RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2020 – 2021

MEDICAL ELECTRONICS

III & IV SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 13 UG programs and 15 PG programs. All these programs are approved by AICTE. All the UG programs & 09 PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with 'A' grade by NAAC in 2014. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs till the year 2029. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility to all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), an initiative of Ministry of Human Resource Development (MHRD), Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. It has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions

in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework, MHRD, Government of India, M S Ramaiah Institute of Technology has achieved 59th rank among 1071 top Engineering institutions of India for the year 2020 and 1st rank amongst Engineering colleges (VTU) in Karnataka.

About the Department

The Medical Electronics department at Ramaiah Institute of Technology (MSRIT), Bangalore was started in the year 1996. The department is offering 4-year full time B. E. degree course in Medical Electronics, affiliated to VTU, Belgaum, recognized by Government of Karnataka, approved by AICTE, New Delhi and accredited by NBA. The department is located at Lecture Hall Complex of RIT Campus. The department consists of a highly motivated & qualified faculty and dedicated supporting staff headed by Dr. N. Sriraam, Academy-industry experienced Professor with specialization in biomedical signal processing.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

Provide quality education, motivational academic environment and foster a conducive Institute-industrial relationship to empower the students to face the real-time challenges in the field of engineering and medicine

MISSION OF THE DEPARTMENT

The department shall transform the entrant of the program into professionally competent engineers through innovative curricula, research, practical training and effective collaboration with industry, hospital and academia

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Solve the real-life engineering problems by employing the knowledge and skills of Medical Electronics

PEO 2: Provide a multi-disciplinary environment to link engineering and medical domains

PEO 3: Inculcate professional and ethical values in lifelong learning process

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Acquire and comprehend the basic skill sets of mathematical approaches along with analog and digital electronics essential in the development of biomedical systems

PSO2: Provide hardware and software oriented real-time solutions in healthcare using the knowledge of Biomedical electronics and instrumentation

PSO3: Utilize the concepts of advanced clinical engineering to cater to the requirements of healthcare oriented applications

Curriculum Course Credits Distribution

Semester	Humanities & Social Sciences (HSS)	Basic Sciences/ Lab (BS)	Engineering Sciences/ Lab (ES)	Professional Courses- Core (Hard core, soft core, Lab) (PC-C)	Professional Courses - Electives (PC-E)	Other Electives (OE)	Project Work (PW)	Internship/ other activities (IS/ OA)	Total semester load
First	-	9	11	-	-	-	-	-	**20**
Second	2	8	10	-	-	-	-	-	**20**
Third	-	4	3	18	-	-	-	-	**25**
Fourth	-	7	-	18	-	-	-	-	**25**
Fifth	3	-	-	15	3	3	-	--	**24**
Sixth	-	-	-	11	3	3	4	-	**21**
Seventh	3	-	-	10	6	-	-	1	**20**
Eighth	-	-	-	-	3	-	14	3	**20**
Total	**8**	**28**	**24**	**72**	**15**	**6**	**18**	**4**	**175**

SCHEME OF TEACHING
III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	ML31	Engineering Mathematics-III	BS	3	1	0	4	5
2	ML32	Analog and Digital Electronics Circuits	PC-C	4	0	0	4	4
3	ML33	Control Systems	PC-C	3	1	0	4	5
4	ML34	Signal Processing	PC-C	3	1	0	4	5
5	ML35	Human Anatomy	PC-C	2	0	0	2	2
	ML36	Human Physiology	PC-C	2	0	0	2	2
6	ML37	Object Oriented Programming (OOP)	PC-C	3	0	0	3	3
7	MLL38	Analog and Digital Electronics circuits Lab	PC-C	0	0	1	1	2
8	MLL39	Object Oriented Programming Lab	PC-C	0	0	1	1	2
Total				**20**	**3**	**2**	**25**	**30**

L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. **The Non Credit Mandatory Course, Additional Mathematics – I** is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	AM31	Additional Mathematics - I	BSC	0	0	0	0	3

2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	ML41	Engineering Mathematics-IV	BS	3	1	0	4	5
2	ML42	Linear Integrated Circuits and its Applications	PC-C	4	0	0	4	4
3	ML43	Biomedical Signal Processing	PC-C	3	1	0	4	5
4	ML44	Digital Image Processing	PC-C	3	1	0	4	5
5	ML45	Biomedical Instrumentation-I	PC-C	3	0	0	3	3
6	ML46	Microcontroller –MSP430	PC-C	4	0	0	4	4
7	MLL47	Linear Integrated Circuits Lab	PC-C	0	0	1	1	2
8	MLL48	Microcontroller –MSP430 Lab	PC-C	0	0	1	1	2
Total				**20**	**3**	**2**	**25**	**30**

L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. **The Non Credit Mandatory Course, Additional Mathematics – II** is prescribed for IV Semester Lateral Entry Diploma students admitted to BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	AM41	Additional Mathematics - II	BSC	0	0	0	0	3

2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points, Eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

ENGINEERING MATHEMATICS III

Course code: ML31

Credits: 3:1:0 **Contact hours: 42+28**

Course Coordinators: Dr. M.V. Govindaraju and Dr. M. Girinath Reddy

Course contents

UNIT I

Numerical solution of Algebraic and Transcendental equations: Method of false position, Newton - Raphson method.

Numerical solution of Ordinary differential equations: Taylor's series method, Euler's and modified Euler's method, fourth order Runge-Kutta method.

Statistics: Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves. Correlation and Regression. Application to Engineering problems.

UNIT II

Linear Algebra: Elementary transformations on a matrix, Echelon form of a matrix, rank of a matrix, Consistency of system of linear equations, Gauss elimination and Gauss – Seidel method to solve system of linear equations, Eigen values and Eigen vectors of a matrix, Rayleigh power method to determine the dominant Eigen value of a matrix, Diagonalization of square matrices, Solution of system of ODEs using matrix method. Application to Engineering problems.

UNIT III

Complex Variables-I: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions.

Transformations: Conformal transformation, Discussion of the transformations - $w = z^2, w = e^z$ and $w = z + \frac{a^2}{z}$ $(z \neq 0)$, Bilinear transformation.

UNIT IV

Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula. Taylor and Laurent series (statements only). Singularities, Poles and residues, Cauchy residue theorem.

UNIT V

Fourier series: Convergence and divergence of infinite series of positive terms. Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period. Half range Fourier series. Applications to Engineering problems: Fourier series for Periodic square wave, Half wave rectifier, Full wave rectifier, Saw-tooth wave with graphical representation, Practical harmonic analysis.

Text Books

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.

Reference Books

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.
2. Dennis G. Zill, Michael R. Cullen - Advanced Engineering Mathematics, Jones and Barlett Publishers Inc. – 3rdedition – 2009.
3. Dennis G. Zill and Patric D. Shanahan- A first course in complex analysis with applications- Jones and Bartlett publishers-2nd edition-2009.

Course Outcomes (COs):

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

1. Apply numerical techniques to solve engineering problems and fit a least squares curve to the given data. (PO-1,2 & PSO-1)
2. Test the system of linear equations for consistency and solve system of ODE's using matrix method. (PO-1,2 & PSO-1)
3. Examine and construct the analytic functions. (PO-1,2 & PSO-1)
4. Classify singularities of complex functions and evaluate complex integrals. (PO-1,2 & PSO-1)
5. Construct the Fourier series expansion of a function/tabulated data. (PO-1,2 & PSO-1)

ANALOG AND DIGITAL ELECTRONICS CIRCUITS

Course code:ML32

Credits: 4:0:0 **Contact hours: 56**

Course Coordinators: Ms. Prabhu Ravikala Vittal, Ms. Uma Arun

Course contents

UNIT I

Diodes and Transistors: Types of diodes, Application in various contexts, comparison of different transistor configuration (CE, CB, CC),Design of RC Coupled amplifier, characteristics parameters and impedance measurement.

UNIT II

Transistor Amplifiers: Design of CC Amplifier (Emitter follower), Darlington emitter follower, Power amplifier and types, multistage amplifier, feedback amplifiers, types-positive and negative feedback , advantages.

UNIT III

Introduction to digital logic families: Digital IC Terminology, The TTL Logic Family, TTL loading and Fan out, MOS Technology, Digital MOSFET circuits, Complementary MOS Logic, Tristate (Three-State) Logic outputs, ECL digital logic family, Comparative study of data sheets of TTL and CMOS circuits for NAND gate.

UNIT IV

Combinational Logic circuits: Introduction to simplification of Logic circuits, Parallel adder, BCD adder, decoders, encoders, multiplexers, de-multiplexers, comparators, Applications of combinational logic circuits

UNIT V

Sequential Logic Circuits: Introduction to NAND and NOR Latch, S-R Flip-Flop, J-K Flip-Flop, J-K Master slave Flip-flop, D Flip-Flop, T Flip-Flop, Shift registers, Asynchronous and synchronous Counters , Up/Down Counters and Presettable Counters, Applications of counters.

Text Books

1. Ronald J Tocci, Neal S Widmer Gregory L. Moss "Digital Systems Principles and Applications"
   Printice hall 12th Edition, 2018 .
2. Robert L. Boylested and Louis Nashelsky "Electronic Devices and Circuit Theory"- Pearson Education. 11th Edition, 2015.

Reference Books

1. David A. Bell "Electronic Devices and Circuits" by - PHI, 5th Edition, 2010
2. John M Yarbrough "Digital Logic – Application and Design" - Thomson Brooks/Cole 7thEdition, 2012

Course Outcomes (COs):

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

1. Apply the basic knowledge of transistor and diode to design various transistor amplifiers. (PO-1,2&PSO-1)
2. Understand the concept of feedback, power and cascading effect in respect to multistage transistor amplifiers. (PO-1,2&PSO-1)
3. Interpret various characteristics of digital logic families (PO-1, 2& PSO-1)
4. Analysis the performance of decoders, encoders, multiplexers, demultiplexers and code converters. (PO-1,2& PSO-1)
5. Apply the knowledge of flip-flops in designing synchronous and asynchronous counters. (PO-1,2,3& PSO-1)

CONTROL SYSTEMS

Course code:ML33

Credits: 3:1:0 **Contact hours: 42+28**

Course Coordinators: Dr C K Narayanappa, Mr. S J Mahendra

Course contents

UNIT I

Introduction to Control Systems: Introduction, Types of control systems, Design considerations, translational & rotational mechanical systems, Analogous systems.

Block Diagram & Signal flow graph: Introduction, transfer function, Elements of block diagram, closed loop transfer function, Block diagram algebra, Signal flow graphs

Examples of Physiological control systems-Muscle stretch Reflex, Linear respiratory mechanics and muscle model mechanics, Introduction to Matlab

UNIT II

Time domain analysis of control systems: Introduction, standard test signals, Time response of First and second order systems, Design specifications of second order systems, Determination of undamped response, natural frequency & damping ratio, Step response of second order systems, Time domain specifications, System types, Different forms of representation, Steady state errors and error constants, Generalized error series, Approximation of higher order systems, Step response of second order systems with zeros.

UNIT III

Stability of Linear Control systems: Introduction, BIBO stability, Relationship between characteristic equation roots & BIBO stability, zero input stability, Stability criterion, RH criterion, RH analysis using Matlab

Root Locus: Introduction, The RL concept, steps for rapid plotting, RL analysis using Matlab

Stability Analysis of Pupillary Light reflex

UNIT IV

Frequency Domain Analysis: Correlation between time and frequency response, Frequency domain specifications.

Bode Plot: Introduction, Asymptotic approximations, Bode diagram for a practical system, Determination of transfer functions

UNIT V

Stability in the frequency domain: Introduction to polar plots (Inverse polar plots excluded)

State Space Theory: Introduction, concepts of state, State variable and state model, Selection of state variables, state model for linear continuous time systems

Solution to state equation, Non-homogenous solution, converting a transfer function to a state model Note: Matlab based problem solving topics are to be taught as demo sessions.

Text Books

1. Nagrath & Gopal, 'Control Systems Engineering', New Age International Publications, 5th Edition, 2009
2. Katsuhiko Ogata, 'Modern Control Engineering', 6th edition, PHI, 2010
3. Michael C.K. Khoo," Physiological Control Systems -Analysis, Simulation and Estimation" Prentice Hall of India Pvt. Ltd., New Delhi, 2001

Course Outcomes (COs):

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

1. Comprehend and interpret the basic concepts of control theory. (PO-1,2,3&PSO-1)
2. Compare the performances of a first and second order system in time domain. (PO-1,2,3&PSO-1)
3. Analyze the stability of a given system using different stability assessment techniques. (PO-1,2,6&PSO-1)
4. Assess the various factors involved with the time and frequency domain approaches and to use BODE plot based approach to conclude on the stability of a given system. (PO-1,2,6&PSO-1)
5. Apply polar plot technique for system stability analysis and to model a given system in state space thereby solving the state space equation. (PO-1,2,6&PSO-1)

SIGNAL PROCESSING

Course code:ML34

Credits: 3:1:0 **Contact hours: 42+28**

Course Coordinators: Ms. Purnima B R, Dr. H S Sanjay

Course contents

UNIT I

Introduction to Signals &Systems: Standard Signals (Continuous and discrete), Classification of Signals (Continuous and discrete), basic operations on signals (Continuous and discrete), Classification of systems.

Linear Time Invariant Systems: Convolution of continuous and discrete time signals, Classification of discrete time systems, Difference equation representation of LTI systems, Solution of difference equation.

UNIT II

Z transforms: Introduction to Z transform, ROC: properties (with proof) of finite and infinite duration sequences, ROC and stability, properties of ROC, Z transform of standard sequences, inverse Z transform (partial fraction method, long division method), unilateral z transform

UNIT III

Fourier transform: Introduction to Fourier series, mathematical development of Fourier transform, magnitude and phase spectra of Fourier transform, properties of Fourier transform (without proof), inverse Fourier transform, applications, sampling theorem, discrete time Fourier series and transforms, DTFT of periodic sequences, applications

UNIT IV

DFT & FFT: Definition of DFT and inverse, Matrix relation to compute DFT and IDFT, Concept of circular shift and circular symmetry, properties of DFT (without proof), relationship between DFT and other transforms (Fourier series, DTFT and ZT), Fast Fourier transform (DIT and DIF approaches)

UNIT V

Filter Design and realizations: Introduction to IIR filters, Analog filter specification and classifications, digital filter, Design of butterworth and

chebyshev filters (both analog and digital versions – BLT and IIT for digitization), realization of IIR filters (Direct forms, cascade and parallel forms) Introduction to FIR filters, advantages and disadvantages of IIR filters and FIR filters

Text Books

1. Simon Haykin, "Signals and systems",5th edition,Wiley India Publications, 2016
2. A. V Oppenheim & R W Schafer "Digital Signal Processing"–*Pearson Education / PHI, 4th Edition, 2013.*

Reference Books

1. Sanjit K Mitra "Digital Signal Processing – A computer based approach" *3rd-edition,* McGraw *Hill publications, 2017*

Course Outcomes (COs):

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

1. Assess the basic concepts of signals and their characteristics. (PO-1, 2,5,12& PSO-1,2)
2. Describe the Properties of various systems with respect to time and frequency domain (PO-1, 2,3,5& PSO1,2)
3. Represent different systems in the Frequency domain using Fourier and Z transforms and highlight their interrelationship. (PO-1, 2,5& PSO-1,2)
4. Analyze the given systems in Time domain using convolution and differential equations. (PO-1,2,5 &PSO-1)
5. Design and implement IIR filters for the given specifications in analog and digital domains along with appropriate realizations. (PO-1, 2,3,12& PSO-1,3)

Human Anatomy

Course code:ML35

Credits: 2:0:0: **Contact hours: 28**

Course Coordinators: Dr. Radhika, Dr.Anupama

Course contents

UNIT I

General Anatomy, General Histology: Terms & terminologies, Tissues: Epithelial tissue-definition, function classification with examples, modifications: Skin, Connective tissue definition, components, function classification with examples, modifications: Cartilage –types features, Bone-definition, components, function classification with examples, parts, blood supply periosteum and microscopic picture. Lymphoid tissue- definition, function classification with examples. Nervous system- definition, components, function, classification with examples, neuroglia: Muscular system-types with example, features. Cardiovascular system- definition, components, function. Joints -definition, components, function, classification with examples.

UNIT II

Musculo-skeletal system: All bones of the body: Joints of upper limb-shoulder, elbow and wrist: Joints of lower limb- hip, knee and ankle. Vertebral column- parts, function, curvatures, vertebrae. Thoracic cage- ribs, sternum.

UNIT III

Cardiovascular and Respiratory system: Heart – pericardium, external features, blood supply to heart, interior of chambers of heart and applied aspects, Blood vessels of the body. Nasal cavity – nasal septum & lateral wall, paranasal air sinuses & larynx & trachea & pleura, lung.

UNIT IV

Nervous and Digestive system: Meninges, classification of nervous system, cerebrum – sulci &gyri, functional areas, blood supply, ventricles of brain, diencephalon, brainstem, cerebellum, spinal cord, cranial nerves, special senses. Nerves of the body. Pharynx, tongue, esophagus, stomach, small intestine, large intestine, liver, pancreas & spleen.

UNIT V

Uro-genital system and Radiological Imaging: Kidneys, ureter, urinary bladder & urethra- parts, relation, functions blood supply applied anatomy, Components of female reproductive system - uterus, ovaries & fallopian tube - parts, relation, functions blood supply applied anatomy, Components of male reproductive system - testis, vas deferens, and scrotum -parts, relation, functions blood supply applied anatomy. Principle& applications of radiography, ultrasound, CT, MRI, Recent advancing imaging.

Text Books

1. Dr.Jayanthi. V –Text book of anatomy for nursing and Allied science-EMMES publishers, 1st edition,2008
2. Vishram Singh or B.D.Chaurasia, General Anatomy. CBS publishers, 6thedition ,2013
3. Vishram Singh or B.D.Chaurasia, Anatomy of Upper Limb & Thorax Volume I ,Elsevier, 1stedition, reprinted 2008.
4. Vishram Singh or B.D. Chaurasia, Anatomy of Lower Limb & Abdomen (Volume II) Elsevier, 1stedition,reprinted 2008
5. Vishram Singh orB.D.Chaurasia, Anatomy of Head, Neck & Brain (Volume III),Elsevier, 1stedition, reprinted 2008.

Course Outcomes (COs):

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

1. Explain the anatomical structure of human body. (PO-1, 6, 12&PSO-1)
2. Relate the various anatomical parts with their structure and functionality. (PO-1, 6,12&PSO-1)
3. Locate and have idea while dealing with images**.** (PO-1, 6, 12&PSO-1)

HUMAN PHYSIOLOGY

Course code:ML36

Credits: 2:0:0 **Contact hours: 28**

Course Coordinators: Dr. Arun Kumar, Mrs.Prabhu Ravikala Vittal

Course contents

UNIT I

General Physiology: Homeostasis, Feedback mechanism body fluids, Measurement of Body fluids, Resting Membrane potential, action potential, Measurement of action potential,

Muscular system: Types of muscles and their properties, Muscle fatigue, Difference in the properties of three types of muscles, Molecular basis of muscle contraction, excitation contraction coupling, EMG measurement Neuromuscular junction, Physiology of exercise Neuromuscular blockers.

UNIT II

Nervous System: Neuron, Properties of neurons, types of nerves**,** synapse and neurotransmitters**,** Nerve conduction studies**,** Functions of cerebrum, cerebellum, cerebrospinal fluid, EEG recording, Lumbar puncture**,** Ascending and descending tracts, Autonomic nervous system: functions and effects. Digital Reflex testing, Autonomic function testing**,**

Special senses: Vision, refractive errors, Refractive error testing, color vision testing, Physiology of vision electro retinogram, electrooculogram, VEP, Physiology of hearing, Physiology of smell and taste Tuning fork tests, audiometry, BAEP.

UNIT III

Hematology: Introduction, Composition and functions of blood (RBC, WBC, Hemoglobin), Measurement of Hemoglobin Blood groups, Blood Transfusion, functions of Platelet, Identification of blood groups, PTT, APTT, INR**.**

Cardiovascular system: Cardiac action potential, conducting system of heart, Principles of ECG Measurement , Heart rate, factors affecting HR, Pulse rate, factors affecting pulse Measurement of HR , Measurement of PR, Cardiac cycle, cardiac output, factors affecting CO, Heart sounds, Measurement of CO, Blood pressure, factors affecting BP, Hypertension Measurement of BP.

UNIT IV

Respiratory system: Functions of respiratory passages and lungs, muscles of respiration, mechanics of breathing, Variables affecting respiration**,** Volume and pressure changes during normal respiration**,** Lung volumes and capacities, Restrictive and obstructive diseases, Vitalograph, Measurement of Dead space, Computerized spirometry, PEFR

Digestive System: Introduction, Saliva and Deglutition, Functions of stomach, Functions of Liver, Jaundice Oesophaealmanometry, Electrogastrogram, Bilirubin measurement, Peristalsis and movements in GIT, Functions of pancreas, Small intestine and large intestine, Defecation Basal Electrical rhythm.

Renal system: Structure and functions of Kidneys, nephron, GFR and factors affecting it Trans epithelial potential difference, Measurement of GFR, clearance tests, Formation of Urine –normal constituents, Micturition reflex, Renal failure, Uroflowmetry, Cystometrogram, Dialysis**.**

UNIT V

Endocrine system: Types of hormones, Hypothalamus, Pituitary Gland, Thyroid gland**,** Thyroid function tests**,** Functions of cortisol, aldosterone, insulin, glucagon, parathyroid glands and miscellaneous hormones**,** Stress assessment, Diabetes Mellitus.

Reproductive system: Gender differentiation and pubertal changes, functions of male reproductive system**,** Karyotyping, Semen testing**,** Female reproductive system, menstrual cycle, Pregnancy and lactation, Contraceptive methods, Tests for ovulation and Tests for pregnancy**,** Environmental physiology**:** Physiology of High altitude, Dysbarism, Regulation of temperature**.**

Text Books

1 Dr. Venkatesh & Dr.Sudhakar, “Basics of Medical Physiology”, Wolters Kluwer Health Lippincott Williams and Wilkins, 3rd edition, 2010.

2 Ross &Wilson’s,“Anatomy and Physiology in Health and Illness”, Anne Waugh and Allison Grant, 9thEdition, Churchill Livingstone Publications.2006

3 Sujit K. Chaudhuri, “Concise Medical Physiology”, 5th Edition, New Central Book Agency Pvt. Ltd.1996.

Course Outcomes (COs):

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

1. Explain the basic physiological functions of various types of organs within the human body. (PO-1, 6, 12&PSO-1)
2. Compare and contrast normal physiological processes and be able to recognize the relationship between pathogenic progression and altered physiological responses. (PO-1, 6, 12; PSO-1)
3. Analyze and interpret physiological data to design of medical instruments used for diagnosis. (PO-1, 6, 12&PSO-1)

OBJECT ORIENTED PROGRAMMING (OOP)

Course code:ML37

Credits: 3:0:0 **Contact hours: 42**

Course Coordinators: Mr. S J Mahendra, Dr. Basavaraj Hiremath

Course contents

UNIT I

Introduction: Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & function components, recursive functions, user -defined types, function overloading, inline functions, Classes & Objects – I: classes, Scope resolution operator, passing objects as arguments, returning objects, and object assignment.

UNIT II

Classes & Objects –II: Constructors, Destructors, friend functions, Parameterized constructors, Static data members, Functions, Arrays of objects, Pointers to objects, this pointer, and reference parameter, Dynamic allocation of objects, Copy constructors, Operator overloading using friend functions such as +, - , pre-increment, post-increment, *, /. Operators.

UNIT III

Templates: Generic functions and Generic classes, Inheritance: Base Class, Inheritance and protected members, Protected base class inheritance, Inheriting multiple base classes, Constructors, Destructors and Inheritance, Passing parameters to base class constructors, Granting access, Virtual base classes.

UNIT IV

Virtual functions and Polymorphism: Virtual function, calling a Virtual function through a base class reference, Virtual attribute is inherited, Virtual functions are hierarchical, pure virtual functions, Abstract classes, Using virtual functions, Early and late binding.

UNIT V

Exception Handling, I/O System Basics, File I/0: Exception handling fundamentals, Exception handling options. C++ stream classes, Formatted I/O,

fstream and the File classes, Opening and closing a file, Reading and writing text files.

Text Books

1. Sourav Sahay, Object Oriented Programming Using C++, 2nd edition 2013

Reference Books

1. Stanley B.Lippmann, Josee Lajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2011.

Course Outcomes (COs):

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

1. Identify classes, objects, members of a class and the relationships among them needed to solve a specific problem. (PO-12,3&PSO-2)
2. Demonstrate the concept of constructors and destructors. And create new definitions for some of the operators (PO-1,2,3& PSO-2)
3. Create function templates, overload function templates, Understand and demonstrate the concept data encapsulation and inheritance (PO-1,2,3&PSO-2)
4. Demonstrate the concept of polymorphism with virtual functions. (PO-1,2,3&PSO-2)
5. Demonstrate the concept of file operations, streams in C++ and various I/O manipulators. (PO-1,2, 3& PSO-2)

ANALOG AND DIGITAL ELECTRONICS CIRCUITS LABORATORY

Course code: MLL38

Credits: 0:0:1 **Contact hours: 28**

Course Coordinators: Ms. Prabha Ravikala Vittal, Ms. Uma Arun

Course contents

1. Design and verification of frequency response of RC coupled amplifier.
2. Design and analysis of Emitter follower circuit
3. Design and analysis of Darlington & Bootstrapped Darlington circuit.
4. Design and verification of characteristics of negative feedback amplifier.
5. Design and verification of Hartely, colpitts, oscillator
6. Design and verification of crystal and RC phase shift oscillators.
7. Verification of encoder and decoder.
8. Implementation of half adder and full adder using MUX 74153
9. Verification of Parallel Adder Using 7483
10. Implementation of code converters using DEMUX- 74139
11. Implementation of 1bit and 2bit comparator using logic gates and NAND gates
12. Implementation T and D flip-flop using JK Master slave configuration and IC 7446
13. Implementation of MOD N Counters using ICs 7476, 7490
14. Verification of SISO, SIPO, PIPO, PISO operation using shift register 7495

Text Books

1. "Electronic Devices and Circuit Theory" by Robert L. Boylested and Louis Nashelsky- Pearson Education,11th Edition, 2015
2. "Digital Systems Principles and Applications" by Ronald J Tocci, Neal S Widmer Gregory L. Moss – Printice hall, 12th Edition, 2018

Course Outcomes (COs):

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

1. Design various linear and nonlinear circuits for requiredapplications. (PO-1,2,3&PSO-1)
2. Demonstrate the practical skills of building circuits. (PO-1,2,3& PSO-1)
3. Analyze the Outputs both theoretically and practically. (PO-1,2,3& PSO-1)

OBJECT ORIENTED PROGRAMMING LAB

Course code:MLL39

Credits: 0:0:1 **Contact hours: 28**

Course Coordinators: Mr. S J Mahendra, Dr. Basavaraj Hiremath

Course contents

1. Inline functions & function overloading.
2. Classes & objects.
3. Constructors, destructors & static data members.
4. Friend functions & generic functions.
5. Operator overloading.
6. Inheritance - protected members, protected base class inheritance
7. Inheritance - inheriting multiple base classes.
8. Passing parameters to base class constructors, granting access and virtual base class.
9. Virtual functions and polymorphism.
10. Pure virtual functions and abstract classes.
11. Opening and Closing of Files
12. Exception handling & Templets

Text Books

1. Stanley B.Lippmann, Josee Lajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. Herbert Schildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2011.

Course Outcomes (COs):

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

1. Develop classes incorporating object-oriented techniques. (PO-1,2,3 & PSO-2)

2. Design and implement object-oriented concepts of inheritance and polymorphism. . (PO-1,2,3& PSO-2)
3. Illustrate and implement STL class of containers and need for exceptions to handle errors for object Oriented programs. (PO-1,2,3& PSO-2)

ADDITIONAL MATHEMATICS – I

Course code: AM31

Credits: 0:0:0 **Contact hours: 40L**

Course Coordinators: Dr. N L Ramesh

Course Objectives:

The students will

1. Learn successive differentiation, polar coordinate system and Taylor's series expansion of functions of single variable.
2. Learn the concept of reduction formula and multiple integrals.
3. Study vector algebra and vector differentiation.
4. Learn the procedure of solving first order and first degree ODE's.

Unit-I

Differential Calculus-I -08 Hrs

Successive differentiation, n^{th} derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

Unit-II

Integral Calculus -08 Hrs

Introduction, Reduction formula, Reduction formula for $\int sin^n x\, dx$, Reduction formula for $\int cos^n x\, dx$, Reduction formula for $\int sin^n x cos^m x\ dx$, Evaluation of double and triple integrals.

Unit-III

Vector Algebra-08 Hrs

Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

Unit –IV

Vector Differentiation-08Hrs

Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector, irrotational vector,Laplace's operator. Vector identities connected with gradient, divergence and curl.

Unit- V

First Order Differential Equations-08 Hrs

Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44thedition, 2017.
2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

At the end of the course the student will be able to

1. Find the length of the perpendicular from pole to tangent and determine the series expansion of differentiable functions (PO-1, 2)
2. Evaluate multiple integrals (PO-1, 2)
3. Analyze and solve problems related to Vector Algebra. (PO-1, 2)
4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1, 2)
5. Solve the first order and first degree ordinary differential equations. (PO-1, 2)

ENGINEERING MATHEMATICS-IV

Course code: ML41

Credits: 3:1:0 **Contact hours: 42+28**

Course Coordinators: Dr. M.V. Govindaraju and Dr. Aruna A S

Course contents

UNIT I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

UNIT II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems: Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra – example and physical interpretation. Limitation of Fourier Transforms and the need of Wavelet transforms.

Z-Transforms: Definition, standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems. Application of Z-transform to solve difference equations. Applications to Engineering problems.

UNIT III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

UNIT IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

UNIT V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions. Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula**.**

Text Books

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B.S. Grewal-Higher Engineering Mathematics-Khanna Publishers - 44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010

3. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

Course Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1)
4. Determine the parameters of stationary random processes and use Markov chain in the prediction of future events. (PO-1,2 & PSO-1)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1)

LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS

Course code:ML42

Credits: 4:0:0 **Contact hours: 56**

Course Coordinators: Ms. Chandana S, Mr. S J Mahendra

Course contents

UNIT I

Introduction to Operational Amplifiers and Characteristics: Introduction to Linear IC's, Block diagram, characteristics and equivalent circuits of an ideal op-amp, various types of Operational Amplifiers and their applications, Power supply configurations for Op-Amp applications, inverting and non-inverting amplifier configurations.

The Practical op-amp: Introduction, Input offset voltage, offset current, thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio, Slew rate and its Effect, PSRR and gain – bandwidth product, frequency limitations and compensations, transient response, interpretation of μA741C datasheet.

UNIT II

Amplifiers and Oscillators: Summing amplifier, Integrators and differentiators, Instrumentation amplifier and its types, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log and Antilog amplifier, Analog Multiplier and Divider, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator.

UNIT III

Active Filters: Characteristics of filters, Classification of filters, Magnitude and frequency response, Butter worth 1st and 2nd order Low pass, High pass and band pass filters, Chebyshev filter characteristics, Band reject filters, Notch filter, All pass filters.

UNIT IV

Comparators and Converters: Comparator, Zero Crossing Detector, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector,

Sample and hold Circuit, Precision rectifiers, DAC- Binary weighted type and R-2R ladder type, ADC- successive approximation type and ADC 0801.

UNIT V

Multivibrators and Advanced Applications: Schmitt Trigger- inverting and non-Inverting type, Monostable and Astable Multivibrators using Opamp, Monostable and Astable Multivibrators using 555 timer, Linear and switching Voltage regulator using Opamp, Isolation Amplifier, Cardiac Pacemaker, PLL and VCO.

Text Books

1. Ramakant A. Gayakwad- "Op - Amps and Linear Integrated Circuits" PearsonIn, 4th Edition,2015
2. D. Roy Choudhury and Shail B. Jain "Linear Integrated Circuits" - New Age International, 5th Edition, 2018 Reprint.
3. B Somanath Nair "Linear Integrated Circuits- Analysis, Design & Applications" by, Wiely India Pvt. Ltd. 1st Edition, 2009.

Reference Books

1. "Operational Amplifiers and Linear IC's" by David A. Bell, Oxford Higher Education, 3rd Edition 2011.
2. "Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E: by James M. Fiore- Thomson Learning, 2019

Course Outcomes (COs):

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

1. Illustrate the working of operational amplifier and relate various characteristics of an operational amplifier. (PO-1,9&PSO-1)
2. Build various signal generation and signal enhancement circuits using op-amp. (PO-1,3,5, 9,10,12&PSO-1,2)
3. Apply the knowledge of analog circuits and Op-Amp in the design of active filters. (PO-1,3,5, 9,10,12&PSO-1,2)
4. Analyze various signal processing circuits using Op-Amp. (PO-1,3,5, 9,10,12&PSO-1,2)
5. Analyze various biomedical applications involving Multivibrator and PLL. (PO-1,9& PSO1)

BIOMEDICAL SIGNAL PROCESSING

Course code:ML43

Credits: 3:1:0 **Contact hours:42+28**

Course Coordinators: Ms. Purnima B R, Dr. H S Sanjay

Course contents

UNIT I

Introduction to Biomedical signal processing: Nature of biomedical signals, examples of biomedical signals (action potential of a cardiac myocyte, action potential of a neuron, Electroneurogram, electromyogram, electrocardiogram, electroencephalogram, Event related potentials, electrogastrogram, Phonocardiogram, carotid pulse, catheter tip sensor signals, speech signals, vibromyogram, vibroarthrogram, optoacoustic emission), objectives of biomedical signal analysis and their problems

UNIT II

FIR filters: Introduction, paley wiener theorm, symmetric and asymmetric filters, locations of zeros in linear phase FIR filters, design of linear phase FIR filters using windows and design procedures, advantages and disadvantages of windowing, design of FIR differentiators, frequency sampling design of FIR filters, realization of FIR filters.

UNIT III

Filtering applications for artifact removal: Random structured and physiological noise, time domain filters, frequency domain filters, optimal filters: Wiener filter, adaptive filters for the removal of interference: Adaptive Noise canceller, LMS adaptive filter, selecting the appropriate filter, applications.

UNIT IV

Detection of events: Event and wave detection: Derivative based methods, PAN TOMPKINS method, Dichrotic notch detection. Correlation analysis of EEG rhythms, cross spectral techniques.

Frequency domain characterization: Estimation of PSD, Moments of PSD functions.

UNIT V

Data Reduction Technique: Turning Point, Huffman Coding**,** Run length Coding

Waveform analysis: waveform complexity in QRS complex in bundle branch blockage, effect of myocardial ischemia on QRS complex, ectopic beats, EMG interferences, PCG intensity patterns, ERP analysis, Morphological analysis of ECG waveforms, envelope extraction and analysis

Text Books

1. Rangaraj M Rangayyan,"Biomedical Signal Analysis", Wily Publications, 2nd Edition, 2016.

Reference Books

1. John L Semlow, "Biosignal& and Biomedical Image Processing" –CRC Press, 3rd Edition, 2014.
2. Willis J Tompkins, "Biomedical Digital Signal Processing", PHI, Eastern economy edition

Course Outcomes (COs):

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

1. Demonstrate an understanding of biomedical signals and identify the need forbiomedical signal analysis. (PO-1,2,3,12& PSO-1,3)
2. Identify physiological interferences and artifacts affecting the biomedical signals and apply various filtering mechanisms for the enhancement of signals. (PO-2,4&PSO-1)
3. Detect various events involved in ECG and apply appropriate data reduction techniques. (PO-1,3&PSO-1)
4. Emphasize the need for signal averaging mechanisms in biomedical signal analysis (PO-2,4&PSO-1)
5. Incorporate different signal processing approaches so as to assess the different features of ECG signals as well as analyze the same from a biomedical signal processing perspective (PO-1,2,12&PSO-1,3)

DIGITAL IMAGE PROCESSING

Course code:ML44

Credits: 3:1:0 **Contact hours:42+28**

Course Coordinators: Dr. C K Narayanappa, Dr Basavaraj Hiremath

Course contents

UNIT I

Introduction: Origin and importance of DIP, fundamental steps in digital image processing, elements of digital image processing system. Digital image fundamentals: image sensing and acquisition, sampling and quantization, some basic relationships between pixels, some basic transformations.

UNIT II

Morphological Image Processing: Preliminaries, dilation and erosion, opening and closing, the Hit-or-miss transformation, some basic morphological algorithms, extensions to gray scale images.

UNIT III

Image Enhancement in the spatial domain: Background, Basic gray level transformations, histogram processing, enhancement using arithmetic/logic operations, basics of spatial filtering, smoothing and sharpening spatial filters, combining spatial enhancement methods.

UNIT IV

Image enhancement in the frequency domain: Background, introduction to the frequency domain, Fourier transform, Discrete Fourier transform, some properties of the 2-dimensional Fourier transform, Fast Fourier Transform, smoothing and sharpening frequency domain filters, homomorphic filtering, implementation, generation of spatial masks from frequency domain specifications.

Color image processing: Color Fundamentals, color Model, Pseudo color processing, Basics of full color processing.

UNIT V

Image restoration: Degradation model, Noise models, restoration in the presence of noise only (Spatial and frequency domain filters), Linear position

invariant degradations, Estimating of degradation function, Inverse filtering, Minimum Mean Square Error filtering, constrained least square filtering.

Text Books

1. R C Gonzalez & R E Woods," Digital Image Processing" , Pearson Education,4e, 2018

Reference Books

1. A K Jain, " Fundamentals of Digital Image processing ", PHI / Pearson Education, 2011
2. Chanda and Majumder," Digital Image Processing and Analysis", PHI Learning Pvt. Ltd., 2011.

Course Outcomes (COs):

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

1. Identify the basic Digital image representation and analyze the relationship between the pixels. (PO-1,2,3&PSO-1)
2. Analyze and implement morphological image processing. (PO-1,2,3&PSO-1,2)
3. Analyze the aspects involved with respect to various enhancement techniques on an image. (PO-1,2,3,5 &PSO-1).
4. Emphasize on the different color models and their importance. (PO-1,2,3&PSO-1)
5. Discuss various restoration technique used in image processing. (PO-1,2,3&PSO-1)

BIOMEDICAL INSTRUMENTATION-I

Course code:ML45

Credits: 3:0:0 **Contact hours:42**

Course Coordinators: Dr. Prabha Ravi, Dr. H S Sanjay

Course contents

UNIT I

Introduction to Biomedical Instrumentation: Introduction, generalized instrumentation system, alternate operating modes, measurement constraints, classification of biomedical instruments, interfering and modifying inputs, compensation techniques, static and dynamic characteristics, design criteria, commercial development process, regulations.

Origin of bioelectric potentials: Electrical activity of the excitable cells, volume conductor fields, functional organization of peripheral nervous system

UNIT II

Basic Sensors & Principles: Displacement measurements, Resistive sensors, bridge circuits, inductive sensors, capacitive sensors, piezoelectric sensors, temperature measurements, thermocouples, thermistors, radiation thermometry, fibre optic temperature sensors, optical measurements, radiation sources, fibre optics, optical filters, radiation sensors.

UNIT III

Biopotential Electrodes: Electrode-electrolyte interface, polarization, polarisable and non- polarizable electrodes, electrode behaviour and circuit models, electrode-skin interface, motionartifacts, body surface recording electrodes, internal electrodes, electrode arrays, microelectrodes, electrodes for electric stimulation of tissues, practical aspects involved.

UNIT IV

Biopotential amplifiers: basic requirements, electrocardiograph, problems encountered, transient protection, interference reduction circuits, amplifiers for biopotential signals – design and working, biopotential signal processors, cardiac monitors, biotelemetry.

UNIT V

Electrical safety: physiological effects of electricity, important susceptibility parameters, distribution of electric power, macroshock and microshock, electrical safety codes and standards, protection against shock, power distribution, equipment design, electrical safety analysers, testing the electric system and appliances.

Text Books

1. John G Webster, "Medical Instrumentation-Application and design", 4th edition, John Wiley Publications, 2009

Reference Books

1. R S Khandpur, "Handbook of biomedical Instrumentation", 3 rd edition, Tata McGraw Hill publications (2017)
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

Course Outcomes

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

1. Accent the basics of biomedical instrumentation used to acquire bio potential signals from human beings. (PO-1,2,3,12&PSO-1,3)
2. Comprehend the origin of bio potentials from human body. (PO-2,3 & PSO-1)
3. Interpret the importance of bio potentials electrodes in the process of signal acquisition. (PO-1, 4&PSO-1)
4. Recognize and realize the need for usage of bio potential amplifiers in biomedical instruments and applications. (PO-3, 4 &PSO-1)
5. Analyze the safety aspects involved with electricity in medical instruments. (PO-2,3&PSO-1)

MICROCONTROLLER- MSP430

Course code:ML46
Credits: 4:0:0 **Contact hours: 56**
Course Coordinators: Ms.Prabhu Ravikala Vittal, Ms.Uma Arun

Course contents

UNIT I

Introduction to Embedded system: What (and Where) are Embedded Systems, Approaches toEmbedded Systems, Anatomy of a Typical Small Microcontroller.

Memory: Computer System and Memory organization, Harvard and Van-Nuemaan architecture, Memory terminology, Basic RAM and ROM architecture, Flash memory, Advanced Memory. Architecture of MSP430, Microcontrollers: Central Processing Unit, Registers, Program Counter, Status Register, Constant Registers, Stack Pointer , Basic Clock Module and their operation.

UNIT II

Programming model of MSP 430: Addressing modes, Instruction set, Basic and Emulated
Instructions, Memory Mapped Peripherals, Programming System Registers, I/O pin multiplexing, Digital I/O Programing-Input &Output Registers, Function Select Register, Port Interrupts, Pull Up/Down Registers, GPIO control, Interrupt, ISR and Interrupt Programming, Clock System in MSP430, Low power modes of operation.

UNIT III

Timers: Timers, PWM and Microcontroller Fundamentals for Basic Programming -Timer Basics, Basic concept of delay generation, Hardware and software delays, Watch dog timer, Real Time Clock (RTC), Timer Block diagram and Operation, Timer Modes, Output Unit, Timer Interrupts, PWM control, Timing generation and measurements.

UNIT IV

Mixed Signals Processing: Comparator, General issues of analog and digital signal conversion, Analog-to-Digital Conversion: Successive Approximation Operation of ADC 10 and ADC 12 inMSP430 Microcontrollers,

Communication protocols and Interfacing: Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, I2C,), Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

UNIT V

Embedded Networking and Internet of Things:Basics of wireless communication, Requirements for the wireless communication. Types of wireless communication. Advantages and limitations of wireless communication, IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capabilityto the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications.

Building IoT applications using CC3100 user API: connecting sensor devices.

Text Books

1. MSP430 Microcontrollers Basics, John H Devis, 1st Edition, Reed Elsevier India Pvt. Ltd 2017
2. MSP430 Microcontrollers in Embedded System Projects, C P Ravikumar, 1st Edition, Elite Publishing House, 2012
3. Analog and Digital Circuits for Electronic Control System Applications: Using the TI MSP430 Microcontroller, Jerry Luecke, 1st Edition, Elsevier Science, 2005

Course Outcomes (COs):

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

1. Visualize the basic building blocks of an embedded system and various units of Microcontroller. (PO1,PO2, PO12 &PSO1)
2. Analyze the architecture and programming model of MSP430. (PO1, PO2, PO12 & PSO1)
3. Analyze the working of Timer unit and interrupt concepts of MSP430 and apply for various applications. (PO1,PO2,PSO1 & PO12)
4. Understand concepts of Data conversion units and serial communication protocols for external communication in MSP430 for various applications. (PO1, PO2, PO12 & PSO1)
5. Interpret the various modalities used for wireless communication. (PO1,PO2, PO12 & PSO1)

LINEAR INTEGRATED CIRCUITS LABORATORY

Course code:MLL47

Credits: 0:0:1 **Contact hours: 28**

Course Coordinators: Ms. Chandana S, Mr. S J Mahendra

Course contents

1. General Linear Applications of Op-Amp:
    a. Summing Amplifier
    b. Difference Amplifier
    c. Integrator
    d. Differentiator
2. Design and Implementation of Instrumentation Amplifier.
3. Design, Implementation and Analysis of 1st order Butterworth Active Low Pass Filter.
4. Design, Implementation and Analysis of 1st order Butterworth Active High Pass Filter.
5. Design, Implementation and Analysis of 1st order Butterworth Active Band Pass Filter.
6. Design, and Implementation of Notch Filter.
7. Design and Implementation of Schmitt Trigger.
8. Design and Implementation of Astable Multivibrator using Op-Amp.
9. Design and Implementation of Monostable Multivibrator using Op-Amp.
10. Design and Implementation of Astable Multivibrator using555 Timer.
11. Design and Implementation of Half wave and Full wave precision rectifier.
12. Design and Implementation of 4- bit, R-2R ladder type DAC using Op-Amp.

Text Books

1. Ramakant A. Gayakwad “Op - Amps and Linear Integrated Circuits” - PearsonIn, 4th Edition,2015
2. Roy Choudhury and Shail B. Jain D “Linear Integrated Circuits” - New Age International, 5th Edition, 2018.

Course Outcomes (COs):

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

1. Design OP-Amp circuits for various applications. (PO-1,3,9,10&PSO-1)
2. Demonstrate the practical skills of building circuits. (PO-1,3,5,9,10 & PSO-1,2)
3. Analyze the Outcomes both theoretically and practically. (PO-1,3,9,1 & PSO-2)

MICROCONTROLLER- MSP430 LABORATORY

Course code: MLL48

Credits: 0:0:1 **Contact hours: 28**

Course Coordinators: Ms.Prabhu Ravikala Vittal, Ms.Uma Arun

Course contents

1. Study of functional Unit of MSP430FR5969 development board.
2. Demonstration of Code Composer Studio Installation and usage.
3. Interfacing and programming GPIO ports in C using MSP430 (blinking LEDs, push buttons).
4. Interrupt programming examples through GPIOs.
5. PWM generation using Timer on MSP430 GPIO.
6. Interfacing potentiometer with MSP430.
7. PWM based Speed Control of Motor controlled by potentiometer connected to MSP430 GPIO.
8. Interfacing MSP430 to terminal on PC and echo back the data using ULP advisor in Code Composer Studio.
9. Master Slave Communication between 2 MSP430s using SPI.
10. I2C communication using MSP430
11. A basic Wi-Fi application – Communication between two MSP430 based sensor nodes.
12. Enable Energy Trace and Energy Trace ++modes in CCS for Experiments No. 4-7

Text Books

1. MSP430 Microcontrollers Basics, John H Devis, 1st Edition, Reed Elsevier India Pvt. Ltd 2017
2. MSP430 Microcontrollers in Embedded System Projects, C P Ravikumar, 1st Edition, Elite Publishing House, 2012
3. User Manual MSP430FR5969.from TI.com

Course Outcomes (COs):

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

1. Use the CCS software and use it to operate the MSP430FR5969 GPIO using basic I/O operation. (PO-1, PO3, PO4 & PSO-1,2)
2. Demonstrate the PWM techniques for control the external device using MSP430F5969. (PO1,PO3,PO4 PO5&PSO1,PSO2)
3. Demonstrate the serial &wireless communication techniques using MSP430FR5969. (PO1,PO3,PO4 & PSO1,PSO2)

ADDITIONAL MATHEMATICS – II

Course code: AM41

Credits: 0:0:0 **Contact hours: 40L**

Course Coordinators: Dr. N L Ramesh

Course Objectives:

The students will

1. Understand the concept of partial derivatives, composite functions and Jacobians.
2. Learn to evaluate line, surface and volume integrals.
3. Learn to use Laplace transform method to solve initial and boundary value problems.
4. Learn the procedure of solving Linear differential equations with constant and variable coefficients.
5. Study the concepts of basic probability.

Unit-I

Differential calculus - 08 Hrs

Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions, Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

Unit-II

Vector integration – 08 Hrs

Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

Unit-III

Laplace transforms - 08 Hrs

Definitions, Laplace transforms of elementary functions, derivatives and integrals, periodic function, unit step function, inverse transforms, applications of Laplace transforms to solve differential equations.

Unit-IV

Higher Order Differential Equations - 08 Hrs

Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

Unit-V

Probability - 08Hrs

Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability-illustrative examples. Bayes theorem –examples.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

At the end of the course the student will be able to

1. Find Jacobian, extreme values and power series expansion of a function. (PO-1, 2)
2. Exhibit the interdependence of line, surface and volume integrals using integral theorems. (PO-1, 2)
3. Use the concept of Laplace transforms to solve initial and boundary value problems (PO-1, 2)
4. Solve Linear differential equations with constant and variable coefficients (PO-1, 2)
5. Demonstrate the understanding of axioms and rules of probability to solve problems. (PO-1, 2)