RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2020 – 2021

ELECTRONICS AND TELECOMMUNICATION 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 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 Department of Electronics &Telecommunication Engineering (Formerly known as Department of Telecommunication Engineering) was established in 1996 to address the increasing demand for professionals with expertise in communication and networking technology in India. The Department has state of the art laboratories, equipment's, resources and committed faculty having best of the academic and industry recognition. The Department started a **M.Tech program in Digital Communication in the year 2004**. The Department also started a **Research Centre** in the year 2012 and currently has 12 Research Scholars carrying out their Research. Department has collaborations with some of the leading industries like **Texas Instruments, Ansys, Rohde & Schwarz, JV Micronics, Nokia, Honeywell, Intel, ARM-Nuvoton, Ericsson, Samsung, ABB** and with leading national and international universities like **Bradley University, Stanford University, IIT-M**, enabling the department to focus on R&D, and thus providing new avenues for PG/UG students for placement and higher studies. Both UG and PG Programs are accredited by the **National Board of Accreditation**. There are **5 Funded Research projects** (Industry and Government) ongoing in the department involving students to carry out innovative projects. Many professional activities are organized regularly to the students under various professional societies like IEEE Sensor Council, IEEE Communication Society and IETE Bangalore.

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

RIT 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 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

To provide an ambience for the students to excel in studies, research and innovation, focusing on meeting global socio-economic needs from a Telecommunication Engineering perspective

MISSION OF THE DEPARTMENT

- Providing high quality technical education to create world class Telecommunication engineers.
- Creating an ambience for skill development, research and entrepreneurial activities to meet socio-economic needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will excel in professional careers in Industry, Academic, Research and Development that meet the needs of Organizations.

PEO2: Graduates will be able to analyze real life problems and be able to suggest solutions to design complex engineering systems that are technically sound, economically feasible and socially acceptable.

PE03: Graduates will exhibit all-round education that includes communication skills, the ability |to function well in a team, an appreciation for ethical behavior and the ability to engage in lifelong learning.

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: Identify, analyze, formulate, design and demonstrate applications relevant to telecommunication engineering using electronic devices.

PSO2: Use current technology and modern tools to address solutions for telecommunication products by taking into account safety, healthy and environmental requirements.

PSO3: Apply project management tools to solve Telecommunication systems by exhibiting teamwork and lifelong learning.

Curriculum Course Credits Distribution

BATCH 2019-2023

Course Category/Semester	1	2	3	4	5	6	7	8	Total credits
Humanities, Social Sciences and Management (HSMC)		2			3		3		8
Basic Sciences(BSC)	9	8	4	4					25
Engineering Sciences (ESC)	11	10							21
Professional courses (PCC)-core			21	21	15	11	10		78
Professional Courses (PEC)-Elective					3	6	6		15
Other Open Elective Courses (OEC)					3	3			6
Project work (PROJ)/Internship (IN)						4	1	17	22
Total	20	20	25	25	24	24	20	17	175

SCHEME OF TEACHING
III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	ET31	Engineering Mathematics – III	BSC	3	1	0	4	5
2.	ET32	Analog Circuit Design	PCC	4	0	0	4	4
3.	ET33	Digital Circuit Design	PCC	4	0	0	4	4
4.	ET34	Network Analysis	PCC	4	0	0	4	4
5.	ET35	Engineering Electromagnetics	PCC	4	0	0	4	4
6.	ET36	Data Structures Using C	PCC	2	1	0	3	4
7.	ETL37	Analog Circuit Design Lab	PCC-Lab	0	0	1	1	2
8.	ETL38	Digital Circuit Design Lab	PCC-Lab	0	0	1	1	2
			Total	**21**	**2**	**2**	**25**	**29**

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.

SCHEME OF TEACHING
IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	ET41	Engineering Mathematics – IV	BSC	3	1	0	4	5
2.	ET42	Microcontroller	PCC	4	0	0	4	4
3.	ET43	Microwave and Antenna Engineering	PCC	4	0	0	4	4
4.	ET44	Systems Modelling and Control	PCC	3	0	1	4	5
5.	ET45	Signals & Systems	PCC	3	1	0	4	5
6.	ET46	OOPS Using C ++	PCC	3	0	0	3	3
7.	ETL47	Microcontroller Lab	PCC-Lab	0	0	1	1	2
8.	ETL48	Microwave and Antenna Lab	PCC-Lab	0	0	1	1	2
			Total	**20**	**2**	**3**	**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.

III Semester

ENGINEERING MATHEMATICS-III

Course Code: ET31 **Credits: 3:1:0**
Course Coordinator: Dr Vijay Kumar **Contact Hours: 42+28**

Course Content

UNIT 1

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 2

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. Applications to Engineering problems.

UNIT 3

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 4

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

UNIT 5

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. 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, 2015.
2. Dennis G. Zill and Michael R. Cullen, "Advanced Engineering Mathematics", Jones and Barlett Publishers Inc., 3rd edition, 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):

1. Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data. **(PO1,2) (PSO 1)**
2. Test the system of linear equations for consistency and solve system of ODE's using matrix method. **(PO1,2) (PSO 1)**
3. Examine and construct the analytic functions. **(PO1,2) (PSO 1)**
4. Classify singularities of complex functions and evaluate complex integrals. **(PO1,2) (PSO 1)**
5. Construct the Fourier series expansion of a function/tabulated data. **(PO1,2) (PSO 1)**

ANALOG CIRCUIT DESIGN

Course Code: ET32 **Credits: 4:0:0**
Course Coordinator: Dr Satish Tunga **Contact Hours: 56**

Course Content

UNIT 1

Field – Effect Transistors: Introduction and Characteristics of JFETs, Transfer Characteristics. FET Biasing Introduction, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing. FET Amplifiers Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed- Bias Configuration, Self-Bias Configuration, Voltage-Divider Configuration, Source Follower Configuration. Low Frequency Response, High Frequency Response - FET Amplifier Miller Effect Capacitance, High Frequency Response- - FET Amplifier.

MOSFET: Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, Biasing in MOS amplifier Circuits, Small Signal Operation and Models, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation modes, single stage MOS amplifiers. MOSFET internal capacitances and high frequency modes, Frequency response of CS amplifiers, CMOS digital logic inverter, and detection type MOSFET.

UNIT 2

Power Amplifiers: Class A large signal amplifiers, second harmonic distortion, high order harmonics generation, Transformer coupled audio power amplifier, Class B push pull amplifiers.

Feedback Amplifiers: Concept of feedback, Transfer gain with feedback, General characteristics of negative feedback amplifiers, Input and Output impedance.

UNIT 3

Introduction to Operational Amplifiers and Characteristics: Introduction, Block diagram, characteristics and equivalent circuits of an ideal op-amp. The Practical op-amp Introduction, Input offset voltage, offset current, thermal drift, common mode rejection ratio, Slew rate and its Effect, PSRR and gain – bandwidth product, Relevant problems.

Amplifiers and Oscillators: Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, isolation amplifiers, Triangular/rectangular wave generator, phase-shift oscillators bridge oscillator, analog multiplier (MPY634) VCO, Relevant Problems.

UNIT 4

Comparators and Converters: Comparator, Zero Crossing Detector, Monostable and Astable Multivibrator, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter. Relevant Problems.

Active Filters: First & Second order high pass & low pass Butterworth filters, higher order filters Band pass filters, Band reject filters & all pass filters.

UNIT 5

A/D & D/Converters: Basics, R–2R D/A Converter, Integrated circuit 8-bit D/A, successive approximation ADC, linear ramp ADC, dual slope ADC, digital ramp ADC

Timer: Internal architecture of 555 timer, Mono stable, Astable multivibrators and applications.

Advanced Applications: Applications as Frequency Divider, PLL, AGC, AVC using op-AMP and analog multipliers, Amplitude modulation using analog multiplier, Frequency Shift Keying, simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs.

TEXT BOOKS

1. Robert L. Boylestad and Louis Nashelsky, "Electronics devices and Circuit theory", Pearson, 10th Edition, 2009.
2. A S. Sedra, K. C. Smith, "Microelectronic Circuits", Oxford University Press, 2011.
3. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson, 4th edition, 2015.

REFERENCE BOOKS

1. I. J. Nagrath, "Electronics: Analog and Digital", PHI. 2. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. David A. Bell, "Operational Amplifiers and Linear ICs" Oxford University Press, 3rd Edition 2011
3. B. Somanthan Nair, "Linear Integrated Circuits; Analysis, Design and Applications", Wiley India 2013
4. J. Millman, C. C. Halkias, Chetan. D. Parekh, "Integrated Electronics", McGraw Hill, 2010.
5. Choudhury Roy D and Shail B. Jain, "Linear Integrated Circuits", Wiley Eastern, 2015

COURSE OUTCOMES (COs):

1. Acquire knowledge of working principles of Electronic devices and Linear IC'S **(PO 1, 2, 3, 5, 6, 9, 10, 12) (PSO 1, 2, 3)**
2. Analyse Various Amplifier Circuits using BJT, FET and MOSFET **(PO 1, 2, 3, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Understand the basics of linear IC's. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Analyse the performance of various circuits using Linear ICs **(PO 1, 2, 3, 5, 11, 12) (PSO 1, 2, 3)**
5. Acquire competency to design circuits basic analog circuits. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**

DIGITAL CIRCUIT DESIGN

Course Code: ET33 **Credits: 4:0:0**
Course Coordinator: Dr Umesharaddy **Contact Hours: 5**

Course Content

UNIT 1

Principle of combinational logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables, incompletely specified functions (Don't Care terms), Simplifying Maxterm equations, Map entered variables.

BCD to excess-3 Code Conversion and vice-versa, Binary to gray Code Conversion and vice-versa, Quine Mccluskey Minimization Technique

Analysis and Design of Combinational logic: General approach, Decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors - Cascading full adders, carry Look ahead carry, Binary comparators. Braun array Multiplier, Parity generator and checker.

UNIT 2

Sequential Circuits: Basic Bistable Element, Latches, SR Latch, Application of SR Latch, A Switch Debouncer, The *R S* Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip- Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic Equations, Registers, Counters - Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-6 Counter using clocked JK Flip-Flops Design of a Synchronous Mod-6 Counter using clocked D, T, or SR Flip-Flops, Design of Mealy and Moore sequential networks. Unidirectional & universal shift register, Sequence generator and Detector.

UNIT 3

Overview of Digital Design with Verilog HDL: Evolution of computer aided digital design- Emergence of HDLs-Typical design flow-importance of HDLs-Popularity of Verilog HDL-Design Methodologies-modules-instances-components of simulation-example-basic concepts, Modules and ports: Modules-ports-Rules-Hierarchical Names.

Gate Level modeling and Data flow modeling: Gate Types-Gate Delays-Delay Examples-Continuous Assignment-Delays-Expressions, Operators, Operands-Operator Types-Examples. Modeling of adder, subtractor, multiplier, comparator using full adder, Switch level modeling of gates & simple boolean expressions.

UNIT 4

Behavioral modeling: Structured procedures-Procedural assignments- Timing controls-conditional statement- Multi way branching-Loops-Sequential and parallel blocks, Generate blocks-Examples. Behavioral modeling of flip-flops and counters.

Tasks and Functions: Difference between Tasks and Functions-Tasks-Functions-Automatic Functions- Constant Function-Signed Functions.

N-bit binary to integer and vice versa conversions.

UNIT 5

Logic Synthesis with Verilog HDL: Logic synthesis-Verilog HDL Synthesis-Interpretation of Verilog Constructs-Synthesis Design flow-examples-verification of the gate level netlist, modeling tips for logic synthesis.

Memory and PLDs: ROM, RAM, Simple PLDs**,** PROM, PLA, PAL, Complex PLDs, CPLD Architecture, FPGA Architecture, CLBs, I/Os, interconnectors, Digital Circuit Design using FPGAs. Composition of Memory, FBGA Fabrics.

TEXT BOOKS

1. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2001.
2. Donald D Givone, "Digital Principles and Design", Tata McGraw Hill Edition, 2002.
3. Samir Palnitkar, "VERILOG HDL-A Guide todigital design and synthesis", 2nd edition, Pearson education.2003.
4. Wayne Wolf, "FPGA based system design", Pearson Education, 2005.

REFERENCE BOOKS

1. R D Sudhaker Samuel, "Logic Design – A simplified approach", Sanguine Technical Publishers, 2011
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital logic with VERILOG design", TMH, 2013

COURSE OUTCOMES (COs):

1. Ability to simplify & design any combinational logic circuit with minimum gates. **(PO1, 2, 3, 6, 12) (PSO1, 2, 3)**
2. Ability to design any sequential network with minimum number of gates. **(PO1, 2, 3, 12) (PSO1, 3)**
3. Demonstrate the basic knowledge of Verilog HDL to design digital circuit. **(PO1, 2, 3, 5, 6, 12) (PSO1, 2, 3)**
4. Ability to apply HDL in modelling combinational and sequential circuits using different abstraction levels. **(PO2, 3, 5, 12) (PSO1, 2, 3)**
5. Use EDA tools to design and synthesize digital circuit target to FPGA processor. **(PO1, 3, 5) (PSO1, 2)**

NETWORK ANALYSIS

Course Code: ET34 **Credits: 4:0:0**
Course Coordinator: Dr Viswanath Talasila **Contact Hours: 56**

Course Content

UNIT 1

Basic Concepts:
Practical and Ideal sources, Source transformations, Mesh and Nodal analysis

UNIT 2

Circuit Analysis Techniques
Superposition theorem, Thevenin's theorem, Maximum power transfer theorem

UNIT 3

Transient Behaviour, Initial conditions and Laplace Transforms with Applications
Analysis of networks (RL, RC and RLC combinations) using Laplace transforms, for various inputs (step, ramp, sinusoidal etc)

UNIT 4

Transfer Function models and Frequency Response of electric circuits
Introduction to Transfer Functions, Transfer function models of electric circuits, Bode plots for frequency response analysis of electric circuits (Circuit bandwidth, Resonance)

UNIT 5

Applications of Circuit Theory
Introduction to Filters and Filter Design (Low, High and Band Pass filters, Notch filters). Introduction to simple signal conditioning: Multi-stage amplifier and filtering stages.

TEXT BOOKS:

1. Hayt, "Engineering Circuit Analysis", Kemmerly and Durbin, 6th Edition, 2002
2. "Analysis of Linear Systems", David K Cheng, Narosa Publishing House, 11th reprint, 2002

REFERENCE BOOKS:

1. "Network Analysis", ME Van Valkenburg, PHI/Pearson, 3rd Edition, 2002
2. "Circuits", Bruce Carlson, Thomson Learning, 2002

COURSE OUTCOMES (COs):

1. Develop the ability to conceptualize key aspects of linear electrical circuits **(PO 1,2,3,4,6) (PSO 1,2)**
2. Use differential equations to model and analyze linear electric circuits **(PO 1,2,3,4,6) (PSO 1,2)**
3. Understand the importance of time and frequency domain approaches towards analyzing linear electric circuits **(PO 1,2,3,4,6) (PSO 1,2)**
4. Design and analyse simple electrical circuits for various applications **(PO 1,2,3,4,9,10,12) (PSO 1,2,3)**
5. Use circuit theorems and transform techniques to simplify the analysis and design of linear circuits **(PO 1,2,3,4,5,6,9,10,12) (PSO 1,2,3)**

ENGINEERING ELECTROMAGNETICS

Course Code: ET35 **Credits: : 4:0:0**
Course Coordinator: Nisha S L **Contact Hours: 56**

Course Content

UNIT 1

Coluomb's Law and Electric Field Intensity: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge and Sheet charge.

Electric flux density and Gauss's Law: Applications of Gauss's Law, divergence, Maxwell's First equation (Electrostatics), Vector Operator Dell and divergence theorem.

UNIT 2

Energy And Potential: Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Energy density in the electrostatic field.

Conductors, Dielectrics and Capacitance: Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, Capacitance and examples.

UNIT 3

Poisson's And Laplace's Equations: Derivation of Poisson's and Laplace's Equations, Examples of the solution of Laplace's equation.

The Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic Potentials.

UNIT 4

Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements. Force and Torque on a closed circuit, Magnetic boundary conditions

Time-varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, the retarded potential.

UNIT 5

Uniform Plane Wave: Wave propagation in free space, Wave propagation in dielectrics, Poynting's theorem and wave power, Propagation in good conductors: Skin Effect.

Transmission lines: Introduction, transmission line equation and solution, Reflection and transmission coefficients, SWR, line impedance, and line admittance, Smith chart.

TEXT BOOKS

1. W.H. Hayt, J.A. Buck and M. Jaleel Akhtar, "Engineering Electromagnetics", 8th Edition, McGraw-Hill, 2015.
2. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford University Press, 2015.

REFERENCE BOOKS

1. John Krauss and Daniel A Fleisch, "Electromagnetics with applications", Mc GrawHill, reprint 2014.
2. N. Narayana Rao, "Fundamentals of Electromagnetics for Engineering", Pearson, reprint 2012.

COURSE OUTCOMES (COs):

1. State several laws and principles of electric, magnetic, and electromagnetic fields **(PO 1, 2, 6,7,8, 9,10, 11, 12) (PSO 1, 2, 3)**
2. Solve problems by applying the concepts of electric, magnetic, electromagnetic fields and to use smith Chart. **(PO 1, 2,3, 4, 6,7, 8, 9,10, 11, 12) (PSO 1, 2, 3)**
3. Analyse theoretical and practical meaning of different expressions related to electric and magnetic fields. **(PO 1, 2,3, 4, 6,7, 8, 9,10, 11, 12) (PSO 1, 2, 3)**
4. Analyse the importance of Electrostatic, Magnetic boundary condition, Time-varying fields and Maxwell's equations. **(PO 1, 2,3, 4, 6,7, 8, 9,10, 11, 12) (PSO 1,2,3)**
5. Evaluate wave equation for Uniform Plane Waves in good conductor, dielectric, transmission lines, and power associated with EM waves using Poynting theorem. **(PO 1, 2,3, 4, 6,7, 8, 9,10, 11, 12) (PSO 1, 2, 3)**

DATA STRUCTURE USING C

Course Code: ET36 **Credits: 2:1:0**
Course Coordinator: Dr Shobha K R **Contact Hours: 28+28**

Course Content

UNIT 1

Introduction to structures, pointers and functions in C

Linked List: Dynamic memory allocation & de allocation functions, Introduction to Linked List, Types of linked list, Basic operations (Insert, Delete, Traverse, Search, and Display), and Algorithms & Programs using Singly, Doubly & Circular linked list. Linked List Applications: Addition of two long positive integers, Addition of two polynomials, and Evaluation of a polynomial.

UNIT 2

Stacks & Queues: Basic stack operations, Stack applications-Conversion & Evaluation of expressions, other applications on stack.

Queues: Introduction to queues: Basic operations, Different types of queues, Queue linked list implementation.

UNIT 3

Trees: Introduction to trees: Basic tree concepts, Binary tree properties, Binary tree traversal, Expression tree. Operations, Algorithms & programs on Binary search tree (BST), equivalence between binary search algorithm and BST.

Basic concepts of AVL trees and B Trees

UNIT 4

Sorting: Sorting: sort concepts-sort order, sort stability, sort efficiency. Types of sorting: Selection sort- Heap sort. Insertion sort-Simple insertion sort, Shell sort, Address calculation sort. Exchange sort-Quick sort, Bubble sort. External sort - Merge sort.

Searching: List searches: Binary search & sequential search. Hashed list searches: Basic concepts, Hashing Methods, Collision Resolution Methods: Open Addressing, Linked list.

UNIT 5

Graphs: Introduction & Basic concepts, Graph operations, Graph traversal-Depth first & Breadth first traversal. Graph storage structure: Adjacency matrix & Adjacency list. Graph Algorithms: Insert, Delete and Append Vertices & Edges. Application of Graph Operations: Web Graph.

Networks: Minimum spanning Tree & Shortest path Algorithms.

TEXT BOOKS

1. Yedidyah Langsam & Moshe J. Augenstein Aaron M. Tanenbaum, "Data Structures using C O Pearson Publication, 2008
2. Richard Gilberg and Behrouz Forouzan, "Data Structures: A Pseudo code approach with C", 2nd edition, Thomson publishing, 2007.
3. E. Balagurusamy, "Data Structures using C", Tata McGraw Hill, 2017

REFERENCE BOOKS

1. Reema Theraja, "Data Structures using C", Oxford publications,2014
2. Sahni Horowitz, "Fundamentals of Data Structures", University Press , Second edition,2008
3. E. Balagurusamy, "Programming in ANSI C", Tata McGraw Hill, 2017.
4. NPTEL online course "Programming and Data Structures", http://nptel.ac.in/courses/106105085/
5. NPTEL online course "Introduction to programming in C", https://onlinecourses.nptel.ac.in/noc17_cs43/preview

COURSE OUTCOMES (COs):

1. Understand the basic concepts of Data structures and C programming **(PO1,2,3,12) (PSO 1,3)**
2. Differentiate between Linear and Non-Linear data bases and their associated concepts **(PO1,2,3,4,12)**
   (PSO 1,3)
3. Design linear and Nonlinear databases suitable to a given application **(PO1,2,3,4,6,8.9.10.11,12) (PSO 1,2,3)**
4. Develop the different functionalities to be performed on databases **(PO1,2,3,4,6,7, 8.9.10.11,12) (PSO 1,2,3)**
5. Evaluate the application for which the database is designed **(PO1,2,3,4,6,7, 8.9.10.11,12) (PSO 1,2,3)**

ANALOG CIRCUITS DESIGN LAB

Course Code: ETL37 **Credits: 0:0:1**
Course Coordinator: Kusuma S M **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS:

1. Design and Testing of diode clipping circuits
2. Design and Testing of diode clamping circuits.
3. Design and testing of rectifiers with filters/simulation
4. Design and testing of regulators
5. Design and testing of RC coupled single stage BJT amplifier
6. Design and testing of Colpitts and crystal oscillators /simulation
7. Design and testing of Complementary Symmetry Class B push pull amplifier.
8. Design and testing of Inverting/Non Inverting and Instrumentation amplifier using Opamp IC741/ simulation
9. Design and testing of integrator and Schmitt trigger using Opamp IC741.
10. Design and testing of Analog filters using OpampIC741.
11. Design and testing of Astable multivibrator using timer IC555.
12. Design and testing of Mono stable multivibrator using timer IC555.
13. Design and testing of ADC
14. Design and testing of DAC

TEXT BOOKS

1. Jacob Millman and Christos C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2009.
2. D. Roy Choudhury and Shail B Jain, "Linear Integrated Circuits", 2nd edition reprint, New Age International, 2006.

REFERENCE BOOKS

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit theory", Pearson Education, 9th Edition, 2009.

COURSE OUTCOMES (COs):

1. Design Clipping and clamping circuits, rectifiers, regulators. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Design and evaluate amplifiers and oscillators. **(PO 1, 2, 3, 4, 5, 6, 9,10,11,12) (PSO 1,2, 3)**
3. Design and evaluate Opamp circuits. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Design and evaluate Multivibrator using 555 timers. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11,12) (PSO 1, 2, 3)**
5. Design and evaluate analog filters and converters. **(PO 1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**

DIGITAL CIRCUIT DESIGN LAB

Course Code: ETL38 **Credits: 0:0:1**
Course Coordinator: Dr Umesharaddy **Contact Hours: 28**

Note:

I. Student should design the logic circuit using **gates** and wiring the circuit using **trainer kit** to verify the design.
II. Student should write the Verilog module to simulate and synthesize the logic circuit using FPGA **XC3S400 IC** hardware with **Xilinx 14.7i** software.

Course Content

LIST OF EXPERIMENTS:

1. Simplification, realization of Boolean expressions using logic gates/Universal gates.
2. Realization of Half/Full adder and Half/Full Subtractors using logic gates.
3. Realization of 4-bit parallel adder/Subtractors using 7483 chip.
4. Realization of 3-bit Binary to Gray code conversion and vice versa.
5. MUX/DEMUX – use of 74153, 74139 for arithmetic circuits and code converter.
6. Realization of One/Two/Four-bit comparator.
7. Design of Decoder and Encoder with & without priority (74147).
8. Truth table verification of Flip-Flops: (i) JK Master slave (ii) T type and (iii) D type.
9. Realization of 3 bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).
10. Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95.
11. Writing the Verilog module to simulate and synthesize Ring/Johnson Counter.
12. Writing a Verilog module to interface Stepper motor,
13. Writing a Verilog module to interface DC-motor
14. Writing a Verilog module to interface DAC to FPGA.

TEXT BOOKS

1. John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2001.
2. Donald D Givone, “Digital Principles and Design “, Tata McGraw Hill Edition, 2002.
3. Samir Palnitkar, “VERILOG HDL-A Guide to digital design and synthesis”, 2nd edition, Pearson education, 2003.
4. Wayne Wolf, “FPGA based system design”, Reprint 2005, Pearson Education, 2005

REFERENCE BOOKS

1. R D Sudhaker Samuel, "Logic Design – A simplified approach", Sanguine Technical Publishers, 2011
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital logic with VERILOG design", TMH, 2013

COURSE OUTCOMES (COs):

1. Ability to design and implement any combinational logic circuit with minimum gates. **(PO1, 2, 3, 5, 12) (PSO1, 2, 3)**
2. Ability to design and implement any sequential network with minimum number of gates. **(PO1, 2, 3, 5, 12) (PSO 1, 2, 3)**
3. Demonstrate the basic knowledge of Verilog HDL to design digital circuit. **(PO1, 2, 3, 5, 6, 12) (PSO1, 2, 3)**
4. Ability to apply HDL in modelling combinational and sequential circuits using abstraction levels. **(PO2, 3, 5, 12) (PSO 1, 2, 3)**
5. Use EDA tools to design and synthesize digital circuit target to FPGA processor. **(PO1, 3, 5) (PSO1, 2)**

ADDITIONAL MATHEMATICS – I

Course Code: AM31 **Credits: 0:0:0**
Course Coordinator: Dr. N L Ramesh **Contact Hours: 40L**

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)

IV Semester

ENGINEERING MATHEMATICS-IV

Course Code: ET41 **Credits: 3:1:0**
Course Coordinator: Dr Vijay Kumar **Contact Hours: 42+28**

Course Content

UNIT 1

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 2

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 3

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 4

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 5

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, 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):

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. **A**nalyse 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)**

MICROCONTROLLER

Course Code: ET42 **Credits: 4:0:0**
Course Coordinator: Ramya H R **Contact Hours: 56**

Course Content

UNIT 1

Introduction to Microcontroller: Small Microcontroller, Anatomy of a Typical Small Microcontroller, Memory, Software, where does MSP430 fit, The Outside View—Pin-Out, Functional Block Diagram, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets, Development Environment, Assembly Language., Access to the Microcontroller for Programming and Debugging.

UNIT 2

Architecture of the MSP430 Processor: Central Processing Unit., Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets.

UNIT 3

Digital I/Os, Interrupts and LP Modes: Parallel ports, Interrupts on Inputs, Application: examples of hex keypad, multiplexed display, LCD and DC motor interfaces. Interrupts and ISRs. Low Power Modes of operation.

Development Environment: Introduction, Aspects of C for Embedded Systems, Access for debugging, MSP430- starter kit

UNIT 4

Clock System & Timers: Clock modules; Crystal oscillators, VLO and DCO, Clock module control, Oscillator Faults, FLL.

Timers: Watchdog timer, Basic Timer1, RTC, Timer_A; Timer block, Capture and compare channels, interrupts, Example application –Generation of a precise frequency and a simple PWM.

UNIT 5

Mixed Signal Systems and Communication Interfaces: General and practical issues with ADCs, Architecture and Basic operations of - The ADC10 Successive-Approximation, Basic introduction to DAC12, Serial Peripheral Interface, SPI with USCI, Software UART using Timer_A.

TEXT BOOKS

1. John H. Davies, "MSP430 Microcontroller Basics"**,** Newnes, Elsevier, 2008.
2. Cris Nagy, "Embedded Systems Design using the TI MSP430 Series", Newnes, Elsevier, 2003.

REFERENCE BOOKS/MATERIAL

1. www.msp430.com

COURSE OUTCOMES (COs):

1. Understand the concepts of microcontroller, interrupts, low power modes, Timers and communication interface (**PO 1, 2, 3, 6, 11, 12) (PSO 1, 2, 3)**
2. understand the development environment of MSP430 processor for the programs the programs using interrupts, Low power modes, Timers and communication interface **(PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Illustrate the programs using interrupts, Low power modes, Timers and communication interface **(PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Implement the programs using interrupts, Low power modes, Timers and communication interface **(PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Differentiate the analysis of implementation of the concepts of interrupts, Low power modes, Timers and communication interface **(PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

MICROWAVE AND ANTENNA ENGINEERING

Course Code: ET43 **Credits: 4:0:0**
Course Coordinator: Dr Swetha Amit **Contact Hours: 56**

Course Content

UNIT 1

Introduction to Microwaves: History of Microwaves, Microwave Frequency bands, Applications of Microwaves, Concept of Mode, Characteristics of TEM, TE and TM Modes, TE_{10} dominant mode. *Rectangular Waveguide*: T junctions, H plane, E plane and Magic Tee junctions, Scattering Parameters, Planar Dielectric Waveguides, The Transmission Line Equations, *Graphical Methods*: Smith Chart.

UNIT 2

Passive and Active Microwave Devices: *Propagation in Good Conductors*: Skin Effect, Planar Transmission line: Stripline, Microstrip Line, Microwave Passive components: Directional Coupler with S-parameters, ring resonator, Isolator. Microwave Semiconductor Devices: Gallium arsenide Devices, RF Filter, Amplifier and RF mixer, Microwave Sources: Klystron, GUNN, YIG oscillator. Microwave Power measurements: RF power meter and sensor, Spectrum analyzer, VSWR meter.

UNIT 3

Microwave Propagation: *Sky Wave Propagation*: Structure of the ionosphere, Critical frequency, Maximum usable frequency, Skip distance, OWF, Effect of Earth‘s magnetic field, *Space Wave Propagation*: Reflection from ground for vertically and horizontally polarized waves, Reflection characteristics of earth, Duct propagation. *Ground Wave Propagation*: Attenuation characteristics for ground wave propagation, Calculation of field strength at a distance, Illustrative Problems.

UNIT4

Antenna and Its Array: Introduction to Antenna basics, current distribution on a thin wire antenna, Radiation pattern, Beam area and beam solid angle, Radiation intensity, directivity, Antenna aperture, Friis Transmission formula, Antenna field zones. Introduction to Arrays: broadside and end fire array, Hansen and Woodyard array. Introduction to short electric dipoles: Expression for far field Electric and Magnetic components, Radiation resistance of a short dipole. EM modelling with MATLAB

UNIT 5

Antenna Types: Horn antenna, Helical antenna, Yagi-Uda antenna, Corner reflectors, Parabolic reflectors, Lens antenna, MIMO antennas, Fractal antenna, Smart

antenna, antennas for satellite, antennas for ground penetrating radars, Embedded antennas, Ultra wide band antennas, Slot antennas. Illustrative problems to design the above said antennas. *Planar Antennas*: Salient features, Advantages and limitations, rectangular micro strip antenna, feeding techniques, design of practical antenna in HFSS.

TEXTBOOKS

1. David M Pozar, "Microwave Engineering", 4th edition, Wiley Publication, 2014.
2. John D Kraus, Ronald J. Marhefka and Ahmed S Khan, "Antenna and Wave Propagation", Fourth edition, McGraw Hill Publication, 2010.
3. K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation", Tech. India Publications, New Delhi, 2010.
4. John Volakis, "Antenna Engineering Handbook", IV Edition, McGraw Hill Publications, 2013

REFERENCE BOOKS

1. Samuel Y Liao, "Microwave Devices and Circuits", 3rd edition, Pearson Publication, 2013.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", McGraw-Hill, 2010.
3. C.A.Balanis,"Antenna Theory Analysis and Design", Third edition John Wiley, 2012.
4. http://www.sjsu.edu/people/raymond.kwok/docs/project172/EE172_YIG_oscillator.pdf
5. https://www.rohde-schwarz.com/cz/products/test-and-measurement/signal-spectrum-analyzers/pg_overview_63665.html

COURSE OUTCOMES (COs):

1. Acquire the basic knowledge of waveguides, RF devices, microwave sources and measurement devices and parameters of antenna. **(PO 1,12) (PSO 1, 2, 3)**
2. Apply the concepts of RF devices in solving problems related to microwave devices, isotropic and non-isotropic sources. **(PO 1,2,3) (PSO 1,2,3)**
3. Analyze the specifications for antenna design to describe the array of antennas, point sources and conditions to increase the directivity of array antennas. **(PO 1,2) (PSO 1)**
4. Analyze the far field components of short dipole to understand its behaviour and interpret the effects of Earth's magnetic field on wave propagation by modelling in MATLAB **(PO 1,2) (PSO 1,2,3,5)**
5. Design a RF device which is used in RF and microwave communication system using HFSS. **(PO 1,2,3,4,5,6,7,8,9,10,11,12) (PSO 1,2,3)**

SYSTEMS MODELLING AND CONTROL

Course Code: ET44 **Credits: 3:0:1**
Course Coordinator: Dr Viswanath Talasila **Contact Hours: 42+28**

Course Content

UNIT 1

Transfer Function Approach to Modelling of Systems and Control Systems: Transfer Function Models of physical systems, Types of Control Systems, Notion of stability and the role of the characteristic equation in determining stability, covering three different application domains (electrical, mechanical, Phase Locked Loops for communication systems); Introduction to simulation of transfer function systems in MATLAB.

UNIT 2

State Space Modelling of Physical Systems (Stability and Controllability): Introduction to state space techniques (from differential equations to state equations), State Transition, Modern notions of Stability, Controllability (also briefly, observability), covering six different application domains (electrical, mechanical, Phase Locked Loops for communication systems, biomechanical systems); Introduction to simulation of state space systems in MATLAB. Self-study in any one application domain (eg., communication, bio-mechanics, ecology, economics, flight control).

UNIT 3

Performance Specifications of Control Systems: Standard test signals, First and second order systems, Time response specifications, Steady state errors. Frequency domain Discussions on characterization of system performance using material from Bernstein's "A Students Guide to Classical Control", IEEE Control Systems, August 1997. Use of MATLAB for computing performance requirements.

UNIT 4

Pole Placement (controller design): Theory of pole placement (the full state feedback case), Full State/output feedback, Design of controllers for pole placement, Problems in pole placement.

UNIT 5

Applications of Systems Modelling: Inertial Navigation, Congestion control in communication networks, the AIMD technique, Antenna Tracking Control System through pole placement, Phase Locked Loop system (in Clock Generation and GPS)

LIST OF EXPERIMENTS:

1. Introduction to MATLAB, Matrix data manipulation
2. Algebraic operations
3. Data visualization
4. Creating user defined functions (Conditional logic and loops)
5. Accessing data from files (excel, .dat, .csv etc) and data visualization
6. Signals:
   - ✓ To create various signals: sinusoidal, exponential, ramp etc and visualize them
   - ✓ To create discrete time signals: square wave, unit step etc
7. Signal operations:

. Perform operations on signals to modify their frequency, addition of two signals etc Introduce noise into signals

8. Curve Fitting

. Fit polynomial models to data

9. System modelling with transfer function approach
   - ✓ Compute poles/zeros (eigenvalues), damping factor etc
   - ✓ Compute time response for first and second order systems
10. Compute time response specifications for first and second order systems for various input signals, and comment on stability
11. Compute frequency response (through Bode plots) and analyze system properties.
12. System modelling with state space approach
13. Design continuous time filters
    - ✓ Low, Band pass, High pass filters, Notch Filters
    - ✓ Test these filters with normal and noisy data
14. Application in Navigation: Demonstrate drift during position / angular computation

TEXT BOOKS:

1. K Ogata, PHI, "Modern Control Engineering", 4th Edition, 2002
2. Farid and Kuo, Automatic Control Systems, John Wiley and Sons, 9th Edition

REFERENCE BOOKS/MATERIAL:

1. NPTEL material on Control Engineering by Dr. Ramkrishna Pasumarthy and Dr.Viswanath Talasila, https://onlinecourses.nptel.ac.in/noc17_ee12/preview
2. Tariq Samad et. al., Impact of Control Technology, IEEE – Control Systems Society Report, February 2011
3. MIT OpenCourse in Feedback Control Systems, http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control-systems-fall-2010/

4. MIT Open Course in Systems and Control, http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/
5. Rudra Pratap, Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, Oxford Publishers, 2010
6. MIT's online course material: http://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/Syllabus/

COURSE OUTCOMES (COs):

1. Acquire knowledge of modelling physical systems using transfer functions and state space techniques, in the context of various application domains. **(PO1, 2, 3, 4, 5, 6,7,12) (PSO 1, 2)**
2. Compute and Analyse performance and stability metrics. **(PO1, 2, 3, 4, 5,12) (PSO 1, 2)**
3. Use of controllability and observability to design controllers using pole placement to meet desired specifications in the context of various application domains. **(PO1, 2, 3, 4, 5,6,12) (PSO 1, 2, 3)**
4. Understand basic data manipulation in MATLAB, develop user defined functions, conditional logic and loops to simulate signals and create system model. **(PO 1, 2, 3,4, 5, 8,9, 10, 11,12) (PSO 1, 2, 3)**
5. Compute time and frequency responses of systems, design filters and analyse impact of noisy sensor data on modelling/control. **(PO 1, 2, 3, 4, 5, 6, 7,8,9,10,11,12) (PSO 1, 2,3)**

SIGNALS AND SYSTEMS

Course Code: ET45 **Credits: 3:1:0**
Course Coordinator: Dr Satish Tunga **Contact Hours: 42+28**

Course Content

UNIT 1

Introduction: Definitions of a signal and a system, classification of signals, basic operations on signals, elementary signals, and systems viewed as interconnections of operations, properties of systems.

UNIT 2

Time-domain representation for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of LTI systems interns of its impulse response representation., Differential and difference equation representations, Block diagram representations.

UNIT 3

Fourier representation for signals: Discrete time and continuous time Fourier series (no derivation) and their properties. Discrete and continuous time Fourier transforms (no derivations) and their properties.

UNIT 4

Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals.

UNIT 5

Z-Transforms: Introduction, Z- transform, properties of ROC, properties of Z-transforms, inverse Z- transforms. Z-Transform analysis of LTI systems, unilateral Z-transform and its application to solve difference equations.

TEXTBOOK

1. Simon Haykins and Barry Van Veen, “Signals and Systems”, John Wiley & Sons, 2002. Reprint 2009.

REFERENCE BOOKS

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems", Pearson Education Asia/PHI, 2nd edition, 1997. Indian reprint 2010.
2. H.P Hsu, R. Ranjan, "Signals and Systems", Scham's Outlines, TMH, 2009
3. B.P Lathi, "Linear systems and signals", Oxford University Press, 2010
4. Ganesh Rao and Satish Tunga, "Signals and Systems", Sanguine Technical Publishers, 2012

COURSE OUTCOMES (COs):

1. Recall the definition of classification of signals and systems, properties of convolution and transforms. **(PO 1, 2, 3, 4, 5,6, 10,12) (PSO 1, 2, 3)**
2. Understand the different types of signals, Fourier analysis and Z-transform analysis of LTI systems. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2, 3)**
3. Apply convolution and properties of transforms to find output of the LTI systems. **(PO 1, 2, 3, 4, 5, 6 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Analyze LTI systems through Fourier and Z-transforms. **(PO 1, 2, 3, 4, 5, 8, 10, 11, 12) (PSO 1, 2, 3)**
5. Evaluate the output of LTI systems through various relevant methods. **(PO 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

OOPS USING C++

Course Code: ET46 **Credits: 3:0:0**
Course Coordinator: Arvind Kumar G **Contact Hours: 42**

Course Content

UNIT -1

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

UNIT-2

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

UNIT -3

Class inheritance: Inheritance, Derived class & Base class, Derived Class Constructors, Overriding member functions, Scope resolution, Public and Private Inheritance levels of inheritance, Multiple, Multi-level, Hierarchical, Hybrid Inheritance

UNIT-4

Address and pointers, the address-of operator &, pointers and arrays, pointers and functions, pointers and c-type strings, memory management new and delete, Pointers to objects Virtual functions, Friend functions, Static Functions, 'this' pointer

UNIT-5

C++ stream classes, stream Errors, Disk file I/O with streams- Formatted I/O, fstream and the File classes, Opening and closing a file, Reading and writing text files. Reason for Multifile Programs, Creating Multifile Programs

TEXT BOOKS

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

REFERENCE BOOKS

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

COURSE OUTCOMES (COs):

1. Articulate the principles of object-oriented problem solving and programming **(PO1, 2, 3, 5, 8, 9, 11) (PSO1, 2, 3)**
2. Outline the essential features and elements of the C++ programming language **(PO1, 2, 3, 5, 8, 9, 11) (PSO1, 2, 3)**
3. Apply the concepts of class, method, constructor, instance, data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism for solving problems **(PO1 2, 3,5,8,9,11) (PSO1,2,3)**
4. Analyze, write, debug, and test basic C++ codes using the approaches introduced in the course **(PO1 2, 3,5,8,9,11) (PSO1,2,3)**
5. Analyze problems and implement simple C++ applications using an object-oriented software engineering approach **(PO1,2,3,5,8,11) (PSO1,2,3)**

MICROCONTROLLER LAB

Course Code: ETL47 **Credits: : 0:0:1**
Course Coordinator: Ramya H R **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS:

1. Simple data handling programs in ALP -- Addition and subtraction
2. Multiplication and division
3. Block move and block exchange
4. Finding largest and smallest
5. Ascending order and descending order
6. Square and cube of 8 bit and 16-bit data.
7. Interfacing on board LED
8. LED using Timer
9. LCD Interfacing.
10. Stepper motor Interface
11. ADC Interfacing
12. DAC Interfacing
13. 4 Experiments using MSP430 Launch Pad

TEXT BOOKS

1. John H. Davies, "MSP430 Microcontroller Basics", Newnes, Elsevier, 2008.
2. Cris Nagy, "Embedded Systems Design using the TI MSP430 Series", Newness, Elsevier, 2003

COURSE OUTCOMES (COs):

1. Understand the concepts of microcontroller and assembly language programming, interrupts, low power modes, Timers and communication interface (PO 1, 2, 3, 6, 11, 12) (PSO 1, 2, 3)
2. Understand the development environment of MSP430 processor for the assembly programs, Low power modes, Timers and communication interface (PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)
3. Illustrate the assembly programs ,Low power modes, Timers and communication interface (PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)
4. Implement the programs using interrupts, Low power modes, Timers and communication interface (PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)
5. Analysis of implementation of the concepts of interrupts, Low power modes, Timers and communication interface (PO 1, 2, 3, 4, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)

MICROWAVE AND ANTENNA LAB

Course Code: ETL48 **Credits: 0:0:1**
Course Coordinator: Dr Swetha Amit **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS:

1. Determination of transit time, electronic tuning range and electronic tuning sensitivity of reflex klystron.
2. Measurement of VSWR, guide wavelength, operating frequency and impedance.
3. Determination of coupling coefficient, power division and insertion loss of a magic tee
4. Determination of coupling factor, insertion loss and directivity of a multi-hole directional coupler.
5. Measurement of Directivity, Half-power beam width and Gain of rectangular horn antenna and parabolic antenna.
6. Study of resonance in a Microstrip ring resonator and determination of dielectric constant of substrate.
7. Measurement of power division & isolation characteristics of 3dB power divider.
8. Determination of coupling and isolation characteristics of Microstrip branchline and backward couplers.
9. Determination of directivity and half power beam width of dipole and Yagi-Uda antennas.
10. Design and simulate waveguides and analyze current distribution using HFSS.
11. Design and simulate Rectangular Patch antenna analyzing S-parameters, VSWR, Smith Chart, Gain, 3D radiation pattern using HFSS.
12. Design and simulate 2*2 array of Patch antenna and analyze the gain enhancement using HFSS.
13. Design and simulate 2 element MIMO antenna and analyze the mutual coupling effects using HFSS.
14. Case study on Network Analyzer, GUNN diode characteristics, Spectrum Analyzer.

TEXT BOOKS

1. Liao, “Microwave Devices and circuits”, Pearson Education, 3rd edition,2012
2. John D Kraus, Ronald J. Marhefka and Ahmed S Khan, “Antenna and Wave Propagation”, Fourth edition, McGraw Hill Publication, 2010.

REFERENCE BOOKS

1. David M Pozar, "Microwave Engineering", John Wiley, 4th edition, 2012
2. John Volakis, "Antenna Engineering Handbook", 4th Edition, McGraw Hill Publications, 2010.

COURSE OUTCOMES (COs):

1. Evaluate the characteristics of waveguide, working of klystron oscillator and GUNN diode. **(PO 1, 2, 3, 9,10,12) (PSO 1, 3)**
2. Analyse the working of passive and active microwave devices. **(PO 1, 2, 3, 9,10) (PSO 1, 3)**
3. Analyses the antenna characteristics with antenna test bench **(PO 1, 2, 3, 5, 9, 10, 12) (PSO 1, 2, 3)**
4. Design antenna and microwave components using HFSS simulation software. **(PO1, 2, 3, 5, 9, 10, 12) (PSO 1, 2, 3)**
5. Evaluate the working of Antennas using HFSS. **(PO 1, 2, 3, 4, 7,8, 9,10,12) (PSO 1, 2, 3)**

ADDITIONAL MATHEMATICS – II

Course Code: AM41 **Credits: 0:0:0**
Course Coordinator: Dr. N L Ramesh **Contact Hours: 40L**

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, 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)