RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

MEDICAL ELECTRONICS ENGINEERING

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 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. 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 for 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, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & 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 Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" 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), by MoE, 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. The institute 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 (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.

About the Department

The Medical Electronics department at M S Ramaiah Institute of Technology (MSRIT), Bangalore was started in the year 1996 and renamed as Medical Electronics Engineering in the year 2020 by Visvesvaraya Technological University (VTU), Belagavi. The department has been accredited by NBA. In 2012, the Department was recognized as a Research Centre by VTU and offers Ph.D. and M.Sc. (Engg.) by research programs. The department is located at Lecture Hall Complex of RIT Campus and includes six established laboratories namely Diagnostic & Therapeutic Equipment Laboratory, Medical Electronics Laboratory, Medical Software Laboratory, Medical Instrumentation Laboratory, Texas Instruments Innovation Laboratory and Centre for Medical Electronics and Computing. The department consists of highly motivated & qualified faculty and dedicated supporting staff headed by Dr. Narayanappa C K having a teaching experience of more than twenty-five years with specialization in control systems and image processing. The current curriculum has been reviewed by experts from GE Healthcare, Philips Innovation Centre, Skanray Healthcare, Forus Healthcare, IIT Madras and MSR Medical College. The department conducts various training programs in addition to the syllabus for giving the students exposure to the latest developments in the industry.

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

Batch 2020-2024

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/ECA)	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	6	3	4	-	**24**
Seventh	3	-	-	10	6	-	-	1	**20**
Eighth	-	-	-	-	-	-	14	3	**17**
Total	**8**	**28**	**24**	**72**	**15**	**6**	**18**	**4**	**175**

III SEMESTER BATCH -2020-2024

SI. No	Subject Code	Subject	Credits			
			L	T	P	Total
1.	ML31	Engineering Mathematics -III	3	1	0	4
2.	ML32	Analog Electronic Circuits	3	1	0	4
3.	ML33	Digital Electronic Circuits	4	0	0	4
4.	ML34	Signal Processing	3	1	0	4
5.	ML35	Human Anatomy	2	0	0	2
6.	ML36	Human Physiology	2	0	0	2
7.	ML37	Object oriented Programming (OOP)	3	0	0	3
8.	MLL38	Analog & Digital Electronics Circuits Lab	0	0	1	1
9.	MLL39	Object oriented Programming Lab	0	0	1	1
TOTAL			**20**	**03**	**02**	**25**

Note: Minimum of 2 subjects should have a Tutorial component of 1 Credit each.

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

SI. No	Subject Code	Subject	Credits			
			L	T	P	Total
1.	ML41	Engineering Mathematics - IV	3	1	0	4
2.	ML42	Linear Integrated Circuits and its Applications	4	0	0	4
3.	ML43	Biomedical Signal Processing	4	0	0	4
4.	ML44	Control Systems	3	1	0	4
5.	ML45	Digital Image Processing	3	0	0	3
6.	ML46	Microcontroller – MSP 430	3	1	0	4
7.	MLL47	Linear Integrated Circuits Lab	0	0	1	1
8.	MLL48	Biomedical Signal Processing Lab	0	0	1	1
TOTAL			**20**	**03**	**02**	**25**

Note: Minimum of 2 subjects should have a Tutorial component of 1 Credit each.

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.

III SEMESTER

ENGINEERING MATHEMATICS -III

Course Code: ML31 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. M.V. Govindaraju, 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. Applications 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, Eigenvalues and Eigenvectors 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. Applications 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 edit 2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 20

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-second 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 ELECTRONIC CIRCUITS

Course Code: ML32 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Ms. Uma Arun , Ms. Chandana S

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

Steady State Analysis: Basic Network Laws, Source mobility techniques, Mesh and Nodal Analysis, concept of Super mesh and super node.

UNIT IV

Network Theorems: Superposition, Reciprocity, Millmann's, Thevenin's, Norton's and Maximum power transfer theorems.

UNIT V

Laplace Transformation: Introduction to Laplace transform and its properties, waveform synthesis, Analysis of networks using Laplace transforms.

Text Books

1. Robert L. Boylested and Louis Nashelsky "Electronic Devices and Circuit Theory"-Pearson Education. 11th Edition, 2017.
2. William H Hayt, "Engineering Circuit Analysis", Kemmerly and Durbin, 9th Edition, 2020

Reference Books

1. David A. Bell "Electronic Devices and Circuits" by - PHI, 5th Edition, 2010
2. "Network Analysis", ME Van Valkenburg, PHI/Pearson, 3rd Edition, 2019

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, 3; PSO-1)
2. Understand the concept of feedback, power and cascading effect in respect to multistage transistor amplifiers. (PO-1, 2, 3; PSO-1)
3. Develop the ability to conceptualize key aspects of linear electrical circuits (PO-1, 2, 3; PSO-1, 2)
4. Apply the knowledge theorems in solving complex linear electric circuits (PO-1, 2, 3; PSO-1, 2)
5. Understand the importance of time and frequency domain approaches towards analyzing linear electric circuits (PO-1, 2, 3; PSO-1, 2)

DIGITAL ELECTRONIC CIRCUITS

Course Code: ML33 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator(s): Dr. Basavaraj V Hiremath, Mrs. Uma Arun

Course contents

UNIT I

Digital Arithmetic: Arithmetic Circuits, Parallel Binary Adder, Design of a Full Adder, Complete Parallel Adder with Registers, Carry Propagation, Integrated-Circuit Parallel Adder.

MSI Logic Circuits: Decoders, BCD-to-7-Segment Decoder/Drivers, Liquid-Crystal Displays, Encoders, Multiplexers (Data Selectors**),** Multiplexer Applications, Demultiplexers (Data Distributors) Magnitude Comparator.

UNIT II

Flip-Flops and Related Devices: NAND Gate Latch, NOR Gate Latch, Clock Signals and Clocked Flip-Flops, Clocked S-R Flip-Flop, Clocked J-K Flip-Flop, Clocked D Flip-Flop, D Latch (Transparent Latch), Asynchronous Inputs, Flip-Flop Timing Considerations, Master slave Flip Flop, Data Storage and Transfer, Serial Data Transfer, Shift Registers.

UNIT III

Counters: Asynchronous (Ripple) Counters, counters with MOD Numbers< 2^N, IC Asynchronous counters, Asynchronous down counters, Propagation delay in ripple counters, Synchronous(parallel)counters, Synchronous down and up/down counters, Presettablecounters, Synchronous counter design.

UNIT IV

Integrated-Circuit 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 digitalIC family.

UNIT V

Memory Devices: Memory Terminology, General memory operations, CPU-Memory connections, Read-only memories, ROM architecture, ROM timing, Types of ROM, Flash memory, ROM applications, Semiconductor RAM, RAM architecture, Static RAM(SRAM), Dynamic RAM (DRAM).

Text books:

1. Ronald J Tocci, Neal S Widmer Gregory L. Moss. “Digital systems Principles and applications” Pearson Publication ,11th edition, 2010.

Reference books:

1. M Morris Mano, Charles R Kime, "Logic and Computer Design Fundamentals"- Pearson Education, 2nd edition, 2012.

Course Outcomes (COs):

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

1. Implement various combinational logic circuits. (PO-1, 2, 3; PSO-1)
2. Describe the working of various flip-flops. (PO-1,2; PSO-1)
3. Implement various counter with the knowledge of sequential circuits (PO-1,2, 3; PSO-1, 2)
4. Interpret various characteristics of digital logic families (PO-1,2; PSO-1)
5. Exemplify different digital storage devices. (PO-1, 2; PSO-1,2)

SIGNAL PROCESSING

Course Code: ML34 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. C K Narayanappa, Ms. Purnima B R

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, Interconnections of systems.

UNIT II

Linear Time Invariant Systems: Convolution of continuous and discrete time Signals, Properties of convolution sum and integral, properties of systems step response of linear time invariant systems, sinusoidal steady state response, Solution of differential and difference equation.

UNIT III

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 IV

Fourier transform: Introduction to Fourier series, mathematical development of Fourier transform, magnitude and phase spectra of Fourier transform, properties of Fourier transform, inverse Fourier transform, applications. Introduction to DTFT, Sampling theorem, quantization.

UNIT V

DFT & FFT: Definition of DFT and inverse, Matrix relation to compute DFT and IDFT, Concept of circular shift and circular symmetry, properties of DFT, Fast Fourier transform (DIT and DIF approaches).

Text Books

1. Simon Haykin, "Signals and systems", 5 Edition, Wiley India Publications, 2016
2. V Oppenheim & R W Schafer "Digital Signal Processing"–Pearson Education / PHI, 5th Edition, 2015.
3. Ganesh Rao, Vineeth P Gejji "Digital Signal Processing"-Cengage publications 2017

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. Perform various operations on elementary signals used in systems and identify its properties. (PO-1; PSO-1)
2. Represent Linear Time Invariant (LTI) system through different techniques and analyze the relation between the input and output of an LTI system through its impulse response. (PO-1; PSO-1)
3. Represent different systems in the Frequency domain using Fourier Transforms and apply various properties of transform techniques in the analysis of signals and systems. (PO-1; PSO-1)
4. Represent different systems in the Frequency Domain Z transforms and highlight interrelationship between different transforms. (PO-1, 2,5; PSO-1,2)
5. To realize Discrete Fourier transforms and recognize the importance of techniques to solve discrete Fourier transforms faster using FFT (PO-1; PSO-1)

HUMAN ANATOMY

Course Code: ML35 **Course Credits: 2:0:0**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Radhika, Ms. Purnima B R

Course contents

UNIT I

General anatomy and histology: Introduction to anatomy, cells and its components, epithelial tissues, connective tissues, integumental system

UNIT II

Joints: classification, joints of head and neck, joints of upper limb, joints of lower limb, joints of thorax and pelvis
Muscular system: classification, spaces, muscles and fascia of head and neck

UNIT III

Cardiovascular system: Introduction, pericardium, sinuses, heart, blood vessels, pulmonary and systemic circulation, lymphatic system
Respiratory system: Introduction, nose and paranasal air sinus, larynx, trachea, pleura, lungs, mediastinum

UNIT IV

Nervous system: Classification, meninges, Dural venous sinuses, CSF, ventricles, structure of neuron, neuroglia, ventricles of brain, cerebrum, white matter, blood supply to brain, diencephalon, brain stem, cerebellum, spinal cord, cranial nerves

UNIT V

Alimentary system: oral cavity, salivary glands, tongue, pharynx, other organs (oesophagus, stomach, small intestine, large intestine, liver, biliary system, pancreas)
Urinary system: kidneys, ureter, urinary bladder, male and female urethra
Reproductive system: male and female reproductive system

Text books:

1. Jayanthi V, “text book of anatomy”, emmess publications

Reference books:

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

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 **Course Credits: 2:0:0**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Vijay Das, Ms. Tejaswini S

Course contents

UNIT I

General Physiology: Homeostasis, Feedback mechanism 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, EMG measurement Neuromuscular junction

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, Autonomic nervous system: functions and effects. Digital Reflex testing, Autonomic function testing,
Special senses: Vision, refractive errors, Refractive error testing, colour vision testing, Physiology of vision electro radiogram, electrooculogram, VEP, Physiology of hearing, Physiology of smell and taste Tuning fork tests, audiometry, BAEP.

UNIT III

Haematology: Introduction, Composition and functions of blood (RBC, WBC, Haemoglobin), Measurement of Haemoglobin Blood groups, 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, Vital graph, Measurement of Dead space, Computerized spirometry, PEFR
Digestive System: Introduction, Saliva and Deglutition, Functions of stomach, Functions of Liver, 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 itTrans epithelial potential difference, Measurement of GFR, Formation of Urine –normal constituents, Micturition reflex, Renal failure, Uroflowmetry, 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

Text books:

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

Reference books:

1. Ross &Wilson's, "Anatomy and Physiology in Health and Illness", Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications.2006
2. 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 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mr. S J Mahendra, Dr. Basavaraj V 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, functions, call by value, call by reference, function overloading, inline functions, functions with default arguments, structure and enumerated data types.

UNIT II

Classes & Objects-I: classes, Scope resolution operator, passing objects as arguments, returning objects, and object assignment. Constructors, Destructors, friend functions, Parameterized constructors, Static data members, Arrays of objects, Pointers to objects, Operator overloading such as +, - ,*, pre-increment, post-increment.

UNIT III

Class and Objects - II and Inheritance: This pointer, and reference parameter, Dynamic allocation of objects, Copy constructors, Operator overloading using friend functions such as +, - ,++,--. 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, 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

Data structures: Data representation, stacks, queues, Circular and priority queues, linked list, single linked list, trees, binary trees.

Text Book:

1. "Object Oriented programming with C++" Robert Lafore, 4th edition, Galgotia Publications. 2019.
2. "Data Structures, Algorithm and Applications in C++" Sartaj Sahni, Tata McGraw Hill Publications,2013.
3. Herbert Schildt, "The Complete Reference C++", 4th Edition, Tata McGraw Hill, 2011.

Reference Books:

1. Stanley B. Lippmann, Josee Lajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. "Object Oriented programming with C++" E Balaguruswamy, 4th Edition, TMH2011.
3. "Data Structures using C++" D.S. Malik, Thomson, 2010.

Course Outcomes (COs):

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

1. Identify classes, objects, members of a class and the relationships among them needed to solve a specific problem. (PO 1,2,3 & 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 & DIGITAL ELECTRONICS CIRCUITS LAB

Course Code: MLL38 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Ms. Chandana S, 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 Hartley, 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 comparator using logic gates and verification of magnitude comparator
12. Implementation T and D flip-flop using JK Master slave configuration and IC 7446
13. Implementation of MOD N Counters using ICs 7476
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 required applications (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 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Mr. Mahendra S J, Dr. Basavaraj V Hiremath

Course contents

1. Program using loops and control statements.
2. Program to illustrate pass by value and pass by reference.
3. Program to illustrate inline function and function with default arguments.
4. Program to illustrate structures and enumerated data type.
5. Program to illustrate class and objects and constructors.
6. Program to illustrate unary and binary operator overloading
7. Program to illustrate unary and binary operators using friend function.
8. Program to illustrate the concept of static data member, static data function and friend functions.
9. Program to illustrate virtual functions and pure virtual functions.
10. Program to implement stack using array.
11. Program to implement queue using array.
12. Program to implement circular queue using array.
13. Program to implement stack using single linked list.
14. Program to implement queue using single linked list.

Text Book(s):

1. Robert Lafore "Object Oriented programming with C++" , 4thedition,Galgotia Publications.2010.
2. E Balaguruswamy ,"Object Oriented programming with C++", 4th Edition, TMH2011.

References:

1. Herbert Schodit, "C++ The Complete Reference", 4th Edition, TMH, 2013.

Course Outcomes (COs):

At the end of the course, the student 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 data structures using object oriented programs. (PO 1,2,3; PSO 2)

ADDITIONAL MATHEMATICS – I

Course Code: AM31 **Course Credits: 0:0:0**
Prerequisite: Nil **Contact Hours: 40L**
Course Coordinator(s): Dr. N L Ramesh

Course Objectives:

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)

IV SEMESTER

ENGINEERING MATHEMATICS - IV

Course Code: ML41 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. M.V. Govindaraju, 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's1/3rd 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-transforms 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 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 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator(s): 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

Multivibrator and Advanced Applications: Schmitt Trigger- inverting and non-Inverting type, Monostable and Astable Multivibrator using Opamp, Monostable and Astable Multivibrator 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. Make use of Op-Amps for advanced applications involving Multivibrator, voltage regulation and PLL. (PO-1,3, 5, 9, 10,12; PSO- 1, 2)

BIOMEDICAL SIGNAL PROCESSING

Course Code: ML43 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator(s): Ms. Purnima B R, Dr. Sanjay H S

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), objectives and difficulties encountered in biomedical signal analysis .

UNIT II

IIR Filter Design and realizations: Introduction to IIR filters, Analog filter specification and classifications, Design of Butterworth and Chebyshev filters (both analog and digital versions – BLT and IIT for digitization), Realization of IIR filters (Direct forms, transposed structures, cascade and parallel forms)

UNIT III

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 IV

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 V

Detection of events: Event and wave detection: Derivative based methods, PAN TOMPKINS method, and Dichroitic notch detection. Correlation analysis of EEG rhythms, cross spectral techniques.
Data Reduction Technique: Turning Point, Huffman Coding, Run length Coding.

Text Books

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis", Wily Publications, 2nd Edition, 2016.
2. Proakis & Manolakis, PHI "Digital Signal Processing" 4th edition 2003, Pearson international edition
3. Ganesh Rao, Vineeth P Gejji "Digital Signal Processing"-Cengage publications 2017

Reference Books

1. John L Semlow, "Bio-signal & 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, students will be able to

1. Demonstrate an understanding of biomedical signals and identify the need for biomedical signal analysis. (PO-1,2,3,12; PSO-1,3)
2. Comprehend and interpret the various techniques involved in the design and implementation of IIR filters (PO-1,3; PSO-1)
3. Comprehend and interpret the various techniques involved in the design and implementation of FIR filters (PO-1,3; PSO-1)
4. Identify physiological interferences and artifacts affecting the biomedical signals and apply various filtering mechanisms for the enhancement of signals. (PO-2,4; PSO-1)
5. Detect various events involved in Biomedical signals and apply appropriate data reduction techniques. (PO-1,3; PSO-1)

CONTROL SYSTEMS

Course Code: ML44 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): 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)

DIGITAL IMAGE PROCESSING

Course Code: ML45 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi, Dr. C K Narayanappa

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
2. A K Jain, "Fundamentals of Digital Image processing ", PHI / Pearson Education, 2011
3. 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)

MICROCONTROLLER – MSP 430

Course Code: ML46 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Ms. UmaArun , Mrs. Tejaswini S

Course contents

UNIT I

Introduction to Embedded system: What (and Where) are Embedded Systems, Approaches to Embedded Systems, Anatomy of a Typical Small Microcontroller.
Memory: Computer System and Memory organization, Harvard and Van-Neumann 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 capability to 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. John H Devis, "MSP430 Microcontrollers Basics", 1st Edition, Reed Elsevier India Pvt. Ltd 2017
2. C P Ravikumar, "MSP430 Microcontrollers in Embedded System Projects", 1st Edition, Elite Publishing House, 2012
3. Jerry Luecke, "Analog and Digital Circuits for Electronic Control System Applications: Using the TI MSP430 Microcontroller", 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. (PO-1, 2, 12; PSO-1)
2. Analyze the architecture and programming model of MSP430. (PO-1, 2, 12; PSO-1)
3. Analyze the working of timer unit and interrupt the concepts of MSP430 and apply various applications. (PO-1, 2, 12; PSO-1)
4. Understand the concepts of data conversion units and serial communication protocols for external communication in MSP430 for various applications. (PO-1, 2, 12; PSO-1)
5. Interpret the various modalities used for wireless communication. (PO-1, 2, 12; PSO-1)

LINEAR INTEGRATED CIRCUITS LAB

Course Code: MLL47 **Credit: 0:0:1**

Prerequisite: Nil **Contact Hours:28**

Course coordinator(s): Ms. Chandana S, Mr. S J Mahendra

List of Experiments

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. "Linear Integrated Circuits" by D. Roy Choudhury and Shail B. Jain- New Age International, 2nd Edition, 2006 Reprint
2. "Op - Amps and Linear Integrated Circuits" by Ramakant A. Gayakwad- PHI, 4th Edition

Reference Books

1. "Operational Amplifiers and Linear IC's" by David A. Bell-PHI/Pearson, 2004, 2nd Edition

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)
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,; PSO:2,3)

BIOMEDICAL SIGNAL PROCESSINGLAB

Course Code: MLL48 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Mrs. Purnima B R, Dr Sanjay H S

Course contents

1. Operations on Signals: Time Scaling, Amplitude Scaling, Shifting, Circular folding, Circular Shifting, Linear Convolution, Circular Convolution.
2. To verify properties of DFT: linearity property, Circular convolution, Multiplication in time domain Complex conjugate property of DFT, Parseval's theorem, Circular folding, Time shifting and frequency shifting.
3. Verification of Sampling Theorem
4. Design of digital IIR Butterworth filters using Bilinear transformation andimpulse invariant methods
5. To design FIR filters using windowing Technique
6. Design and Implementation of Moving Average filters
7. Design and Implementation of Derivative Based Filters
8. Design and Implementation of Notch Filters and Comb Filters
9. To perform QRS detection using PAN-TOMPKINS algorithm
10. To perform derivative based QRS detection
11. Detection of EEG rhythms
12. To perform Spectral Analysis of Biomedical Signals

Text Books

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis", Wiley IndiaPublications, 2015

Reference Books

1. Robert J. Schilling, Sandra L Harris, "Fundamentals of Digital Signal Processingusing MATLAB, 2011
2. Bio-signal& Biomedical Image Processing – John L Semmlow, Dekker Media

Course Outcome (COs):

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

1. Reminisce the basics of biomedical signal processing using MATLAB (PO-1,2,4 &PSO-1)
2. Accent the design and implementation of various signal processing techniques and apply the same to biomedical signals. (PO-3,12 & PSO-1,3)
3. Relate the results obtained to the concepts of biomedical signal processing so as to obtain a better understanding of the same (PO-9,12 & PSO-1)

ADDITIONAL MATHEMATICS – II

Course Code: AM41 **Course Credits: 0:0:0**
Prerequisite: Nil **Contact Hours: 40L**
Course Coordinator(s): 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 transform 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, 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 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)