B M S C E

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾ ವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾಸಂಸ್ಥೆ)

ಬೆಂಗಳೂರು ೫೬೦ ೦೧೯

BMS COLLEGE OF ENGINEERING

(Autonomous College under VTU)

BANGALORE - 560019

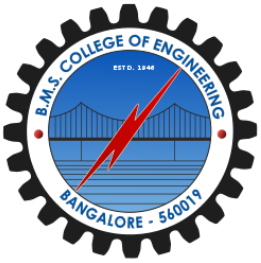
ELECTRONICS & COMMUNICATION ENGINEERING

SCHEME & SYLLABUS

III to IV SEMESTER

2022-23 Batch Onwards

ECE



ಬಿ. ಎಂ. ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬಸವನಗುಡಿ ರಸ್ತೆ, ಬೆಂಗಳೂರು ೫೬೦೦೧೯

B.M.S. College of Engineering, Bengaluru – 19

Autonomous College under VTU

Department of Electronics & Communication Engineering

Scheme and Syllabus for III – IV Semester

Batch admitted 2022

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

INSTITUTE MISSION

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

DEPARTMENT VISION

To emerge as a Centre of Academic Excellence in Electronics, Communication and related domains through Knowledge acquisition, Knowledge dissemination and Knowledge Generation meeting global needs and standards

DEPARTMENT MISSION

Imparting Quality Education through state of the art curriculum, Conducive Learning Environment and Research with scope for continuous improvement leading to overall Professional Success

PROGRAM EDUCATIONAL OBJECTIVES

PEO1 Graduates will Professionally Progress in Electronics, Communication and related areas with an inclination towards Continuous Learning

PEO2 Graduates will work in Diversified Teams of Multidisciplinary Environment

PEO3 Graduates will exhibit good Inter-personal skills, adapt themselves for changes in Contemporary Technology

PROGRAM SPECIFIC OUTCOMES

The students will be able to:

PSO1 Analyse and design electronic systems for signal processing and communication applications.

PSO2 Demonstrate the Conceptual domain Knowledge with respect to Architecture, Design, Analysis and Engineering deployment in Data communication and Computer networking.

PSO3 Identify and apply domain specific tools for design, analysis, synthesis and validation of VLSI and Communication systems.

PROGRAM OUTCOMES

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

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 modelling 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.

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SCHEME

SEMESTER: III

Sl. No.	Course Type	Code	Course Title	Credits				Contact Hours	Marks		
				L	T	P	Total		CIE	SEE	Total
1	BS	23MA3BSTFN	Transform Calculus, Fourier Series and Numerical Techniques	2	1	0	3	4	50	50	100
2	ES	23EC3ESHDL	HDL Programming	3	0	0	3	3	50	50	100
3	PC	23EC3PCAEC	Analog Electronic Circuits	3	0	0	3	3	50	50	100
4	PC	23EC3PCDCD	Digital Circuit Design	3	0	0	3	3	50	50	100
5	PC/IPCC	23EC3PCSAS	Signals and Systems	3	0	1	4	5	50	50	100
6	PC/IPCC	23ES3PCNAL	Network Analysis*	2	1	0	3	4	50	50	100
7	BS	23ES3BSBFE	Biology for Engineers**	1	0	0	1	1	25	25	50
8	PC/IPCC	23EC3PCIEL	Integrated Electronics Lab	0	0	1	1	2	25	25	50
9	AE/SDC	23EC3AEHPL	HDL Programming Lab	0	0	1	1	2	25	25	50
10	NCMC	23NCMC3NS1	NSS	-	-	-	-	2	-	-	P/NP
		23NCMC3YG1	Yoga								
		23NCMC3PE1	Physical Education								
Total				**17**	**2**	**3**	**22**	**29**	**375**	**375**	**750**

***Common to EC, EE, EI, ET & MD**

****Common to EC, EE, EI & ET**

SCHEME

SEMESTER: IV

Sl. No.	Course Type	Code	Course Title	Credits				Contact Hours	Marks		
				L	T	P	Total		CIE	SEE	Total
1	BS	23MA4BSCPS	Complex Analysis, Probability and Statistical Methods	2	1	0	3	4	50	50	100
2	ES	23ES4ESCST	Control Systems*	2	1	0	3	4	50	50	100
3	PC	23EC4PCFAW	Fields and Waves	2	1	0	3	4	50	50	100
4	PC	23EC4PCAIC	Analog Integrated Circuits	3	0	0	3	3	50	50	100
5	PC/IPCC	23ES4PCAPP	ARM Processor and Programming**	3	0	1	4	5	50	50	100
6	PC/IPCC	23EC4PCPCS	Principles of Communication Systems	3	0	1	4	5	50	50	100
7	UHV	23MA4AEUHV	Universal Human Values	0	1	0	1	2	50	50	100
8	AE	23EC4AEAPL	Applied Python Programming Lab	0	0	1	1	2	25	25	50
9	NCMC	23NCMC4NS2	NSS	-	-	-	-	2	-	-	P/NP
		23NCMC4YG2	Yoga								
		23NCMC4PE2	Physical Education								
Total				**15**	**4**	**3**	**22**	**31**	**375**	**375**	**750**

***Common to EC, EI & ET**

****Common to EC, EE, EI, ET & MD**

III Semester Syllabus

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Course Title	**TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES**				
Course Code	**23MA3BSTFN**	**Credits**	**3**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the concepts of Series, Transform Techniques, Calculus of Variation and Finite Difference Methods to solve engineering problems.	1	–
CO2	**Apply** the concepts of Transform Techniques, Calculus of Variation and Finite Difference Methods in engineering using modern IT tools.	1, 5	–

UNIT – I

LAPLACE TRANSFORMS:
Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems.
Inverse Laplace transforms: definition and problems. Solution of differential equations.

UNIT – II

FOURIER SERIES:
Introduction to trigonometric polynomial, trigonometric series. Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

UNIT – III

FOURIER TRANSFORMS:
Definition and problems on Fourier Transform. Fourier sine and cosine transforms – Problems.
Inverse Fourier transform, Inverse Fourier cosine and sine transforms - Problems. Convolution theorem (only statement) – problems.

UNIT – IV

NUMERICAL SOLUTION OF PDE:
Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt and Bendre-Schmidt explicit formulae. Solution of one-dimensional wave equation using finite difference method.

UNIT – V

CALCULUS OF VARIATIONS:
Definition, Variation of a functional, Euler-Lagrange equation, variational problems. Applications: Hanging cable problem, Brachistochrone problem.

z-TRANSFORMS:
Definition, Standard z-transforms, Damping rule, Shifting rule. Inverse z-transform and applications – Solution of difference equations.

Text Books:

1. "Higher Engineering Mathematics", B. S. Grewal, 44th edition, 2018, Khanna Publishers.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition (reprint), 2016, John Wiley & Sons.

Reference Books:

1. "Higher Engineering Mathematics", B. V. Ramana, 11th Edition, 2007, McGraw-Hill Education.
2. "Engineering Mathematics", Srimanta Pal and Subodh C. Bhunia, 3rd reprint, 2016, Oxford University Press.
3. "A Textbook of Engineering Mathematics", N. P. Bali and Manish Goyal, Laxmi Publications.
4. "Advanced Engineering Mathematics", C. Ray Wylie and Louis C. Barrett, 6th edition, McGraw-Hill Book Company, New York.
5. "Engineering Mathematics for Semester I and II", Gupta C. B., Sing S. R. and Mukesh Kumar, 2015, McGraw-Hill Education (India).
6. "Higher Engineering Mathematics", H. K. Dass and Rajnish Verma, 2014, S. Chand Publication.
7. "Calculus", James Stewart, 7th edition, 4th reprint, 2019, Cengage Publications.

E books and online course materials:

1. `http://www.class-central.com/subject/math` (MOOCs)
2. `http://academicearth.org/`
3. `http://www.bookstreet.in/`
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

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Course Title	**HDL PROGRAMMING**				
Course Code	**23EC3ESHDL**	**Credits**	**3**	**L – T – P**	**3:0:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course outcomes: At the end of the course, the student will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the knowledge of HDL for modeling and functional verification of Digital circuits.	1	3
CO2	**Analyze** digital circuits using suitable Verilog HDL modeling.	2	3
CO3	**Design** and synthesize a digital circuit for complex systems using Verilog HDL and state machines.	3	3

UNIT – I

Introduction: VLSI design flow, importance of HDLs, Verilog HDL and Design Methodologies, modules, instances, components of simulation, example, basic concepts. Modules and ports: Modules, ports, Rules.

UNIT – II

Gate Level Modeling: Gate Types, Gate Delays, Examples. Dataflow Modeling: Continuous assignment, Delays, Expressions, Operators, Operands, Operator Types, and Examples.

UNIT – III

Behavioral Modeling: Structured procedure, procedural assignments, timing control, conditional statements, multi-way branching, loops, sequential and parallel blocks, generate blocks, Examples.

UNIT – IV

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.

UNIT – V

Synchronous sequential circuits: Moore and Mealy FSM, Design and implementation of sequence detector, serial adder, code converter. FPGA based systems: Introduction, basic concepts, Digital design with FPGAs, FPGA based system design.

Choice: Unit-III and Unit-V

Text Books:

1. "Verilog HDL-A Guide to Digital Design and Synthesis," Sameer Palnitkar, 2nd Edition, Pearson Edition 2003.

Reference Books:

1. "Fundamentals of Digital Logic with Verilog Design," Stephan Brown and Zvonk Vranesic, 2nd Edition, McGraw-Hill, 2008.

E-Books:

1. http://access.ee.ntu.edu.tw/course/dsd_99second/2011_lecture/W2_HDL_Fundamentals_2011-03-02.pdf
2. http://www.ics.uci.edu/œalexv/154/VHDL-Cookbook.pdf
3. http://ece.niu.edu.tw/œchu/download/fpga/verilog.pdf

MOOCs:

1. Electronic Design Automation: http://nptel.ac.in/courses/106105083/
2. Digital System Design with PLDs and FPGAs: http://nptel.ac.in/courses/117108040/
3. Fundamentals of HDL (Lecture #008): https://www.youtube.com/watch?v=rdAPXzxeaxs&index=8&list=PLE3BC3EBC9CE15FB0

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Course Title	ANALOG ELECTRONIC CIRCUITS				
Course Code	23EC3PCAEC	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Prerequisites: Elements of Electronics Engineering

Course outcomes: At the end of the course, the student will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Define, understand**, and **explain** concepts related to diodes and transistors (BJTs and MOSFETs).	–	–
CO2	**Apply** the knowledge of network theorems and device models to solve given analog electronic circuits.	1	1, 3
CO3	**Analyze** a given analog electronic circuit to compute required parameters.	2	1, 3
CO4	**Design** analog electronic circuits for a given specification.	3	1, 3
CO5	**Submit** a report and give a presentation on recent technological development in the Analog Electronics domain	10, 12	1, 3

UNIT – I

Diode applications: Clippers, Clampers.
Bipolar Junction Transistor (BJTs): DC biasing – Introduction, operating point, voltage divider Bias configuration.
BJT AC Analysis: Introduction, Application in the AC Domain, BJT Transistor Modeling, the r_e Transistor model, Voltage Divider Bias.

UNIT – II

BJT Frequency Response: Introduction, Logarithms, Decibels, Low-frequency Response-BJT Amplifier, Miller effect Capacitance, High-Frequency response – BJT Amplifier.
Feedback concepts: Feedback connection types - Voltage series, Voltage-shunt, Current Series, and Current Shunt Feedback.
Practical feedback Circuits: Voltage series, Current series feedback, and voltage Shunt feedback.

UNIT – III

Power Amplifiers: Introduction - Definitions and Amplifier Types, Amplifier Efficiency.
Series-Fed Class A Amplifier: DC Bias Operation, AC operation, Power Consideration, Efficiency.
Transformer-coupled Class A Amplifier: Operation of Amplifier Stage: DC load line, Quiescent operating point, AC load line, Signal Swing, and Output AC power.
Class B operation: Class B Amplifier Circuits - Transformer-coupled Push-Pull Circuits, Complementary Symmetry Circuits, Amplifier Distortion.

UNIT – IV

MOSFETs: Introduction, Device structure, and physical operation - Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the i_d–V_{DS} relationship, The P-Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub-threshold region.
Current-voltage Characteristics: Circuit symbol, i_d–V_{DS} characteristics, characteristics of the P-Channel MOSFET.
MOSFET Circuits at DC: The MOSFET as an amplifier and as a switch – Large signal operation, Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.
Biasing in MOS amplifier circuits: Biasing by fixing V_{GS}, Biasing by fixing V_G, and connecting a resistor in the source, Biasing using a drain-to-gate feedback resistor, biasing using a current source.

UNIT – V

Small-signal operation and models of MOSFETs: The DC bias point, the signal current in the drain terminal, the voltage gain, separating DC analysis and the signal analysis, small signal equivalent circuit models, the transconductance gm, the T equivalent circuit model.
Single stage MOS amplifiers: The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance. Common gate (CG) Amplifier, The common Drain or source follower Amplifier. **IC Biasing**: Current sources, current mirror, and current steering circuits - The basic MOSFET current source, MOS current steering circuits.
Current mirror circuit with improved performance: The Wilson MOS mirror.

Choice: Unit-I and Unit-V

Text Books:

1. "Electronic Devices and Circuit Theory," Robert L. Boylestad and Louis Nashelsky, 10th edition (PEARSON EDUCATION).
2. "Microelectronic Circuits-Theory and applications" by Adel S. Sedra and Kenneth C. Smith, Fifth Edition (OXFORD INTERNATIONAL STUDENT EDITION).

Reference Books:

1. "Electronic Devices and Circuits," Millman and Halkias, TMH.
2. "Electronic Devices and Circuits," David A Bell - PHI 4th edition.

3. “Integrated Electronics,” Jacob Millman, Christos Halkias and Chetan Parikh, 2nd edition, Mc-Graw Hill Education.

E-Books:

1. www.pyroelectro.com/edu/analog
2. http://freevideolectures.com/course/3020/circuits-for-Analog-System-Design

MOOCs:

1. https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true
2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/
3. Introductory Analog Electronics Laboratory (Spring 2007) by MIT open courseware Reviews and Ratings.

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Course Title	DIGITAL CIRCUIT DESIGN				
Course Code	23EC3PCDCD	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Prerequisites: Elements of Electronics Engineering

Course outcomes: At the end of the course, the student will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Apply** the fundamental logic functions to realize basic building blocks of digital logic design	1	2, 3
CO2	**Analyse** the digital logic circuits and optimize with cost effective solutions	2	2, 3
CO3	**Design** a complete digital circuit for given specification using digital circuit concepts	3	2, 3

UNIT – I

Introduction to Boolean algebra, Simplification of Boolean functions, K-Maps: Three Variable and Four Variable, Design with Basic gates, NAND gates and NOR gates .

UNIT – II

Combinational Logic Circuits: Introduction, Parallel Adders (Ripple carry adder and Carry Look Ahead Adder), Decimal Adder, Code conversion, Magnitude Comparator, Decoders, Encoder, Multiplexers, Demultiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs).

UNIT – III

Sequential Logic Circuits: The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master-Slave Flip-Flops, Edge Triggered Flip-Flops, Characteristic Equations, Conversion of flip-flops, Shift Registers, Ripple Counters, Synchronous Counters

UNIT – IV

Sequential systems: Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations, Sequence detector

UNIT-V

Algorithmic State Machine: Introduction, ASM Charts, Synchronous sequential network design with ASM charts, State Assignment, ASM table, ASM realization, Asynchronous Inputs.

Choice: Unit-III and Unit-V

Text Books:

1. Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education
2. Digital Principles and Design- Donald Givone, Tata McGraw Hill
3. Digital Principles and Applications- Donald P Leach, Albert Paul Malvino, Goutam Saha, 7th Edition, Tata McGraw Hill.

Reference Books:

1. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education

E-Books:

1. http://www.panstanford.com/pdf/9789814364591fm.pdf
2. https://easyengineering.net/digital-logic-and-computer-design-by-morris-mano/
3. https://www.sciencedirect.com/book/9780750645829/digital-logic-design

MOOCs:

1. https://nptel.ac.in/courses/108105113/
2. https://nptel.ac.in/courses/106105185/

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Course Title	**SIGNALS AND SYSTEMS**				
Course Code	**23EC3PCSAS**	**Credits**	**4**	**L – T – P**	**3:0:1**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the mathematical concepts and transform techniques to solve the continuous and discrete LTI systems	1	2
CO2	**Analyze** various methods to categorize the LTI systems and identify solutions for mathematical representations of systems	2	2
CO3	**Design** a linear, time-invariant system for a given specification	3	2
CO4	**Simulate and Conduct** experiments involving various operations on signals and response of systems using appropriate tools	5	2

UNIT – I

Signals: Definition of Signals, Classification of Signals, Basic Operations on Signals: Operations Performed on the Independent and Dependent Variable, Precedence Rule, Elementary Signals.

UNIT – II

Systems: Definition of Systems, System Viewed as Interconnection of Operations, Properties of Systems: Linearity, Time Invariance, Memory, Causality, Stability and Invertibility with numerical problems.

UNIT – III

Time domain representations of Linear Time Invariant Systems: Introduction: Impulse response representation of LTI systems, Properties of impulse response representation of LTI systems, Differential and Difference equation representation for LTI systems, Block diagram representation of Continuous time systems.

UNIT – IV

Application of Fourier Representation for signals: Discrete Time Fourier Series, Properties of DTFS, Discrete Time Fourier Transform, Properties of DTFT, Frequency response of LTI Systems, Sampling, Application of DTFT.

UNIT – V

Applications of z-transform: Transform Analysis of LTI Systems using z-transform, Relating the transfer function and difference equation, Causality and stability, Inverse Systems, Determining the frequency response from poles and zeros, Computational structures for implementing Discrete Time Systems, Unilateral z-transform and solution of difference equations.

Choice: Unit-III and Unit-V

Text Books:

1. "Signals and Systems", Simon Haykin and Barry Van Veen, 2nd Edition, 2008, John Wiley & Sons.

Reference Books:

1. "Signals and Systems", H. P. Hsu and R. Ranjan, Schaum's Outlines, 2006, Tata McGraw-Hill.
2. "Fundamentals of Signals and Systems", Benoit Boulet, 2006, Thomson.
3. "Signals and Systems", Uday Kumar S., Third Edition, 2004, Elite Publishers.
4. "Signals and System", D. Ganesh Rao and Satish Tunga, Fourth Edition, 2008, Sanguine Technical Publishers.

E books:

1. https://www.amazon.in/Signals-Systems-Oppenheim-Willsky-Hamid/dp/9332550239
2. https://www.amazon.in/SIGNALS-SYSTEMS-2nd-H-Hsu/dp/007066918X

MOOCs:

1. NPTEL Lecture Video on Signals and Systems by Prof. S. C. Dutt Roy http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.htm
2. NPTEL online course modules – By Prof. Aditya K. Jagannatham — IIT Kanpur Principles of Signals and Systems - Course (nptel.ac.in)

List of Lab Experiments

1. Program to create, display and modify a matrix
2. Programs on arithmetic operations on matrix
3. Program to solve system of linear equations
4. Program to generate elementary, continuous and discrete signals
5. Program on basic operations on continuous and discrete signals
6. Program to find linear convolution of two sequences

7. Given the input signal, program to find the response of a system
8. For a given network circuit find the impulse response and unit step response of a system
9. Program to perform verification of properties of convolution sum
10. Program to compute frequency response of a system
11. Programs to find z-transform and inverse z-transform of a sequence. Simulate pole-zero plot.
12. Program to solve difference equation (up to 2nd order)
13. Program to simulate frequency and power spectrum of time-domain signals using Fourier Transform
14. Open ended experiments as assignments in Lab Sessions

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Course Title	**NETWORK ANALYSIS**				
Course Code	**23ES3PCNAL**	**Credits**	**3**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** basic circuit laws and network theorems to linear electrical networks	1	1, 3
CO2	**Analyse** linear circuits in time and frequency domain	2	1, 3
CO3	**Simulate** linear circuits using appropriate tools	5	1, 3

UNIT – I

Basic Concepts: Active and passive elements, Concept of ideal and practical sources. Source transformation and Source shifting, Concept of Super-Mesh and Super node analysis. Analysis of networks by (i) Network reduction method including star-delta transformation, (ii) Mesh and Node voltage methods for AC and DC circuits with independent and dependent sources.

UNIT – II

Network Theorems: Super Position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

UNIT – III

Resonant Circuits: Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance, Duality of networks.

UNIT – IV

Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp, Waveform synthesis. Initial and Final value theorems. solution for RL, RC networks for DC excitation.

Transient Analysis: Transient analysis of RL and RC circuits under DC excitations: Behaviour of circuit elements under switching action ($t = 0$ and $t = \infty$), Evaluation of initial conditions.

UNIT – V

Two Port Network and its Parameters: Definition, Open circuit impedance, short circuit admittance, hybrid and Transmission parameters. Relation between the different parameters. Evaluation of electrical circuits for Independent sources only.

Choice: Unit-I and Unit-IV

Text Books:

1. "Network Analysis", Van Valkenburg M.E., Prentice Hall India, 2014.
2. "Circuit Theory Analysis and Synthesis", Chakrabarti, A., Dhanpat Rai & Co., 7th Revised Edition, 2018.

Reference Books:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, 6th Edition, Tata McGraw-Hill.
2. "Network Analysis and Synthesis", Franklin F. Kuo, Wiley.
3. "Analysis of Linear Systems", David K. Cheng, 11th reprint, 2002, Narosa Publishing House.
4. "Circuits", Bruce Carlson, 2002, Thomson learning.
5. "Network Analysis and Synthesis", Anand Kumar, 2019, PHI learning.

E books and online course materials:

1. `https://www.pdfdrive.com/introduction-to-electrical-circuit-analysis-e195167204.html`

MOOCs:

1. `http://elearning.vtu.ac.in/06ES34.html`
2. `https://www.coursera.org/course/circuits`

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Course Title	BIOLOGY FOR ENGINEERS				
Course Code	23ES3BSBFE	Credits	1	L – T – P	1:0:0
CIE	25 Marks (100% weightage)		SEE	50 Marks (50% weightage)	

Course Objectives: At the end of the course, the student will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Understand** Biological concepts from an engineering perspective	–	–
CO2	**Familiarize** with the concepts of biological sensing, bio-printing techniques and materials and the role of Artificial Intelligence for disease diagnosis	1	–
CO3	**Understand** the basics of radiation and its effects on Human Body	6, 7	–

Sensing Techniques: Understanding of Sense organs working – Sensing mechanisms – Sensor Development issues – Physiological Assist Device: Artificial Organ Development: Kidney, Liver, Pancreas, heart valves – Design Challenges and Technological developments.

Nature-bio-inspired mechanisms (qualitative): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces).

Bio printing techniques and materials: 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio imaging and Artificial Intelligence for disease diagnosis.

Introduction to Radiation: Source and Types of Radiation, Types of Ionizing Radiation, X-rays for Medical Use and Generators Types of Electromagnetic Waves, Ionization of Radiation – Property of Ionizing Radiation. Penetrating Power of Radiation within the Body, Penetrating Power and Range of Effects on the Human Body.

Radiation Effects on Human Body: Types of Effects, Exposure Modes and Effects Classification of Radiation Effects Deterministic Effects and Stochastic Effects, Mutation, Mechanism of Causing Effects on Human Body. Ionization due to Radiation, Damage and Repair of DNA. Radio sensitivity of Organs and Tissues.

Reference Books:

1. "Human Physiology," Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.

2. “Biology for Engineers,” Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. “Biomedical Instrumentation,” Leslie Cromwell, Prentice Hall 2011.
4. “Biomimetics: Nature-Based Innovation,” Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
5. “Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies,” D. Floreano and C. Mattiussi, MIT Press, 2008.
6. “3D Bioprinting: Fundamentals, Principles, and Applications” by Ibrahim Ozbolat, Academic Press, 2016.
7. “Electronic Noses and Tongues in Food Science,” Maria Rodriguez Mende, Academic Press, 2016.

On-line resources:

1. VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2. https://nptel.ac.in/courses/121106008
3. https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
4. https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
5. https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
6. https://www.coursera.org/courses?query=biology
7. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8. https://www.classcentral.com/subject/biology
9. https://www.futurelearn.com/courses/biology-basic-concept

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**INTEGRATED ELECTRONICS LAB**				
Course Code	**23EC3PCIEL**	**Credits**	**1**	**L – T – P**	**0:0:1**
CIE	**25 Marks (100% weightage)**		**SEE**	**50 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the knowledge of network theorems, device models and basics of analog and digital electronics to conduct a given experiment	1	1, 3
CO2	**Identify** and **analyse** analog and digital electronic circuits to obtain the expected output for the given parameters	2	1, 3
CO3	**Design** analog and digital electronic circuits for the given specifications and conduct the experiment	3	1, 3
CO4	**Involve** in independent / team learning, communicate effectively and engage in life long learning	9, 10, 12	1, 3

List of Analog Electronics Experiments

1. Implementation and verification of Diode and Transistor as Switch
2. Design and testing of clipper circuits to generate the required waveform
3. Design and verification of Clamping Circuits
4. Design and testing of crystal oscillator
5. Design of Class B Complementary symmetry Power Amplifier
6. Design and Verification of Amplifiers using OP-AMP
7. Design and verification of Zener diode as voltage regulator
8. Design and Verification of RC-Coupled amplifier determine gain, frequency response, input and output impedance.

List of Digital Electronics Experiments

9. Realization of Full adder using MUX and DEMUX

10. Design and Realization of MOD-N counter using 7493
11. Simplification and realization of Boolean expression
12. Realization of shift register using 7495 and use it for
    (i) Shift right operation (SIPO, SISO, PISO, PIPO)
    (ii) Shift left operation.

Reference Books:

1. "Electronic Devices and Circuit Theory", Robert L. Boylestad and Louis Nashelsky, 10th Edition, Pearson Education.
2. "Digital Principles and Design", Donald Givone, Tata McGraw Hill.

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**HDL PROGRAMMING LAB**				
Course Code	**23EC3AEHPL**	**Credits**	**1**	**L – T – P**	**0:0:1**
CIE	**25 Marks (100% weightage)**		**SEE**	**50 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the knowledge of HDL programming for modeling and functional verification of Digital circuits using EDA tools.	1, 5	3
CO2	**Analyse** digital circuits using suitable Verilog HDL modeling using EDA tools.	2, 5	3
CO3	**Design** and synthesize a digital circuit for complex systems using EDA tools.	3, 5	3
CO4	**Involve** in independent / team learning, communicate effectively and engage in life long learning	9, 10, 12	3

List of Experiments

1. Introduction to Vivado FPGA Tool Suite
2. Gate-level modelling: Half adder, Full adder
3. Gate-level modelling: Multiplexers and demultiplexers
4. Gate-level/Dataflow modelling: Decoders
5. Dataflow modelling for 2-bit magnitude comparator
6. Data flow modelling: Ripple Carry adder
7. Dataflow modelling: Carry Look-ahead Adder
8. Structural Modelling: Multibit Subtractor (using Adder)
9. Behavioural modelling for multibit magnitude comparator
10. Behavioural modelling for Encoder with and without priority
11. Behavioural modelling: SR latch, JK and D flip-flops
12. Behavioural modelling: Universal Shift Register

13. Behavioural modelling: Synchronous Counters
14. Structural Modelling: Asynchronous counters
15. Behavioural modelling: Sequence detection

Text Books:

1. "Verilog HDL: A Guide to Digital Design and Synthesis", Sameer Palnitkar, 2nd Edition, 2003, Pearson.

Reference Books:

1. "Fundamentals of Digital Logic with Verilog Design", Stephan Brown and Zvonk Vranesic, 2nd Edition, 2008, McGraw-Hill.

B.M.S. College of Engineering, Bengaluru – 19

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Course Title	**ADDITIONAL MATHEMATICS – I** (For lateral entry students)				
Course Code	**22MA3BSMAT**	**Credits**	**0**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No	**Course Outcomes**	**PO**	**PSO**
CO1	**Demonstrate** the concepts of Differential Calculus and Integral Calculus.	1	–
CO2	**Apply** the concepts of differential calculus to solve ordinary and partial differential equations	1	–

UNIT – I

DIFFERENTIAL AND INTEGRAL CALCULUS:
List of standard derivatives including hyperbolic functions, rules of differentiation. Polar curves, angle between the radius vector and the tangent, angle between two curves (No proof). Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. List of standard integrals, integration by parts. Definite integrals-problems.

UNIT – II

MULTIVARIATE CALCULUS:
Partial differentiation, total derivative-differentiation of composite functions. Jacobian and problems.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

UNIT – III

ORDINARY DIFFERENTIAL EQUATIONS (ODE's) OF FIRST ORDER:
Bernoulli's differential equations. Exact and reducible to exact differential equations. Applications of ODE's – Orthogonal trajectories.

Nonlinear differential equations: Introduction to general and singular solutions; Solvable for p only.

UNIT – IV

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER:
Higher-order linear ODE's with constant coefficients – Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. Problems.

UNIT – V

PARTIAL DIFFERENTIAL EQUATIONS (PDE's):
Formation of PDE's by elimination of arbitrary constants and functions. Solution of non homogeneous PDE by direct integration. Solution of PDE by the method of separation of variables. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation.

Text Books:

1. "Higher Engineering Mathematics", B. S. Grewal, 44th edition, 2018, Khanna Publishers.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition (reprint), 2016, John Wiley & Sons.

Reference Books:

1. "Higher Engineering Mathematics", B. V. Ramana, 11th Edition, 2007, McGraw-Hill Education.
2. "Engineering Mathematics", Srimanta Pal and Subodh C. Bhunia, 3rd reprint, 2016, Oxford University Press.
3. "A Textbook of Engineering Mathematics", N. P. Bali and Manish Goyal, Laxmi Publications.
4. "Advanced Engineering Mathematics", C. Ray Wylie and Louis C. Barrett, 6th edition, McGraw-Hill Book Company, New York.
5. "Engineering Mathematics for Semester I and II", Gupta C. B., Sing S. R. and Mukesh Kumar, 2015, McGraw-Hill Education (India).
6. "Higher Engineering Mathematics", H. K. Dass and Er. Rajnish Verma, 2014, S. Chand Publication.
7. "Calculus", James Stewart, 7th edition, 4th reprint, 2019, Cengage Publications.

E books and online course materials:

1. `http://nptel.ac.in/courses.php?disciplineID=111`
2. `http://www.class-central.com/subject/math` (MOOCs)
3. `http://academicearth.org/`
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

IV Semester Syllabus

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS**				
Course Code	**23MA4BSCPS**	**Credits**	**3**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the concepts of complex variables, special functions, probability and statistics to solve engineering problems.	1	–
CO2	**Apply** the concepts of complex variables, special functions and statistical methods using modern IT tools.	1, 5	–

UNIT – I

COMPLEX ANALYSIS:

Review of a function of a complex variable, limits, continuity and differentiability.

Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z} (z \neq 0)$.

UNIT – II

SPECIAL FUNCTIONS:

Introduction, Ordinary and Singular Points, Series solution of Bessel's differential equation leading to $J_n(x)$, Bessel's function of the first kind, Properties, generating function for $J_n(x)$. Series solution of Legendre's differential equation leading to $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) – Problems.

UNIT – III

STATISTICAL METHODS:

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = ax^b$) by the method of least

squares.

Correlation and regression: Karl Pearson's coefficient of correlation and rank correlation. Lines of regression, angle between two regression lines.

UNIT – IV

PROBABILITY DISTRIBUTIONS:
Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

UNIT – V

STATISTICAL INFERENCE:
Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means (single mean and difference between two means), student's t-distribution (single mean and difference between two means), Chi-square distribution-goodness of fit.

Text Books:

1. "Higher Engineering Mathematics", B. S. Grewal, 44th edition, 2018, Khanna Publishers.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition (reprint), 2016, John Wiley & Sons.

Reference Books:

1. "Advanced Engineering Mathematics", C. Ray Wylie and Louis C. Barrett, 6th edition, McGraw-Hill Book Company, New York.
2. "Higher Engineering Mathematics", B. V. Ramana, 11th Edition, 2007, McGraw-Hill Education.
3. "A Textbook of Engineering Mathematics", N. P. Bali and Manish Goyal, Laxmi Publications.
4. "Advanced Engineering Mathematics", Chandrika Prasad and Reena Garg, 2018, Khanna Publishing.

E books and online course materials:

1. `http://nptel.ac.in/courses.php?disciplineID=111`
2. `http://www.class-central.com/subject/math` (MOOCs)
3. `http://academicearth.org/`
4. `http://www.bookstreet.in/`
5. VTU EDUSAT Program – 20
6. VTU e-Shikshana Program

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**CONTROL SYSTEMS**				
Course Code	**23ES4ESCST**	**Credits**	**3**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the knowledge of engineering fundamentals to form mathematical model and obtain transfer function/state space representation of a system.	1	2
CO2	**Analyse** the stability of LTI systems in time/frequency domain using different techniques	2	2
CO3	**Investigate** the stability of LTI systems in the time/frequency domain as a team/an individual using modern tools	3, 5	2

UNIT – I

Introduction: Examples of Control Systems, Open loop vs Closed loop Systems.

Mathematical Modelling of Linear Systems: Transfer functions, Transfer function of electrical circuits, Block diagram, Signal Flow graph.

UNIT – II

Time response analysis: Step response of first order, second order systems, response specification, steady state error and error constants.

UNIT – III

Stability Analysis: Concept of stability, R-H criterion, applications of R-H criterion with limitations.

Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot.

UNIT – IV

Frequency response Analysis: Frequency domain specification, Polar plots, Nyquist plot, Stability Analysis using Nyquist criterion, Bode plots, GM and PM, Stability Analysis using Bode Plot.

UNIT – V

State Variable Analysis: Concept of state variables, physical variable model, phase variable model, obtaining transfer function from state model.

Choice: Unit-III and Unit-IV

Text Books:

1. "Control Engineering" Nagrath and Gopal, New Age International Publishers.
2. "Engineering Control Systems", Norman S. Nise, 5th Edition, John Wiley and Sons.

Reference Books:

1. "Modern Control Engineering", Ogata, Prentice Hall.
2. "Automatic Control Systems", B. C. Kuo, John Wiley and Sons.

E books and online course materials:

1. http://en.wikibooks.org/wiki/Control_Systems
2. http://www.electrical4u.com/control-system-closed-loop-open-loop-control system/#practical-examples-of-open-loop-control-system
3. http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html

MOOCs:

1. https://swayam.gov.in/explorer
2. https://www.edx.org/course

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**FIELDS AND WAVES**				
Course Code	**23EC4PCFAW**	**Credits**	**3**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the principles of Electrostatics and Magnetostatics to obtain the field, potential and boundary conditions; and Maxwell's equations to study electromagnetic wave propagation in different media	1	1, 2
CO2	**Analyse** and solve Electromagnetic problems related to Electrostatics, Magnetostatics, Time-varying fields and wave propagation	2	1, 2
CO3	**Engage** in self-learning through online/multimedia resources and by working on mini-projects related to electromagnetic fields and waves	9, 10, 12	1, 2

UNIT – I

Electrostatics: Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss' Law and Applications, Electric field due to line charge, sheet charge and volume charge, Divergence Theorem. Energy spent in moving a charge in an Electric field, Definition of Potential and Potential Difference, Potential gradient, Energy Density.

UNIT – II

Electrostatics: Electric field due to dipole, Properties of Conductors and Dielectrics, Continuity equation for Current, Boundary Conditions. Poisson's equation, Laplace's equation and its solution for Single Variables. Capacitance of parallel-plate, annular ring and concentric spheres.

UNIT – III

Steady Magnetic Field: Biot-Savart Law, Ampere's Circuital Law, Magnetic Flux and Flux Density. Force on a moving charge, Force on differential current element, Magnetic Boundary Conditions.

UNIT – IV

Time varying fields: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form.
Wave Propagation: Uniform plane wave propagation through free space, Wave propagation through dielectrics, Poynting's Theorem, Propagation in Good conductors, skin depth, Wave polarization.

UNIT – V

Plane Wave Reflection and Dispersion: Reflection at normal incidence, Standing Wave Ratio, Plane Wave propagation in general directions, Reflection at Oblique incidence, Wave propagation and Pulse broadening in dispersive media.

Choice: Unit-I and Unit-IV

Text Books:

1. "Engineering Electromagnetics", William H. Hayt, John A. Buck, M. Jaleel Akhtar, 8th Edition, 2014, Tata McGraw-Hill.
2. "Electromagnetics", Schaum's Outline series, Joseph A. Ediminister, Revised Second Edition, 2014, Tata McGraw-Hill.

Reference Books:

1. "Electromagnetics with Applications", John Krauss and Daniel A Fleisch, 5th Edition, 1999, McGraw-Hill.
2. "Classical Electromagnetism", H. C. Verma, 1st Edition, 2022, Bharati Bhawan Publishers.
3. "Elements of Electromagnetics", Mathew N. O. Sadiku, 2014, Oxford University Press.

E books and online course materials:

1. "Electromagnetic Field Theory: A Problem Solving Approach", Markus Zahn, 2008. https://hibp.ecse.rpi.edu/~connor/education/Fields/Zahn/electromagnetic_field_theory_mod2_tag.pdf

MOOCs:

1. Classical Electromagnetics-1, Prof. H. C. Verma, https://bsc.hcverma.in/cee1/#/home
2. Classical Electromagnetics-2, Prof. H. C. Verma, https://bsc.hcverma.in/cee2/#/home

B.M.S. College of Engineering, Bengaluru – 19

(Autonomous College under VTU)

Course Title	**ANALOG INTEGRATED CIRCUITS**				
Course Code	**23EC4PCAIC**	**Credits**	**3**	**L – T – P**	**3:0:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Define, understand** and **explain** the DC and AC performance characteristics of op-amp, applications of op-amp.	–	–
CO2	**Apply** the knowledge of network theorems to analog integrated circuits.	1	1, 3
CO3	**Analyze** analog integrated circuits to obtain the response at different points that meet desired specifications	2	1, 3
CO4	**Design** an analog circuit for given problem statement by applying the analog integrated circuit concepts	3	1, 3

UNIT – I

Operational Amplifier Characteristics: Introduction, Amplifiers in closed loop configuration, DC Characteristics, AC Characteristics, Frequency compensation.

Operational Applications: Instrumentation Applier, V to I and I to V converter, Op-amp circuits using Diodes – Half wave rectifiers, Full wave rectifier, Peak detector, Sample and hold circuit.

UNIT – II

Comparators and Waveform Generators: Introduction, Comparator, Regenerative comparator (Schmitt Trigger), Square wave generator using Astable Multi-vibrator, Monostable Multi-vibrator, Triangular wave generator. Sinusoidal oscillators: *RC* and Wien bridge oscillators.

UNIT – III

Voltage Regulators: Introduction, Basics, Linear Voltage Regulator using Op-Amps, IC voltage regulator – 78XX, 79XX, LM317, LM723. Switched-Mode Power Supplies, Comparison between Linear and Switched-Mode Power Supplies.

Active Filters: Introduction, *RC* Active Filters, First order low pass filter, Second order active filter, Higher order low pass filter, High pass active filter, All Pass filter – phase shift lead and lag circuit.

UNIT – IV

D/A Converters: Introduction, Analog and Digital data converter, Specifications of D/A and basic DAC techniques – Weighted resistor DAC, R-2R ladder DAC.

A/D Converters: Specifications of A/D converter, Classification of ADCs: The parallel Comparator (Flash) ADC, Counter type ADC, Successive Approximation Converter, Single slope type ADC and Dual slope type ADC, Sigma-delta ADC.

UNIT – V

Timers: Functional block diagram of 555, Applications: Astable and Monostable multi-vibrators, Ramp generator.

Phase locked loops: Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO).

Choice: Unit-I and Unit-IV

Text Books:

1. "Linear Integrated Circuits", S. Salivahanan and V. S. Kanchana Bhaaskaran, 2nd Edition, Tata McGraw – Hill Publication.
2. "Linear Integrated Circuits", D Roy Choudhury and Shail B. Jain, New Age Publication.

Reference Books:

1. "Op-Amps and Linear ICs", David A. Bell, Prentice-Hall Publication.
2. "Op-Amps and Linear Integrated Circuits", Ramakanth A. Gayakwad, 4th Edition, PHI.

E books:

1. https://www.analog.com/en/education/education-library/tutorials/analog-electronics.html
2. https://electronicsforu.com/resources/7-free-ebookstutorials-on-op-amp

MOOCs:

1. https://swayam.gov.in/nd1_noc19_ee39/previewopamppracticalapplications:design,simulationandimplementation by Dr.Hardik J. Pandya, IISc Bengaluru.
2. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware — Reviews and Ratings
3. http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/

B.M.S. College of Engineering, Bengaluru – 19

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Course Title	ARM PROCESSOR AND PROGRAMMING				
Course Code	23ES4PCAPP	Credits	4	L – T – P	3:0:1
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Prerequisities: Digital Electronic Circuits

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Apply** knowledge of combinational, sequential, and timing circuits in recognizing functional blocks of computers and their working *mechanisms*	1	2
CO2	**Analyse** the Architectural features of 32-bit microprocessor with necessary Input/Output and Memory Operations to build an embedded Controller	2	2
CO3	**Design** simple programming modules in machine and higher-level programming language using simulators to develop logical skills *and testing skills*	3	2
CO4	**Select and implement** appropriate Structured and *modular* programming using techniques such as subroutines, *data stores*, interrupt service routines and *exception handling mechanisms*	4	2
CO5	**Build** simple Embedded Applications using Input and output devices with ARM core and a controller	5	2

UNIT – I

ARM Processor fundamentals: Basic Structure of computers- Von Neumann and Harvard Architecture, Basic Processing Unit, Bus Structure, RISC and CISC Architecture, RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, ARM pipeline.

UNIT – II

ARM Assembly Programming: load/store architecture, ARM instruction set, Assembler rules and Directives, ARM-THUMB interworking, Assembly Language Programs.

UNIT – III

Embedded C Programming: Basic C data types, Local variable types, C compiler, Optimization; C looping and structures, Registrar allocation, function calls, Writing and optimizing assembly codes, mixing C and Assembly programming, Instruction scheduling.

UNIT – IV

Subroutines and stacks: Introduction, stack, subroutines, passing parameters to Subroutines, Exception and interrupt handling- Vector Table, Exception priorities, link register offsets, interrupts. Interrupt handling schemes-Non Nested.

UNIT – V

Application of ARM controller LPC 2148: Memory map, memory and I/O mapped peripherals, ADC, DAC and UART-Interfacing Programs, firmware and boot loader, introduction to Embedded Operating System

Choice: Unit-II and Unit-III

Text Books:

1. "Computer Organization and Architecture", Carl Hamacher, Zvonko Vranesic, 2001, McGraw-Hill.
2. "ARM System Developer's Guide", Sloss, Symes and Wright, Morgan Kaufmann Publishers, 2005, Elsevier.
3. "ARM Assembly Language- Fundamentals and Techniques", William Hohl, 2009, CRC press, Taylor and Francis.

Reference Books:

1. "Computer Organisation & Architecture", William Stallings, 2010, PHI.
2. "ARM System On-Chip Architecture", Steve Furber, Seocnd Edition, 2010, Pearson.

E books and online course materials:

1. ARM Microprocessor Systems, `https://www.pdfdrive.com/arm-microprocessor-systems-cortex-m-architecture-programming-and-interfacing-e157100364.html`

MOOCs:

1. `https://www.arm.com/resources/education/online-courses`

List of Lab Experiments

1. Divide an 8-bit variable into two 4 bit nibbles and store one nibble in each byte of a 16 bit variable. Store the disassembled byte in memory location (pointed by result)
2. Compare 2 values stored in memory location and store the higher value in a memory location (pointed by result)
3. Write a program to add two 64-bit numbers and store the result in a memory location.

4. Add a series of 16-bit numbers stored in sequential location in memory (called Table) and store the result in memory
5. Find the factorial of a given number
6. Write an assembly language program using the ARM instruction set to find the largest in a series of numbers stored in memory. Store the largest number in a memory location
7. ALP to multiply two 16 bit binary numbers.
8. ALP to find the sum of the first 10 integer numbers.
9. Write a program in C for the ARM processor to read data from the 8-bit on-board DIP switch and display the value on the 8 LEDs
10. Write a program in C for the ARM processor to use the built-in DAC to generate the following waveforms - square, ramp, triangle, and sine
11. Write a program in C for the ARM processor to rotate the stepper motor in both directions.
12. Establish serial communication between the ARM kit and the PC and do the following:
    (i) Send a character from the ARM kit to the serial terminal on the PC
    (ii) Send a character from the PC to the ARM Kit and display it on the LED
    (iii) Send a character from the PC to the ARM Kit. The program on the ARM processor should add 2 to it and send it back to the PC

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Course Title	PRINCIPLES OF COMMUNICATION SYSTEMS				
Course Code	23EC4PCPCS	Credits	4	L – T – P	3:0:1
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Prerequisities: Signals and Systems

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Apply** various concepts of theorems and Transforms for computing parameters of Communication systems	1	2
CO2	**Analyze** performance of different types of Analog modulation Techniques for a given set of parameters	2	2
CO3	**Design** Analog Communication subsystems for given set of specifications	3	2
CO4	**Simulate and conduct** experiments on different types of Analog communication subsystems	4, 5	2
CO5	**Involve** in independent/team learning, Communicate effectively and engage in life-long learning.	9, 10, 12	2

UNIT – I

Amplitude Modulation: Introduction to communication system, Channel: Types, Characteristics, and Modelling. Modulation Techniques: Need for modulation, Types of Modulation (AM, FM, PM, PAM, PWM, PPM). Amplitude modulation Time domain and frequency domain description, single tone modulation, power relations in amplitude modulation waves; Generation of amplitude modulation wave using, square law and switching modulators; Detection of amplitude modulation waves using square law and envelope detectors.

UNIT – II

Double Side Band Suppressed Carrier & SSB Modulation:

Double side band modulation: Time domain and frequency domain description; Generation of DSBSC

waves using Ring modulators; Coherent detection; Costas loop; Quadrature Carrier Multiplexing.

Single Side Band Modulation: Time & Frequency domain description, Generation of SSB-SC frequency discrimination method; Phase discrimination method; Vestigial side band modulation: Time & Frequency description, generation; Envelope detection; Comparison of AM techniques; Applications of AM systems.

UNIT – III

Angle Modulation: Single tone frequency modulation, Spectrum analysis of sinusoidal frequency modulation wave, narrow band frequency modulation, wide band frequency modulation, transmission bandwidth of frequency modulation wave, phase modulation, comparison of frequency modulation and phase modulation; Generation of frequency modulation waves, direct frequency modulation and indirect frequency modulation, Zero Crossing Detector, FDM, Frequency Translation. Comparison of FM & AM.

UNIT – IV

Noise performance of Analog modulation schemes: Noise sources, Types, Receiver characteristics: Sensitivity, Selectivity, Image Frequency Rejection Ratio, Choice of intermediate frequency, fidelity, Signal to Noise Ratio, Receiver model, Noise figure, Noise in AM, DSB & SSB System, Noise in Angle Modulation Systems, Threshold effect in Angle Modulation System, Pre-emphasis & De-emphasis.

UNIT – V

Introduction to Digital Communication: Introduction, Sampling theorem, Quadrature Sampling of Band pass signals, Practical aspects of sampling and signal recovery, PAM, TDM.

Choice: Unit-II and Unit-III

Text Books:

1. "Communication Systems", Simon Haykin and Moher, 5th Edition, 2010, Wiley.
2. "An Introduction to Analog and Digial Communications", Simon Haykin, 2008, Wiley.

Reference Books:

1. "Communication Systems Engineering", John G. Proakis and Masoud Salehi, (2/e), 2015, Pearson.
2. "Digital and Analog Communication Systems", K. Sam Shanmugam, Wiley, 1994.

MOOCs:

1. `https://nptel.ac.in/courses/117/105/117105143/`
2. `http://nptel.ac.in/courses/117102059/1`

List of Lab Experiments

1. Conduction of Second Order filters – LPF, HPF, BPF, BEF
2. Class C tuned amplifier
3. Generation and detection of AM
4. Generation and detection of DSBSC waves
5. FM Wave generation
6. Conduction on Frequency Mixer
7. Generation and Detection of PAM, PWM, PPM
8. Verification of sampling theorem

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Course Title	UNIVERSAL HUMAN VALUES				
Course Code	23MA4AEUHV	Credits	1	L – T – P	0:1:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No	Course Outcomes	PO	PSO
CO1	**Conduct** self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intention and Competence of an individual	1, 12	–
CO2	**Analyse** the value of harmonious relationship based on trust and respect in personal and professional life	2, 9	–
CO3	**Examine** the role of a human being in ensuring harmony in society and nature	2, 10	–
CO4	**Apply** the understanding of ethics in life and profession	1, 8	–

UNIT – I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration – what is it? Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity – A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility – the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT – II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health v/s dealing with disease.

UNIT – III

Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT – IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature.

Holistic perception of harmony at all levels of existence.

UNIT – V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist *etc*.

Text Books:

1. "Human Values and Professional Ethics", R. R. Gaur and G. P. Bagaria, 2010, Excel Books, New Delhi.

Reference Material:

1. "Jeevan Vidya: Ek Parichaya", A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. "Human Values", A.N. Tripathi, New Age International Publishers, New Delhi, 2004.
3. "The Story of Stuff", Annie Leonard.
4. "The Story of My Experiments with Truth", Mohandas Karamchand Gandhi
5. "Small is Beautiful", E. F. Schumacher
6. "Slow is Beautiful", Cecile Andrews
7. "Economy of Permanence", J. C. Kumarappa
8. "Bharat Mein Angreji Raj", Pandit Sunderlal
9. "Rediscovering India", Dharampal
10. "Hind Swaraj or Indian Home Rule", Mohandas K. Gandhi
11. "India Wins Freedom", Maulana Abdul Kalam Azad
12. "Vivekananda", Romain Rolland (English)

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Course Title	APPLIED PYTHON PROGRAMMING LAB				
Course Code	23EC4AEAPL	Credits	1	L – T – P	0:0:1
CIE	25 Marks (100% weightage)		SEE	50 Marks (50% weightage)	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Understand** Python libraries, OOP Concepts in Python Programming	–	–
CO2	**Apply** different mathematical concepts: Probability and Statistics, Laplace, Fourier and z-Transforms using python IDE platform (Jupyter notebook, pycharm, *etc*.)	1	2
CO3	**Implement** real-time applications in signal analysis and control systems	2, 3	2

List of Experiments

- **Basics of Python and Python Modules**

1. Program to find the best of two test average marks out of three test's marks accepted from the user.
2. Program to generate a Fibonacci sequence up to specified length.
3. Develop a program to check whether a given number/character is Palindrome or not.
4. Develop a program to convert Decimal to binary, Octal and Hexa-decimal and vice-versa using functions and Loops.

- **OOPS Concepts in Python Programming: Classes, Objects and Inheritance**

5. Declare a base class to calculate Resistance from voltage and current and extend the class to calculate inductance and capacitance with varying voltage and current values with respect to time.
6. By using the concept of inheritance, write a program to find the area of triangle, circle and rectangle.

- **Application to Field Theory**

7. Demonstration of electric field lines due to a point charge

8. Standing waves animation

- **Application to signals and systems and control systems**

9. Develop a Program for Sine Wave Generation.
10. Program to display pole – zero plot for a given transfer function.
11. Program to solve a given 2nd order difference equation using Z transform.
12. Program to solve a given 2nd order differential equation using Laplace transform.
13. Program to display Bode plot for a given second order system.
14. Program to display Nyquist plot for a given second order system.

Reference Books:

1. "Python Cookbook", David Beazley and Brian K. Jones, 3rd Edition, 2013, O'Reilly Media Inc.
2. "Python: The Complete Reference", Martin C. Brown, 4th Edition, 2018, McGraw-Hill.

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Course Title	**ADDITIONAL MATHEMATICS – II** (For lateral entry students)				
Course Code	**22MA4BSMAT**	**Credits**	**0**	**L – T – P**	**2:1:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:

At the end of the course, students will have the ability to:

Sl. No.	**Course Outcomes**	**PO**	**PSO**
CO1	**Apply** the concepts of linear algebra and numerical methods	1	–
CO2	**Apply** the concepts of integral calculus	1	–

UNIT – I

NUMERICAL METHODS – 1:

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations; Gauss-elimination method and Approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors.

UNIT – II

NUMERICAL METHODS – 2:

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae and Lagrange's interpolation formula (without proof). Problems.

Numerical integration: Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof): Problems.

UNIT – III

NUMERICAL METHODS – 3:

Numerical Solution of Ordinary Differential Equations (ODE's):

Numerical solution of ordinary differential equations of first order and first degree: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth-order, Milne's predictor-corrector formula (No derivations of formulae). Problems.

UNIT – IV

INTEGRAL CALCULUS:

Multiple Integrals: Evaluation of double integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Evaluation of triple integrals. Problems.

UNIT – V

BETA-GAMMA FUNCTIONS AND VECTOR INTEGRATION:

Beta and Gamma functions: Definitions, properties, the relation between Beta and Gamma functions.

Vector Integration: Line integral, Green's theorem and Stokes' theorem.

Text Books:

1. "Higher Engineering Mathematics", B. S. Grewal, 44th edition, 2018, Khanna Publishers.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, 10th edition (reprint), 2016, John Wiley & Sons.

Reference Books:

1. "Higher Engineering Mathematics", B. V. Ramana, 11th Edition, 2007, McGraw-Hill Education.
2. "Engineering Mathematics", Srimanta Pal and Subodh C. Bhunia, 3rd reprint, 2016, Oxford University Press.
3. "A Textbook of Engineering Mathematics", N. P. Bali and Manish Goyal, Laxmi Publications.
4. "Advanced Engineering Mathematics", C. Ray Wylie and Louis C. Barrett, 6th edition, McGraw-Hill Book Company, New York.
5. "Engineering Mathematics for Semester I and II", Gupta C. B., Sing S. R. and Mukesh Kumar, 2015, McGraw-Hill Education (India).
6. "Higher Engineering Mathematics", H. K. Dass and Er. Rajnish Verma, 2014, S. Chand Publication.
7. "Calculus", James Stewart, 7th edition, 4th reprint, 2019, Cengage Publications.

E books and online course materials:

1. `http://nptel.ac.in/courses.php?disciplineID=111`
2. `http://www.class-central.com/subject/math` (MOOCs)
3. `http://academicearth.org/`
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

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Course Title	**FUNCTIONAL ENGLISH** (For lateral entry students)				
Course Code	**23MA3HSENG / 23MA4HSENG**	**Credits**	**0**	**L – T – P**	**1:0:0**
CIE	**50 Marks (100% weightage)**		**SEE**	**100 Marks (50% weightage)**	

Course Outcomes:
At the end of the course, students will have the ability to:

Sl. No.	Course Outcomes	PO	PSO
CO1	**Communicate** effectively and creatively in both non-verbal and verbal forms in various multi-disciplinary activities.	10	–
CO2	**Upgrade** organizational skills/traits, team spirit/working in liaison and thus boost professional etiquette and ethics.	9, 10	–
CO3	**Write** effective technical reports, dissertation and project documents and make effective oral and written presentations.	9, 10	–
CO4	**Enhance** employability via training in writing correct and effective Applications/Resumes.	10	–
CO5	**Perform** well against Domestic and International Industry Standards via group discussions and Power Point Presentations.	9, 10	–
CO6	**Strengthen** basic grammar components/structures and overcome mistakes/wrong pronunciation and thereby, encourage speaking/writing in flawless English.	10	–

UNIT – I

COMMUNICATION:

- Introduction – Role and Importance of English in the Corporate World.
- Communication – Importance of technical communication-levels, flow of organizational communication
- Effective Presentation strategies: non-verbal communication aspects, Preparing Power Point Presentation

- Public Speaking
- Listening –Types, traits and importance of listening
- Telephone Etiquette
- Interviews-types and preparation.
- Interpersonal Communication Skills –Group Discussion

Additional Reference:

- Communication: Organizational communication, Communication cycle, Barriers
- Language as a tool of communication, characteristics of language
- Non-verbal communication
- Power point presentations
- Traits of a good listener, barriers
- Interviews: questions frequently asked
- Business Meetings/Conferences: Spoken
- Effective reading skills

UNIT – II

Technical Writing / Speaking: Specific Focus:

- Letter Writing – Job Applications, E-mails and other Official Letters
- Writing a résumé
- Writing reports and dissertation / thesis-structure and significance
- Description of Graphics – kinds, construction, use and application (in scientific texts) and Interpretation

Additional Reference:

- Paragraph Writing, Expansion of ideas – Précis Writing
- Business Letters: Significance, purpose, structure, layout, types and samples
- Curriculum Vitae / résumé / bio-data–different formats
- Technical Reports: objectives, characteristics and categories
- Manuscript format, prefatory parts and main text
- Interpretation of the diagrams and graphs in paragraphs
- Structure of a Research dissertation/thesis.

UNIT – III

Grammar: Basics and Structures:

- Parts of Speech-in brief
- Transformation of Sentences, Active and Passive Voice, Direct and Indirect Speech.
- Subject-Verb Agreement

Additional Reference:

- Nouns, Pronouns, Tenses, Articles and Prepositions. Adjectives, Conjunctions, Adverbs, Interjection

- Degrees of comparison
- Punctuation
- Types of sentences
- Simple-compound and complex sentences
- Rules governing Active-Passive voice and Direct-Indirect Speech
- Singular and plural nouns and verbs.

UNIT – IV

Vocabulary:

- Correct pronunciation of important words
- Identifying errors in sentences – often mispronounced and misspelt words
- Difference between American and British English,
- Indianism – Mother tongue influence
- Using Idioms and phrases – words commonly misused and confused
- Analogy of Comparison
- Corporate/conventional idioms.

Additional Reference:

- IPA script chart to read sounds-vowels and consonants
- Spellings chart
- Words often mispronounced
- Homophones and homonyms
- American English – evolution, expressions and slangs
- How American English has influenced corporate world
- Indianized expressions in English
- Phrasal verbs and proverbs.

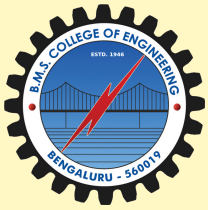
Text Books:

1. "Practice and Perfect" – a workbook issued by the Department of Mathematics and Humanities, B.M.S. College of Engineering.
2. Additional Reference Source prepared by the Faculty of English issued by the Department of Mathematics and Humanities, B.M.S. College of Engineering.

Reference Books:

1. "IELTS Preparation and Practice", Wendy Sahanaya and Terry Hughes, Oxford University Press, 2007.
2. "Technical Communication: Principles and Practice", Meenakshi Raman and Sangeetha Sharma.
3. "English for Presentations", Marion Grussendorf, Oxford Uuniversity Press, 2015.
4. "Making Sense of English", M.Yadugiri, Viva Publications.
5. "Advanced English Grammar", Thomson and Martinet, Cambridge University Press.

NOTE: Each student has to earn 100 AICTE Activity Points during 1st to 8th semester. Lateral-entry students are required to earn 75 AICTE Activity Points during 3rd to 8th semester.



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