals,intelligentmaterialsandstructures.
MEMSapplicationsinmedicine(BIOMEMS):specialfeatures/requirementsformedicalapplication.CurrentscenarioofMEMSforhealthcare.DrugdeliverysystemandMEMS.Applicationmodels,bloodpressuresensors,biochip,microneedles,microelectrodes,neuralprosthesis,andcatheterendsensors.
IntroductiontoNanotechnology:Nanomaterials,Nanomaterialsfabricationbybottom,
upandTopdownapproaches,ClassificationofNanodevicesbasedonthecharacteristics,MedicaluseofNanomaterials.

Reference books:

1. SergeyEdwardLysherski.NanoandMicro-electromechanicalsystems.Second Edition.CRCPress.2005
2. WanjunWang,StevenA. Soper, BioMEMSTechnologiesandApplications.CRCPress. 2006

3.N.P.Mahalik, Micromanufacturing&Nanotechnology.Springer. 2006

15EI2034BIOMETRICSYSTEMS

Credits: 3:0:0

Course Objective:

- To introduce the basic concepts of fingerprint, iris, face and speech recognition.
- To impart knowledge on the general principles of design of biometric systems and the underlying trade-offs
- To render knowledge on personal privacy and security implications of biometrics based identification technology and the issues realized

Course Outcome:

- Apply the technologies of fingerprint, iris, face and speech recognition.
- Analyze the general principles of design of biometric systems and the underlying trade-offs.
- Inculcate knowledge on personal privacy and security implications of biometrics based identification technology and the issues involved.

Introduction and back ground, Biometric technologies, Biometric systems, Enrollment, templates, verification, Biometric applications, biometric characteristics, Authentication technologies -Need , Protecting privacy and biometrics and policy.
Fingerprint pattern recognition, modeling of fingerprint images, fingerprint classification, fingerprint matching. Introduction to face recognition, Neural networks for face recognition, face recognition from correspondence maps, Hand geometry, scanning, Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification, Biometric fusion. Voice Scan, physiological biometrics, Behavioral Biometrics, Introduction to multimodal biometric system, Integration strategies, Architecture, level of fusion, combination strategy, training and adaptability, examples of multimodal biometric systems, Performance evaluation-Statistical Measures of Biometrics ,Memory requirement and allocation.
Introduction - Biometric Authentication Methods, Biometric Authentication Systems, Support Vector Machines. Securing and trusting a biometric transaction, matching location, local host - authentication server, match on card (MOC), Multibiometrics and Two-Factor Authentication.

References:

1. James Wayman, Anil Jain, DavideMaltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" Prentice Hall, 2005
3. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
4. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003
5. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition" CRC Press, 1999.

15EI2035 IONIZING AND NON-IONIZING RADIATION

Credit 3:0:0

Course Objective:

- To expose the student to the use of ionizing radition and its biological effects in the medical field.
- To know about the use of ionizing radiation in medical and industrial applications.
- To understand the biological effects of low and high doses of ionizing radiation.

Course Outcome:

- Analyze the effect of radiation at cellular level.
- Analyze the effect of microwave on human organs and systems.
- Suggest suitable diagnostic and therapeutic devices to prevent unnecessary effects due to radiations.

Action of radiation in living cells: Various theories related to radiation at cellular level. Dna and chromosomal damages.Somatic application of radiation.Radio sensitivity protocols of different tissues of human. Ld50/30 effective radiation on skin, bone marrow,Eye, endocrine glands, and basis of radio therapy.Genetic effects of radiation: Threshold and linear dose, gene control hereditary diseases effect of dose.Effect of microwave: Effects on various human organs and systems. Wavelength in tissue, non thermal interaction.Standards ofProtection, national and international standards and precautions.UV radiation, Classification of sources, measurement, photo medicine, uv radiation safety visible and infrared radiation.

References:

1. Mary Alice S, Paula J Visconti, E Russell Ritenour, Kelli Haynes," Radiation Protection In medical Radiography,"Elsevier Health Sciences,2014
2. GlasserO.,"Medical Physics", Volume I,II,III,The year book publishers inc, chicago 1980.
3. Moselly H., "Non ionizing radiation", Adam-hilgar, Bristol 1988.

15EI2036 RADIATION ANDNUCLEARMEDICINE

Credits: 3:0:0

Course Objective:

- To introduce the basic principles radiology,computer tomography and nuclear medicine.
- To impart knowledge on radioactivity, radiation measurement techniques and detectors
- To render knowledge on phototherapy, radioisotopes,application areas and hazards of radiation

Course Outcome:

- Analyze the basic principles radiology,computer tomography and nuclear medicine.
- Apply the knowledgeacquired on radioactivity, radiation measurement techniques and detectors.
- Inculcate knowledge on phototherapy, radioisotopes, application areas and hazards of radiation.

X-Rayspectrum, ProductionofX-rays,ModernX-raytubes, QualityofX-rays,Photographic effectsonX-rayfilms,Fluorescent and Intensifyingscreen, Scatteredrays, Useoffilters, HVL, Collimators,Cones,BuckyGrids, Fluoroscopy,Imageintensifier,DigitalRadiography,Computed Tomography(CT).Basiccharacteristics andunits ofradioactivity, Ionizationchamber,GMtubes,Gasfilleddetectors, scintillationdetectors, semiconductordetectors,Liquidscintillationcounter, Statisticalaspectsofnuclear medicine.
Rectilinearscanners,
ScintillationCamera,principleofoperation,collimator,photomultipliertube,PulseheightAnalyzer,computerizedmulticrystalGammacamera,PrinciplesofPETandSPECT.PrinciplesofRadiationTherapy,RadiotherapytreatmentplanningDoseinRadiotherapy, Mega voltagetherapy,IntensitymodulatedRadiationtherapy, Brachy-therapy, Radiotherapyusingradio isotopes.
Radiationsensitivityofbiologicalmaterials,Evidenceonradiobiologicaldamagefromcellsurvival

curve,Radiationeffectsonhumans,Maximumpermissibledoseequivalentlimits,Hazardfrom ingestedradioactivity,substances,ICRPregulations,Qualityfactorandsievert,Principlesofradiological protection,personneldosimetry.

References:

1. Dendy,P.P&Heaton.B, PhysicsforRadiologists.Third Edition.CharlesC.Thomas PublisherS.A.,2000
2. .Khan,F.M, PhysicsforRadiationTherapy, Williams&Wilkins.2009
3. GopalB.Saha, PhysicsandRadiation biologyofNuclearMedicine.2006
4. PenelopeJ.Allisy, RobertsObefipsm. Farr'sPhysicsforMedicalImaging,Ferry Williams.2007

15EI2037INTELLIGENT INSTRUMENTATION SYSTEM

Credits: 3:0:0

Course Objective:

- To introduce the basic principles of embedded systems.
- To impart knowledge on the design of embedded systems,memory requirements and interfacing.
- To render knowledge on real time operating systems and software development tools.

Course Outcome:

- Design interfacing circuits to acquire real time data and process it using software.
- Develop intelligent instrumentation systems for biomedical applications.
- Use communication protocols for data transmission.

Conceptofembeddedsystemsdesign,Embeddedmicrocontrollercores,embeddedmemories,Examples ofembeddedsystem, Designchallengesinembeddedsystem Design.
Serialdatacommunication, Microcomputerbasedcontrolsystems.
Issues in sensor interfacing, Interfacing Keyboard displays, signalconditioning, interfacingwithexternalsystems, user interfacing,ADC, DAC, relay, optoisolator, LEDs. Process parameter measurement system. (DAQ), Digital Weighing machine, Embedded Implementation of temperature controller, Speed control of DC motor. Frequency counter. Stepper motor control.
Introductiontorealtimeoperatingsystems:Tasksandtaskstates, tasksanddata, semaphoresandshareddata, messagequeues,mailboxesandpipes, timerfunctions, Events, memorymanagement, InterruptroutinesinanRTOS environment.Emulator,Simulators, Hostandtargetmachines, Linkers/locatorsforembeddedsoftware, gettingembedded softwareintothetargetsystemandtestingonhostmachine.

References:

1. A.Rajkamal, "Embeddedsystems,Architecture,Programminganddesign",Tata McGrawHill,New Delhi.2008
2. David.E.Simon, AnEmbeddedSoftwarePrimer.AddisonWesley,New Delhi. 2001
3. MichealPredko,MykePredko, PICMicrocontrollerPocketReference.McGraw Hill,NewDelhi.2000
4. WayneWolf.

ComputersasComponents:PrinciplesofEmbeddedComputerSystemDesign.Morgan Kaufman. 2004
5. John.B. Peatman, DesignwithPICMicrocontrollers.PrenticeHall,NewDelhi.2006

15EI2038 MODERN AUTOMOTIVE AND INTELLIGENT SYSTEMS

Credits: 3:0:0

Course Objective:

- To understand the basic knowledge about the Automotive Industry.
- To understand the fundamentals of Modern automotive systems.
- To understand the fundamentals of safety systems.

Course Outcome:

- Identifying the challenges of electronics in modern automobile.
- Gaining fundamental knowledge about the physical system.
- Explore potential new functions and applications.

Description

Vehicle classifications, Modern automotive systems , need and application areas for electronics in automobiles, Sensors and actuators, Possibilities and challenges in automotive industry, Enabling technologies and industry trends-Ignition systems , Fuel delivery system and control, Engine control functions, modes and diagnostics. Transmission fundamentals, Types, Components, Electronic transmission control-Shift point control, Lockup control/torque converter clutch, Engine torque control during shifting, Safety and diagnostic functions, Improvement of shift quality Vehicle braking fundamentals and its dynamics during braking, Brake system components, Antilock braking systems, Components and control logic, Electronic stability, Steering system basics, Fundamentals of electronically controlled power steering: type, Electronically controlled hydraulic system, Electric power steering Active Passive and Functional Safety.

References:

1. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth-Heinemann, Elsevier Incorporation, Massachusetts, 7th Edition, 2012.
2. Tom Denton "Automotive Electrical and Electronic Systems", Butterworth-Heinemann, Elsevier Incorporation,2009.
3. Jack Erjavec, "Automotive Technology- A System Approach", Thomas Delmar Learning, New York, 3rd Edition, 2004.
4. Ronald K. Jurgrn, "Automotive Electronics Handbook", McGraw Hill Incorporation, New York, 2nd Edition, 2007.
5. Robert Bosch, "Automotive Electrical and Electronics", Robert Bosch, Germany, 3rd Edition, 1999.

15EI2039 AUTOMOTIVE CONTROL AND HIL SIMULATION

Credits: 3:0:0

Course Objective:

- To understand need for simulation and co-simulation
- To understand the Real time prototyping
- To understand the concept of SIL, MIL and HIL

Course Outcome:

- Ability to work with integrated platforms
- Ability to generate model based codes
- Skills to develop and validate the controller

Description:

Model Based system design, HIL simulation, need Basics of continuous and discrete simulation, modelling basics. Connection between Hardware and Simulation, Event Discrete simulation. xPc target, Real Time Workshops, state flow and Real Time Embedded coder. Using Simulink: for plant model, controller (PID) designs for an automotive application. Analog output, targeting a processor for plant. System modelling and validation using test setup. Interfacing of software models with hardware design. System programming and development of experimental setup for hardware in loop simulation. HIL: Separate and In the loop testing of plant and controller system verification and Validation: Comparing the HIL test results with real world result, Hardware in-the-loop testing.

References:

1. Christain Kohler, "Enhancing Embedded systems Simulation: A Chip-Hardware-in-the-Loop Simulation Framework", Viewe+TeubnerVerlag/Springer, Germany, 1st Edition,2011.
2. GaberialNicolescu, Pieter J. Mosterman, "Model-Based Design For Embedded Systems", CRC Press, Boca Raton,2010
3. Fabio Patern, "Model -based Design and Evaluation of Interaction Applications", Springer-Verlag, Germany, 2000.
4. Mathworks Courseware, "InTroducing to Model-Based System Design"
5. Mathworks Courseware, "Advanced Model-Based System Design"

15EI2040 AUTOMOBILE ELECTRIC AND ELECTRONICS SYSTEM

Credits: 3:0:0

Course Objective:

- To understand the automotive electrical and electronics systems

- To understand the design aspect with respect to EMI/EMC
- To understand the safety constrains associated with electrical systems

Course Outcome:

- Gain fundamental knowledge about the physical system
- Ability to develop integrated control system
- Explore potential new functions and applications

Description:

Electrical systems and circuits, EMI/EMC, Earthing , Positive and negative Relays, Charging systems, Starting systems, Ignition systems, Electronic Ignition system, Electronic fuel control, Interior and Exterior lighting Windscreen washers and wipers, Horns ,Chassis electrical systems comfort and safety ,Seats ,mirrors and sun-roofs, Central locking and electric windows, Cruise control, In-car multimedia, Security, Airbags and belt tensioners, Other safety and comfort systems, Diagnosing comfort and safety system faults, Active Passive and Functional Safety, Advanced comfort and safety systems technology, New developments in comfort and safety systems

References:

1. James D. Haldermen , ”Automotive Electricity and Electronics”, Prentice Hall ,New Jersey,4th Edition,2013.
2. Tom Denton, ”Automobile Electrical and Electronic Systems”, Elsevier Butterworth-Heinemann,Oxford,3rd Edition,2004.
3. Robert Bosch GmBH ,”Bosch Automotive Hand Book”, Bentley publishers,8th Edition,Cambridge,2011.

15EI2041 AUTOMOTIVE IN-VEHICLE COMMUNICATION SYSTEM

Credits: 3:0:0

Course Objective:

- To understand the need for in vehicle communication.
- To analyze automotive communication protocols.
- To understand the automotive standards for communication.

Course Outcome:

- Depth knowledge on data communication and networking.
- Ability to select the suitable protocol for an application.
- Ability to integrate different communication platforms.

Needs and benefits of IVN, Classes of IVN Protocols, Multiplexed electrical systems, Vehicle multiplexing, Bitwise contention, Network elasticity, Error processing and management. Overview of the automotive communication protocols: TCP/IP, CAN, LIN, Flexray, MOST: Features, Specifications, baud rate, timing, synchronizing, error detection and correction mechanisms, frames, standards, advantages and limitation. Cross protocol compatibility, gateway ECU,

Comparison of different IVN protocols.

References:

1. Gilbert Held, "Inter and Intra Vehicle Communications", Auerbach Publications, CRC Press, Boca Raton, 2007.
2. Behrouz Forouzan, "Data Communications and Networking", McGraw-Hill Limited, NewYork, 4th Edition, 2006
3. Ronald K. Jurgen, "Automotive Electronics Handbook", McGraw-Hill Incorporation, NewYork, 1999
4. Marc Emmelmman, BrendBochow, Christopher Kellum, "Vehicular Networking : Automotive Applications and Beyond", John Wley& Sons, 2010
5. Robert Bosch, "Bosch Automotive Networking: Expert know-how on Automotive Technology", Bently Publishers, Cambridge, 2007

15EI2042 AUTOMOTIVE TELEMATICS AND INFOTAINMENT

Credits: 3:0:0

Course Objective:

- To understand the role of Telematics and Infotainment
- To understand the role of electronics in driver assistant system
- To understand the role of inter vehicle communication

Course Outcome:

- Depth knowledge about different assistive system
- Ability to explore new infotainment system
- Ability to develop fleet management system

Description:

Driver Assistance Systems: driver support systems, Vehicle support systems, Safety Systems: Anti - spin regulation, traction control systems Security Systems: Anti-theft technologies, smart card system, number plate coding. Comfort Systems Adaptive cruise control, adaptive noise control, active roll control system, cylinder cut- off technology. Telematics basics, applications and technologies: HUD, Global Positioning Systems (GPS), Inertial Navigation Systems (INS), Vehicle Location and Navigation, Bluetooth, UWB, RFID, Intelligent Transportation Systems (ITS) and Wireless Access in Vehicular Environments (WAVE), Communications, Air-interface, Long and Medium range (CALM), Real-time management and planning of commercial vehicle operation, Satellite Radio(XM-Radio and SIRIUS), Fleet Management

References:

1. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth-Heinemann, Elsevier Incorporation, Massachusetts, 7th Edition, 2012.
2. Dennis Foy, "Automotive Telematics: The One-stop Guide to In-vehicle Telematics and Infotainment Technology and Applications, Red Hat Publishing Company Incorporation, Maryland, 2002.

3. LjuboVlacic, Michel Parent, Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001.
4. Robert Bosch GmBH, "Bosch Automotive Hand Book", Bentley Publishers, 8th Edition, Cambridge, 2011.
5. Ronald K Jurgen, "Navigation and Intelligent Transportation Systems – Progress in Technology", Automotive Electronics Series, SAE, USA, 1998.

15EI2043AUTOMOTIVE FAULT DIAGNOSTICS

Credits: 3:0:0

Course Objective:

- To understand the importance about diagnostics
- To understand the methods of diagnostics
- To understand the tools available for fault diagnostics

Course Outcome:

- Knowledge about different diagnostic tools
- Depth knowledge about the diagnostic process
- Ability to identify the faults on the vehicle

Description:

Need for diagnostics, Circuit testing, Vehicle specific details, The 'six-steps' approach, Skills required for effective diagnosis, An approach to fault finding, Tools and equipment, Oscilloscope diagnostics, On-board diagnostics, Diagnostics of Engine system, chassis System, Electrical and Transmission system.

References:

1. Allan W. M. Bonnick, "Automotive Computer Controlled Systems Diagnostic tools and techniques", Butterworth-Heinemann, Oxford, 1st Edition, 2001.
2. Tom Denton, "Advanced Automotive Fault Diagnosis", Elsevier Butterworth-Heinemann, Oxford, 2nd Edition, 2006.
3. Tracy Martin, "How to Diagnose and Repair Automotive Electrical Systems", Motor Books/MBl Publishing Company, London, 1st Edition, 2005.
4. James D. Halderman Jim Linder Automotive Fuel And Emissions Control Systems third edition Pearson Education, 2012.
5. AlexanderA.Stotsky, "Automotive Engines Control, Estimation, Statistical Detection"Springer-Verlog, Berlin Heidelberg 2009.