

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾ ವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾಸಂಸ್ಥೆ)

ಬೆಂಗಳೂರು ೫೬೦ ೦೧೯

# BMS COLLEGE OF ENGINEERING

(Autonomous College under VTU)

BANGALORE - 560019



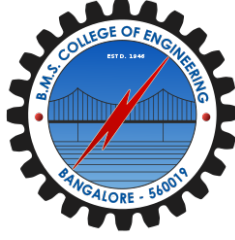
## ELECTRONICS & COMMUNICATION ENGINEERING

SCHEME & SYLLABUS

III to VI SEMESTER

2021-22 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-VI Semester**

**Batch admitted 2021**

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### **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**

- PEO 1** Graduates will Professionally Progress in Electronics, Communication and related areas with an inclination towards Continuous Learning
- PEO 2** Graduates will work in Diversified Teams of Multidisciplinary Environment
- PEO 3** 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 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.

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

**SEMESTER: III**

Sl. No.	Code	Course Title	Type	Credits				Hours	Marks		
				L	T	P	Total		CIE	SEE	Total
1	22MA3BSTFN	Transform Calculus, Fourier Series and Numerical Techniques	BS-7	2	1	0	3	4	50	50	100
2	22EC3PCAEC	Analog Electronic Circuits	PC-1	3	1	0	4	5	50	50	100
3	22EC3PCDSD	Digital System Design	PC-2	3	1	0	4	5	50	50	100
4	22EC3PCSAS	Signals and Systems	PC-3	3	0	1	4	5	50	50	100
5	22ES3PCNAL	Network Analysis	PC-4	2	1	0	3	4	50	50	100
6	22EC3PCIEL	Integrated Electronics Lab	PC-5	0	0	1	1	2	50	50	100
7	22EC3AEHDL	HDL Programming	AE-3	0	0	1	1	2	50	50	100
8	22MA3HSUHV	Universal Human Values	AE-4	0	1	0	1	2	50	50	100
9	22MA3HSSAK	Samskruthika Kannada	HS-3	1	0	0	1	1	50	50	100
	22MA3HSBAK	Balake Kannada									
10	22EC3NCCLA	Cultural Activity	NCMC-1	–	–	–	–	2	–	–	P/NP
<b>Total</b>				<b>14</b>	<b>5</b>	<b>3</b>	<b>22</b>	<b>32</b>	<b>450</b>	<b>450</b>	<b>900</b>

**SEMESTER: IV**

Sl. No.	Code	Course Title	Type	Credits				Hours	Marks		
				L	T	P	Total		CIE	SEE	Total
1	22MA4BSCPS	Complex Analysis, Probability and Statistical Methods	BS-8	2	1	0	3	4	50	50	100
2	22EC4PCFAW	Fields and Waves	PC-6	2	1	0	3	4	50	50	100
3	22ES4ESCST	Control Systems*	PC-7	3	1	0	4	5	50	50	100
4	22ES4PCAPP	ARM Processor and Programming**	PC-8	3	0	1	4	5	50	50	100
5	22EC4PCPCS	Principles of Communication Systems	PC-9	3	0	1	4	5	50	50	100
6	22EC4SRIN1	Seminar on Internship involving Social Activity / Technical Activity	INT-1	0	0	1	1	2	50	50	100
7	22EC4AEMCP	Mathematics Concepts Using Python	AE-5	0	0	1	1	2	50	50	100
8	22CV4HSEVS	Environmental Studies	HS-4	1	0	0	1	1	50	50	100
9	22MA4HSCPH	Constitution of India, Professional Ethics and Human Rights	HS-5	1	0	0	1	1	50	50	100
10	22EC4NCPYA	Physical Activity	NCMC-2	–	–	–	–	2	–	–	P/NP
<b>Total</b>				<b>15</b>	<b>3</b>	<b>4</b>	<b>22</b>	<b>31</b>	<b>450</b>	<b>450</b>	<b>900</b>

\*Common to EC, EE, EI & ET

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



**SEMESTER: V**

Sl. No.	Code	Course Title	Type	Credits				Hours	Marks		
				L	T	P	Total		CIE	SEE	Total
1	22EC5PCFOV	Fundamentals of VLSI	PC-10	3	0	0	3	3	50	50	100
2	22EC5PCMTA	Microwave Theory and Antenna	PC-11	3	1	0	4	5	50	50	100
3	22ES5GCDSP	Digital Signal Processing*	PC-12	3	0	1	4	5	50	50	100
4	22EC5PCDCT	Digital Communication Theory	PC-13	3	0	0	3	3	50	50	100
5	22EC5PCACL	Advanced Communication Lab	PC-14	0	0	1	1	2	50	50	100
6	22EC5PE1XX	Program Elective-1	PE-1	3	0	0	3	3	50	50	100
7	22EC5PWPJ1	Project Work-1	PW-1	0	0	2	2	4	50	50	100
8	22ES5HSPMF	Project Management and Finance**	HS-6	2	0	0	2	2	50	50	100
9	22EC5NCTWD	Technical Writing and Documentation	NCMC-3	-	-	-	-	2	-	-	P/NP
<b>Total</b>				<b>17</b>	<b>1</b>	<b>4</b>	<b>22</b>	<b>29</b>	<b>400</b>	<b>400</b>	<b>800</b>

\*Common to EC & EI

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

**Program Elective-1:**

Course Code	Course Title	Course Code	Course Title
22EC5PE1IP	Image Processing	22EC5PE1VR	Introduction to AR/VR
22EC5PE1SC	Satellite Communication	22EC5PE1OS	Operating Systems
22EC5PE1AI	Introduction to AI	22EC5PE1IT	IoT and its Applications
22EC5PE1AD	Advanced Digital Logic Design	22EC5PE1OP	Object Oriented Programming
22EC5PE1IC	Information Theory for Cyber-security		

### SEMESTER: VI

Sl. No.	Code	Course Title	Type	Credits			Hours	Marks		
				L	T	P		CIE	SEE	Total
1	22EC6PCECS	Electronics and Communication for Sustainable Development	PC-15	3	0	0	3	50	50	100
2	22EC6PCCCN	Computer Communication Net-works	PC-16	3	0	1	4	50	50	100
3	22EC6PCMSD	Mixed Signal Design	PC-17	3	0	1	4	50	50	100
4	22EC6PE2XX	Program Elective-2	PE-2	3	0	0	3	50	50	100
5	22EC6OE1XX	Open Elective-1	OE-1	3	0	0	3	50	50	100
6	22EC6PWPJ2	Project Work-2	PW-2	0	0	2	2	50	50	100
7	22EC6SRIN2	Internship Based Seminar	INT-2	0	0	1	1	50	50	100
8	22ES6HSIPL	Intellectual Property Rights and Cyber Law*	HS-7	2	0	0	2	50	50	100
9	22EC6NCPDC	Personality Development and Communication	NCMC-4	-	-	-	-	-	-	P/NP
<b>Total</b>				<b>17</b>	<b>0</b>	<b>5</b>	<b>22</b>	<b>400</b>	<b>400</b>	<b>800</b>

\*Common to EC, ET & ML

### Program Elective-2:

Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
22EC6PE2CV	Computer Vision	22EC6PE2SV	System Verilog and Verification	22EC6PE2MC	Multi-core Computing
22EC6PE2RS	Radar System	22EC6PE2DE	Data Encryption and Compression	22EC6PE2WS	Wireless Sensor Networks
22EC6PE2ML	Machine Learning	22EC6PE2DS	Data Structures using C++	22EC6PE2VR	Design of Virtual Reality

### Open Elective-1:

Course Code	Course Title	Course Code	Course Title
22EC6OE1AC	Analog and Digital Circuits	22EC6OE1IR	Introduction to Robotics

# **III Semester Syllabus**



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

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Course Title	<b>TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES</b>				
Course Code	<b>22MA3BSTFN</b>	Credits	<b>3</b>	L – T – P	<b>2:1:0</b>
CIE	<b>50 Marks (100% weightage)</b>		SEE	<b>100 Marks (50% weightage)</b>	

**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 Transform Techniques, optimization and Finite Difference Methods to solve engineering problems.	1	–
CO2	Analyze Engineering Application Problems using the concepts of Transform Techniques, optimization and Finite Difference Methods.	2	–
CO3	Demonstrate the importance of Transform Techniques, optimization and Finite Difference Methods in engineering using programming 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 infinite series, convergence and divergence. Periodic functions, Dirichlet's conditions. Fourier series of periodic functions with period  $2\pi$  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 explicit formula and Crank- Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

### UNIT – V

#### **CALCULUS OF VARIATIONS:**

Definition, Variation of a functional, Euler's equation, variational problems. Applications: Hanging cable problem, Brachistochrone problem.

#### **$z$ -TRANSFORMS:**

Definition, Standard  $z$ -transforms, Damping rule, Shifting rule, Initial value and final value theorems-problems. Inverse  $z$ -transform and applications to solve 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 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://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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<b>Course Title</b>	<b>ANALOG ELECTRONIC CIRCUITS</b>				
<b>Course Code</b>	<b>22EC3PCAEC</b>	<b>Credits</b>	<b>4</b>	<b>L – T – P</b>	<b>3:1:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Define, understand and explain</b> concepts related to diodes, transistors (BJTs and MOSFETs) and Op-Amps	–	–
CO2	<b>Apply</b> the knowledge of network theorems and device models to solve given analog electronic circuits	1	1
CO3	<b>Identify and analyse</b> given analog electronic circuits for the given parameters	2	1
CO4	<b>Design</b> analog electronic circuits for given specifications	3	1
CO5	<b>Present</b> case studies / seminar on advanced topics in Analog Electronic Circuits as an individual / team	4, 9, 10	1

**UNIT – I**

**Diode Applications:** Clippers, Clampers.

**Bipolar Junction Transistor (BJT):** DC biasing - Introduction, Operating point, Voltage divider Bias configuration.

**BJT AC Analysis:** Introduction, Application in the AC Domain, BJT Transistor Modeling, Voltage Divider Bias, BJT Frequency Response.

**UNIT – II**

**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.

**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 and Amplifier Distortion

### UNIT – III

**MOSFETs:** Introduction, Device structure and physical operation - Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small  $V_{DS}$ , Operation as  $V_{DS}$  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 – IV

**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  $g_m$ , 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

### UNIT – V

**Differential amplifier using MOSFET:** Large-Signal and small signal operation.

**Op-Amp applications:** Phase shift Circuits, Voltage follower, Current controlled current source, Voltage to current converter, Current to voltage converter, Adder or summing amplifier, subtractor, Adder-Subtractor, Instrumentation amplifier, AC Amplifier, Integrator, Differentiator, Logarithmic amplifier, antilogarithmic amplifier, Single power supply Operation, Analog computation.



**Voltage Regulators:** Introduction, Basics, Linear Voltage Regulator using Op-Amps, IC voltage regulator – 78XX, 79XX, LM317, LM723.

**Timers:** Functional block diagram of 555, Applications: Astable and Monostable multivibrators, applications of timer.

**Phase locked loop:** Introduction, Operation of the basic PLL, Closed loop analysis of PLL, Integrated circuit Phase-locked-Loop.

**Unit Choice:** III and 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”, Adel S. Sedra and Kenneth C. Smith, 5th Edition, Oxford International Student Edition.
3. “Linear Integrated Circuits”, S. Salivahanan and V. S. Kanchana Bhaaskaran, 2nd Edition, Tata McGraw – Hill.

**Reference Books:**

1. “Electronic Devices and Circuits”, David A Bell, 4th Edition, PHI.
2. “Fundamentals of Microelectronics”, Behzad Razavi, 3rd edition, John Wiley.
3. “Linear Integrated Circuits”, D Roy Choudhury and Shail B Jain, New Age Publication.

**E books:**

1. <https://www.pdfdrive.com/analog-electronics-circuits-systems-and-signal-processing-e43200016.html>
2. <https://www.pdfdrive.com/foundations-of-analog-and-digital-electronic-circuit-e43124869.html>
3. <https://www.electronicsforu.com/resources/free-and-helpful-ebooks-on-microelectronics>

**MOOCs:**

1. [https://onlinecourses.nptel.ac.in/noc19\\_ee54/preview](https://onlinecourses.nptel.ac.in/noc19_ee54/preview)
2. <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/>



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

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Course Title	DIGITAL SYSTEM DESIGN				
Course Code	22EC3PCDSD	Credits	4	L – T – P	3:1:0
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	<b>Apply</b> the concepts of logic functions to realize basic building blocks in digital logic circuits.	1	2, 3
CO2	<b>Analyse</b> digital logic circuits and employ Verilog HDL for modeling and functional verification.	2	2, 3
CO3	<b>Design</b> complete digital circuit(s) for a given specification using digital circuit concepts, state machines, and Verilog HDL.	3	2, 3

**UNIT – I**

**Introduction:** Introduction to Boolean algebra, Simplification of Boolean functions using K-Maps: Three Variable and Four Variable, Design with Basic gates, NAND gates and NOR gates. Structure of Verilog module, Operators, Data Types, and Styles of Description. Highlights of Data flow description, Structure of Data flow description.

**UNIT – II**

**Combinational Logic Circuits:** Introduction, Parallel Adders (Carry Look Ahead Adder and Ripple carry adder), Decimal Adder, Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs). Verilog: Highlights of Structural description, Organization of structural description, Structural description of combinational Logic circuits.

**UNIT – III**

**Behavioural Modeling of combinational Logic Circuits:** Structured procedure, procedural assignments, timing control, conditional statements, multi way branching, loops, sequential and parallel blocks, generate blocks, Implementation of combinational circuits using behavioural description.

## UNIT – IV

**Sequential systems:** 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. Verilog implementations of sequential circuits.

## UNIT – V

**Synchronous sequential networks:** Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations, Sequence detector, implementation of FSM using Verilog.

**Unit Choice:** III and IV

### 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. “Verilog HDL: A Guide to Digital Design and Synthesis”, Sameer Palnitkar, 2nd Edition, 2003, Pearson.

### Reference Books:

1. “Fundamental of Logic Design”, Charles Roth Jr., Thomas Learning.
2. “Fundamentals of Digital Logic with Verilog Design”, Stephan Brown and Zvonk Vranesic, 2nd Edition, 2008, McGraw-Hill.

### 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>
4. <https://easyengineering.net/fundamentals-of-digital-circuits-by-anand-kumar/>

### 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	22EC3PCSAS	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	<b>Apply</b> the mathematical concepts and transform techniques to solve the continuous and discrete LTI systems	1	1
CO2	<b>Analyze</b> various methods to categorize the LTI systems and identify solutions for mathematical representations of systems	2	1
CO3	<b>Design</b> a linear, time-invariant system for a given specification	3	1
CO4	<b>Simulate and Conduct</b> experiments involving various operations on signals and response of systems using appropriate tools	4, 5	1
CO5	<b>Involve</b> in independent/team learning, Communicate effectively and engage in life long learning	5, 9, 10, 12	1

**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.

### 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, Convolution and Modulation with Mixed Signal classes, 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.

**Unit Choice:** III and IV

#### 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.

#### 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](http://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



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

(Autonomous College under VTU)

Course Title	NETWORK ANALYSIS				
Course Code	22ES3PCNAL	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	<b>Apply</b> basic circuit laws and network theorems to linear electrical networks	1	1
CO2	<b>Analyse</b> linear circuits in time and frequency domain	2	1
CO3	<b>Simulate</b> linear circuits using appropriate tools	1, 2, 5	1

**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.

**Unit Choice:** I and 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>





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

(Autonomous College under VTU)

Course Title	INTEGRATED ELECTRONICS LAB				
Course Code	22EC3PCIEL	Credits	1	L – T – P	0:0:1
CIE	50 Marks (100% weightage)		SEE	50 Marks (100% weightage)	

#### Course Outcomes:

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

Sl. No	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of network theorems, device models and basics of analog and digital electronics to conduct a given experiment	1	2
CO2	<b>Identify</b> and <b>analyse</b> analog and digital electronic circuits to obtain the expected output for the given parameters	2	2
CO3	<b>Design</b> analog and digital electronic circuits for the given specifications and conduct the experiment	3	2
CO4	<b>Involve</b> in independent / team learning, communicate effectively and engage in life long learning	4, 9, 10, 12	2

#### List of Analog Electronics Experiments

- Design and Test of Clipper circuits to generate the required waveform
  - Design and verification of clamping circuit
- Design and verification of
  - RC-coupled amplifier
  - Amplifiers using Op-Amp
  - Oscillators
- Design of square wave generator circuit using 555 timer
- Design and study of performance parameters 723 as a High Voltage and Low Voltage regulator

5. Design of a class B complementary symmetry Power amplifier

List of Digital Electronics Experiments

1. Digital Puzzles
2. Counters
3. Multiplexer and De-multiplexer
4. Shift Registers
5. Sequence generation and Detection

**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				
Course Code	22EC3AEHDL	Credits	1	L – T – P	0:0:1
CIE	50 Marks (100 % weightage)		SEE	50 Marks (100 % weightage)	

**Course Outcomes:**

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

Sl. No	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of HDL programming for modeling and functional verification of Digital circuits using EDA tools.	1, 5, 9, 10, 12	2, 3
CO2	<b>Analyse</b> digital circuits using suitable Verilog HDL modeling using EDA tools.	2, 4, 5, 9, 10, 12	2, 3
CO3	<b>Design</b> and synthesize a digital circuit for complex systems using EDA tools	3, 4, 5, 9, 10, 12	2, 3
CO4	<b>Involve</b> in independent / team learning, communicate effectively and engage in life long learning	3, 4, 5, 9, 10, 12	2, 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**

(Autonomous College under VTU)

<b>Course Title</b>	<b>UNIVERSAL HUMAN VALUES</b>				
<b>Course Code</b>	<b>22MA3AEUHV</b>	<b>Credits</b>	<b>1</b>	<b>L – T – P</b>	<b>0:1:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>50 Marks (100% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Conduct</b> 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	<b>Analyse</b> the value of harmonious relationship based on trust and respect in personal and professional life	2, 9	–
CO3	<b>Examine</b> the role of a human being in ensuring harmony in society and nature	2, 10	–
CO4	<b>Apply</b> 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)



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

(Autonomous College under VTU)

Course Title	ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ				
Course Code	22MA3HSSAK	Credits	1	L – T – P	1:0:0
CIE	50 Marks (100% weightage)	SEE	100 Marks (50% weightage)		

**Course Outcomes:**

After successfully completing the course, students will be able to understand the following topics:

Sl. No.	Course Outcomes	PO	PSO
CO1	ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.	10	–
CO2	ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅಸಕ್ತಿ ಮೂಡುತ್ತದೆ.	10	–
CO3	ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ; ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.	9	–

**ಘಟಕ - ೧**

ಲೇಖನಗಳು:

೧. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ.
೨. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ - ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

**ಘಟಕ - ೨**

ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯಭಾಗ:

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕ ಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಚೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.
೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸರು  
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು



**ಘಟಕ - ೩**

ಆಧುನಿಕ ಕಾವ್ಯಭಾಗ:

೧. ಕುರುಡು ಕಾಂಚಾಣ: ದ. ರಾ. ಬೇಂದ್ರೆ.

೨. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

**ಘಟಕ - ೪**

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ:

೧. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ: ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ: ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

**ಘಟಕ - ೫**

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ: ಕನ್ನಡ-ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ

**ಪಠ್ಯ ಪುಸ್ತಕ:**

‘ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ’, ಡಾ. ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ

ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.



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

(Autonomous College under VTU)

Course Title	ಬಳಕೆ ಕನ್ನಡ				
Course Code	22MA3HSBAK	Credits	1	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	Create awareness regarding the necessity of learning local language for a comfortable living and to know more about Kannada culture and literature.	10	–
CO2	Develop proper speaking, reading and writing skills in Kannada.	10	–
CO3	Engage as a member of a team and enhance the skill in group communication and presentation.	9	–

**UNIT – I**

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conversation, Listening and Speaking Activities, Key to Transcription.
3. ವಯ್ಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯ ಸೂಚಕ / ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು. Personal pronouns, Possessive forms, Interrogative words.

**UNIT – II**

1. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣ (ಬಣ್ಣ) ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, quantitative and colour adjectives, numerals.
2. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು, ಸಪ್ತಮಿ, ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು (ಅ, ಅದು, ಅವು, ಅಲ್ಲಿ). Predictive forms, locative case.

### UNIT – III

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು Dative cases and numerals.
2. ಸಂಖ್ಯಾವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು Ordinal numerals and plural markers.

### UNIT – IV

1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು. Permission, Commands, Encouraging and Urging words (Imperative words and sentences)
2. ‘ಇರು ಮತ್ತು ಇರಲ್ಲ’ ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯ ಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು. Helping verbs “iru” and “iralla”, corresponding future and negation verbs.

### UNIT – V

1. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮತ್ತು ರಾಜ್ಯದ ಬಗ್ಗೆ ಕುರಿತಾದ ಇತರ ಮಾಹಿತಿಗಳು. Karnataka State and General Information about the state.
2. ಕನ್ನಡ ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯ. Kannada Language and History.
3. Kannada Language Script, Part – I.

#### ಪಠ್ಯ ಪುಸ್ತಕ:

‘ಬಳಕೆ ಕನ್ನಡ’, ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.



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

(Autonomous College under VTU)

Course Title	<b>ADDITIONAL MATHEMATICS – I</b> (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://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

## **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	22MA4BSCPS	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	Analyze the engineering data/problems using special functions, complex variables and statistical methods.	1	–
CO3	Demonstrate the importance of complex variables, special functions and statistical methods using programming tools.	1	–

## 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, Problems.

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

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

## 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  $P_n(x)$ , generating function for  $P_n(x)$ . Legendre polynomials, Rodrigue's formula (without proof) - Problems.

### UNIT – III

#### STATISTICAL METHODS:

**Correlation and regression:** Karl Pearson's coefficient of correlation and rank correlation, problems.

**Regression analysis:** lines of regression, angle between two regression lines - problems.

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

### 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, Problems (derivations for mean and standard deviation for Poisson distribution only), Illustrative examples.

**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 as a test of 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 e-Shikshana Program
6. VTU EDUSAT Program



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

(Autonomous College under VTU)

Course Title	FIELDS AND WAVES				
Course Code	22EC4PCFAW	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	<b>Apply</b> 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
CO2	<b>Analyse</b> and solve Electromagnetic problems related to Electrostatics, Magnetostatics, Time-varying fields and wave propagation	2	1
CO3	<b>Engage</b> in self-learning through online/multimedia resources and by working on mini-projects related to electromagnetic fields and waves	5, 9, 10	1

### 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, Electric field due to dipole, Energy Density.

### UNIT – II

**Electrostatics:** 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.

**Steady Magnetic Field:** Biot-Savart Law, Ampere's Circuital Law, Magnetic Flux and Flux Density.

### UNIT – III

**Steady Magnetic Field:** Scalar and Vector Magnetic Potentials, Force on a moving charge, Force on differential current element, Magnetic Boundary Conditions.

**Time varying fields:** Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form.

### UNIT – IV

**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.

**Unit Choice:** I and II

#### 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](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/ceel/#/home>
2. Classical Electromagnetics-2, Prof. H. C. Verma, <https://bsc.hcverma.in/ceee2/#/home>



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

(Autonomous College under VTU)

Course Title	CONTROL SYSTEMS				
Course Code	22ES4ESCST	Credits	4	L – T – P	3:1:0
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	<b>Understand</b> the basic concept related to control systems.	–	–
CO2	<b>Apply</b> the knowledge of mathematical concepts to obtain transfer function of various systems.	1	1
CO3	<b>Analyse</b> the performance of a linear time invariant system in time/frequency domain.	2	1
CO4	Conduct/ demonstrate the concepts of linear control systems using modern tools as an individual / team.	3, 5, 9, 10	1

**UNIT – I**

**Introduction:** Examples of Control Systems, open loop vs Closed loop Systems.

**Mathematical Modelling of Linear Systems:** Transfer functions, Mechanical Systems, Analogous Systems, Block diagram, Signal Flow graph, Transfer Functions of Lag and Lead Compensators.

**UNIT – II**

**Controllers and Time response analysis:** Step response of first order, second order systems, response specification, steady state error and error constants. Effect of PI, PD and PID controllers on the time response of the system.

**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, Relative stability.

#### **UNIT – V**

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

**Unit Choice:** I and 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](http://en.wikibooks.org/wiki/Control_Systems)
2. <http://www.electrical4u.com/control-system-closed-loop-open-loop-controlsystem/#practical-examples-of-open-loop-control-system>
3. <http://www.bfacstaff.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)

<b>Course Title</b>	<b>ARM PROCESSOR AND PROGRAMMING</b>				
<b>Course Code</b>	<b>22ES4PCAPP</b>	<b>Credits</b>	<b>4</b>	<b>L – T – P</b>	<b>3:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

### Course Outcomes:

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> knowledge of combinational, sequential, and timing circuits in recognizing functional blocks of computers and their working mechanisms	1	2
CO2	<b>Analyse</b> the Architectural features of 32-bit microprocessor with necessary Input/Output and Memory Operations to build an embedded Controller	2	2
CO3	<b>Design</b> simple programming modules in machine and higher-level programming language using simulators to develop logical skills and testing skills	3	2
CO4	<b>Select and implement</b> appropriate Structured and modular programming using techniques such as subroutines, data stores, interrupt service routines and exception handling mechanisms	4	2
CO5	<b>Build</b> simple Embedded Applications using Input and output devices with ARM core and a controller	5, 9, 10	2

## UNIT – I

**Overview of computing systems:** Basic structure of computers- function units of a computer, bus structure, performance of the processor, memory location and addresses, memory and I/O systems , basic processing unit, pipelining, computer peripherals.

## UNIT – II

**ARM Processor fundamentals:** RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, exceptions and interrupts, ARM pipeline, ARM instruction set, Assembler rules and Directives, load/store architecture, ARM-THUMB interworking, programming.

## UNIT – III

**Embedded C codes:** Overview of C compiler and optimization, Basic C data types, Local variable types, C looping and structures, Register allocation, Function calls, 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 off-sets, interrupts. Interrupt handling schemes.

## UNIT – V

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

**Unit Choice:** II and 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, Second 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. 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. Find the largest in a series of numbers stored in memory.
7. Multiply two 16 bit binary numbers.
8. Sum of first 10 integer numbers.
9. Embedded C program to read data from the 8-bit on board DIP switch and display the value on the 8 LEDs
10. Embedded C program to use the built in DAC to generate the following waveforms - square, ramp, triangle and sine
11. Interfacing ARM processor to stepper motor in both directions
12. Serial Communication





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

(Autonomous College under VTU)

<b>Course Title</b>	<b>PRINCIPLES OF COMMUNICATION SYSTEMS</b>				
<b>Course Code</b>	<b>22EC4PCPCS</b>	<b>Credits</b>	<b>4</b>	<b>L – T – P</b>	<b>3:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** Signals and Systems

### Course Outcomes:

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

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

### 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 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.

**Unit Choice:** II and III

#### Text Books:

1. “Communication Systems”, Simon Haykin and Moher, 5th Edition, 2010, Wiley.
2. “An Introduction to Analog and Digital 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



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>SEMINAR ON INTERNSHIP INVOLVING SOCIAL ACTIVITY / TECHNICAL ACTIVITY</b>				
<b>Course Code</b>	<b>22EC4SRIN1</b>	<b>Credits</b>	<b>1</b>	<b>L – T – P</b>	<b>0:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>50 Marks (100% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Develop</b> awareness about current global and contemporary issues in society, engineering and technology in keeping with sustainable solutions	6, 7, 12	1, 2, 3
CO2	<b>Familiarize</b> oneself with the skills needed to work in an industry or an organization and <b>apply</b> domain knowledge for addressing the societal/technical issues	1, 7, 9	1, 2, 3
CO3	<b>Comprehend</b> and present a report on the work done	10	1, 2, 3

Note: Non-Technical Internship

Minimum duration of 4 weeks or 1 month



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>MATHEMATICS CONCEPTS USING PYTHON</b>				
<b>Course Code</b>	<b>22EC4AEMCP</b>	<b>Credits</b>	<b>1</b>	<b>L – T – P</b>	<b>0:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>50 Marks (100% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Understand</b> Python libraries, OOP Concepts in Python Programming	–	–
CO2	<b>Apply</b> different mathematical concepts: Probability and Statistics, Laplace, Fourier and $z$ -Transforms using python IDE platform (Jupyter notebook, pycharm, <i>etc.</i> )	1, 5	1, 2
CO3	<b>Implement</b> real-time applications in signal analysis and control systems	2, 3	1, 2

**List of Experiments**

1. Basics of Python and Python Modules
2. OOP Concepts in Python Programming: Classes, Objects and Inheritance
3. Python Programming for Probability and Statistics
4. Python Programming for implementing Laplace, Fourier and  $z$ -Transforms
5. Introduction to Machine Learning libraries: numpy, pandas, matplotlib  
Applications of Python for Control Systems (Bode, Nyquist and Polar plots) and Signals and Systems (Pole-zero plot, Frequency response plot)

**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.



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

(Autonomous College under VTU)

Course Title	ENVIRONMENTAL STUDIES				
Course Code	22CV4HSEVS	Credits	1	L – T – P	1:0:0
CIE	50 Marks (100% weightage)		SEE	50 Marks (100% weightage)	

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	Understand the components and impacts of human activities on environment.	7	–
CO2	Apply the environmental concepts for conservation and protection of natural resources.	1	–
CO3	Identify and establish relationship between social, economical and ethical values from environmental perspectives.	6	–

**UNIT – I**

**Introduction to Environment:**

- Definition, About the Earth, Earth's Structure *i.e.*, Atmosphere and its parts, Lithosphere, Hydrosphere and Biosphere.
- Ecology & Ecosystem, Balanced Ecosystem, Types of Ecosystem.

**UNIT – II**

**Human Activities on Environment:**

- Human activities – Food, Shelter, Economic and Social Security.
- Effects of Human activities on Environment – Agriculture, Housing, Industries, Mining and Transportation activities.
- Environmental Impact Assessment (EIA)
- Sustainable development

### UNIT – III

#### **Natural Resources:**

- Definition, Renewable and Non-Renewable sources.
- Major Natural Resources:
  - Water resources, its availability, quality, water-borne and water-induced diseases
  - Mineral resources, classification, uses in various Industries as byproducts
  - Forest resources – causes and consequences of deforestation, various afforestation programs
- Conventional and Non-conventional energy resources:
  - Hydroelectric, Wind power, Solar, Biogas, geothermal energy
  - Fossil fuel based energy resources – Coal, Oil and Gas, Nuclear power
  - Hydrogen as an alternate future sources of energy

### UNIT – IV

#### **Environmental pollution:**

Introduction, following are few types of pollution to study:

- Water pollution – definition, types, sources, effects and control of water pollution.
- Land pollution – definition, types, sources, effects, Solid waste management.
- Noise pollution – definition, sources, effects and control of noise pollution.
- Air pollution - definition, sources, effects and control of air pollution.

### UNIT – V

#### **Current environmental issues and importance:**

Introduction, following are few types of pollution to study:

- Population growth, effects and Control, Climatic changes.
- Global warming, Acid rain, Ozone layer depletion and its effects.
- Environmental protection – initiatives by Government and non-Govt. Organizations (NGO's), Role of Legal aspects.
- Environmental Education, Women education.

#### **Text Books:**

1. “Environmental studies”, Dr. Geetha Balakrishanan, Revised Edition, Sun star publication.
2. “Ecology”, Subramanyam, Tata McGraw Hill Publication.
3. “Environmental studies”, Dr. J. P. Sharma, Fourth edition.

4. “Environmental studies”, Smriti Srivastav, Kataria and Sons publication.

**Reference Books:**

1. “Environmental studies”, Benny Joseph.
2. “Environmental studies”, Dr. D. L. Manunath.

**Learning Resources:**

1. NPTEL (Open Sources / power-point and visuals)
2. Ecological studies / IITR / Open Sources
3. Ministry of Environment and forest and wildlife.

**MOOCs:**

1. <https://www.coursera.org/course/sustain>





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

(Autonomous College under VTU)

<b>Course Title</b>	<b>CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS</b>				
<b>Course Code</b>	<b>22MA4HSCPH</b>	<b>Credits</b>	<b>1</b>	<b>L – T – P</b>	<b>1:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>50 Marks (100% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	Recognize the significance of the Indian Consitution as the supreme legal authority.	6	–
CO2	Analyse the theories and concepts of Human Rights	6	–
CO3	Apply the principles of moral/ethical obligations and duties to ensure public welfare and safety.	8	–

**UNIT – I**

**Introduction to Indian Constitution:**

Framing of the Indian constitution: Role of the Constituent Assembly, Preamble and Salient features of the Constitution of India, Fundamental Rights and its limitations. Fundamental Duties and their significance. Directive Principles of State Policy: Importance and its relevance. Case Studies.

**UNIT – II**

**Union Executive and State Executive:**

**The Union Executive:** The President and The Vice President, The Prime Minister and The Council of Ministers. The Union Parliament – Lok Sabha and Rajya Sabha.

The Supreme Court of India.

**State Executive:** The Governors, The Chief Ministers and The Council of Ministers.

**State Legislature:** Legislative Assembly and Legislative Council. State High Courts.

**UNIT – III**

### **Election Commission of India, Amendments and Emergency Provisions:**

Election Commission of India – Powers & Functions – Electoral Process in India.

Methods of Constitutional Amendments and their Limitations.

Important Constitutional Amendments: 42nd, 44th, 61st, 74th, 76th, 77th, 86th and 91st.

Emergency Provisions. Case Studies.

## **UNIT – IV**

### **Human Rights:**

Human Rights: Meaning and significance, Types Human Rights, Powers and Functions of National and State Human Rights Commission of India. Human rights in constitution of India.

## **UNIT – V**

### **Professional Ethics:**

Scope and Aims of Engineering Ethics, Responsibilities of Engineers and impediments to Responsibilities. Honesty, Integrity and Reliability; Risks – Safety and Liability in Engineering. Case Studies.

### **Text Books:**

1. “An Introduction to Constitution of India and Professional Ethics”, Merunandan K. B. and B. R. Venkatesh, 3rd edition, 2011, Meragu Publications.
2. “Constitution of India & Professional Ethics & Human Rights”, Phaneesh K. R., 10th edition, 2016, Sudha Publications.

### **Reference Books:**

1. “V.N. Shukla’s Constitution of India”, Prof. (Dr.) Mahendra Pal Singh, 13th Edition (Revised), 2017, Reprint 2019, Eastern Book Company.
2. “Ethics in Engineering”, Mike W. Martin, Roland Schinzinger, 4th Edition, 2004, McGraw-Hill Education.

### **E books and online course materials:**

1. <https://www.smartzworld.com/notes/constitution-of-india-and-professional-ethics-notes-vtu-cip-pdf/>
2. <https://legalstudymaterial.com/constitution-of-india/>



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

(Autonomous College under VTU)

Course Title	<b>ADDITIONAL MATHEMATICS – II</b> (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  $(1/3)^{\text{rd}}$  and  $(3/8)^{\text{th}}$  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://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

## **V Semester Syllabus**



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>FUNDAMENTALS OF VLSI</b>				
<b>Course Code</b>	<b>22EC5PCFOV</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** Basic concepts of MOSFETs

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of CMOS technology and Digital System Design in the context of VLSI circuits and subsystems.	1	3
CO2	<b>Analyze</b> CMOS circuits and subsystems to obtain the desired performance parameters.	2, 5, 9, 10	3
CO3	<b>Design</b> CMOS based combinational and sequential circuits for given specifications.	3, 5, 9, 10	3

### UNIT – I

MOS Transistor: Long Channel I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non ideal I-V Effects.

CMOS Logic: Inverter, NAND Gate, NOR Gate, CMOS Compound Gates. VLSI design flows.

### UNIT – II

CMOS Processing Technology: CMOS Technologies, CMOS Inverter Fabrication and Layout, Layout Design Rules, Gate Layouts and Stick Diagrams. CMOS Process enhancements. Manufacturing Issues.

### UNIT – III

Static CMOS Inverter: DC Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistor DC Characteristics, Circuit design using Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers.

Sequential MOS logic circuitry: SR Latch Circuitry, Clocked latch and Flip Flop Circuitry (SR and JK), CMOS D-Latch and Edge Triggered Flip-Flop.

#### **UNIT – IV**

Sequencing Static Circuits: Sequencing Methods, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew.

Array Sub system: SRAM: SRAM Cells, Row Circuitry, Column Circuitry. DRAM: Subarray Architectures, Column Circuitry, Embedded DRAM.

#### **UNIT – V**

Silicon Debug Principles, Manufacturing Test Principles, Design for Testability, Boundary Scan.

**Choice:** Unit-III and Unit-IV

#### **Text Books:**

1. “CMOS VLSI Design: A Circuits and Systems Perspective”, Neil H. E. Weste and David Harris, Pearson Education, 4th Edition, 2011, ISBN: 0-321-54774-8.
2. “CMOS Digital Integrated Circuits”, Sung-Mo Kang and Yusuf Leblebici, Tata McGrawHill, 3rd Edition, ISBN: 0-7923-7246-8.

#### **Reference Books:**

1. “Basic VLSI Design”, Douglas. A. Pucknell and Kamaran Eshraghian, PHI, 3rd Edition, 2010, ISBN: 0-321-26977-2.
2. “Introduction to VLSI Circuits & Systems”, John P. Uyemura, Wiley India Edition.

#### **E books and online course materials:**

1. <http://swarm.cs.pub.ro/~mbarbulescu/SMPA/CMOS-VLSI-design.pdf>

#### **MOOCs:**

1. <https://nptel.ac.in/courses/117101058/>



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>MICROWAVE THEORY AND ANTENNA</b>				
<b>Course Code</b>	<b>22C5PCMTA</b>	<b>Credits</b>	<b>4</b>	<b>L-T-P</b>	<b>3:1:0</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>		<b>SEE</b>	<b>100 Marks (50 % weightage)</b>	

**Prerequisites:** None.

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> the concepts of Antennas for practical systems	1, 2	1
CO2	<b>Analyse</b> the concepts of Microwaves and Antennas	2	1, 2
CO3	<b>Use</b> Modern tools for the design of Antennas	3, 5, 9, 10	2, 3

### UNIT – I

Transmission line theory: lumped element circuit model- wave propagation on a transmission line, the lossless line, terminated lossless line, the impedance equation, principles of the Smith chart, quarter-wave transformer

Fundamentals of waveguide theory: TE modes in a rectangular waveguide.

### UNIT – II

Microwave Network analysis: the scattering matrix, reciprocal and lossless matrix. Concept of vector network analyzer and its significance in the industry. Basic properties of dividers and couplers – three-port networks, four-port networks, T-junction power divider – lossless divider, resistive divider.

### UNIT – III

Fundamentals of Antennas: Principle of antenna, fields from oscillating dipole, antenna field zones, basic antenna parameters, patterns, beam area, Radiation intensity, beam efficiency, directivity and gain, antenna aperture, effective height and radio communication link (Friis formula).



## **UNIT – IV**

Point Source and Arrays: Point source, Types of Arrays (Broadside, End fire, Extended End fire), Arrays of two point sources, linear array of n-isotropic point sources of equal amplitude and spacing, null direction for arrays n isotropic point source of equal amplitude and spacing, pattern multiplication.

## **UNIT – V**

Types of Antennas: Introduction, Radiation resistance of dipole antenna. Thin linear antenna, field components of  $\lambda/2$  (Hertz) dipole antenna, Radiation resistance of dipole antenna. Directivity of dipole antenna, Yagi-Uda antenna, Horn antenna, parabolic reflectors, Microstrip rectangular patch antenna design. Steps to design an antenna in a commercial industry-standard software.

### **Textbooks:**

1. “Microwave Engineering”, David M. Pozar, 4th Edition, Wiley Publications, 2011.
2. “Antennas and Wave Propagation”, John D Kraus, Ronald J Marhetka, Ahmad S Khan, 5th Edition, Tata McGraw Hill, 2017.

### **Reference Books:**

1. “Microwave Engineering”, Annapurna Das, Sisir K Das, 3rd Edition, McGraw-Hill, 2015.
2. “Antenna, Theory, Analysis & Design”, Constantine A Balanis, 4th Edition, John Wiley & Sons, 2016.



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

(Autonomous College under VTU)

Course Title	DIGITAL SIGNAL PROCESSING				
Course Code	22ES5PCDSP	Credits	4	L – T – P	3:0:1
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** Signals and systems

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of signal processing to solve Engineering problems on Discrete Fourier Transform and Filters.	1	1
CO2	<b>Analyze</b> frequency domain characteristics of a signal and Filter performance for a given specification.	2	1
CO3	<b>Design</b> and realize Analog and Digital Filter algorithms.	3	1
CO4	<b>Use</b> modern tools to carry out analysis on Signals using Discrete Fourier Transform, and to simulate filters for chosen applications.	4, 5, 9, 10	1, 3

### UNIT – I

Introduction to DSP, Frequency-domain Sampling, DFT, IDFT, DFT as a Linear Transformation (Matrix formulation), Properties of DFT: Periodicity, Linearity, Circular Time shifting, Circular Frequency Shifting, Circular Time Reversal, Conjugation and Conjugate Symmetry (Symmetry properties), Duality, Circular Convolution (Multiplication of two DFTs), Circular correlation, Multiplication (or Modulation) property, Parseval's Relation.

### UNIT – II

Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap adds and save methods. Relation between DFT and other transforms. Direct computation of DFT. Necessity for efficient computation of DFT. Radix2 Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation in time algorithm, decimation in frequency

algorithms. Radix2FFT algorithm for computation of Inverse Discrete Fourier Transform (IDFT).

### **UNIT – III**

Introduction to IIR filters, Pole zero placement method for simple IIR Filters, Impulse invariant & Bilinear Transformations, Design of analog Butterworth and Chebyshev filters, Design of Digital Butterworth and Chebyshev filters. Introduction to realization of digital systems, Infinite Impulse Response (IIR) systems: parallel form, cascade form.

### **UNIT – IV**

Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, Frequency sampling technique of designing FIR filters, Windowing design of FIR filters using Rectangular, Triangular & Hamming windows. Realization of Finite Impulse Response (FIR) systems: Direct Form, Linear Phase Form.

### **UNIT – V**

Application of digital filters in noise cancellation; Limitations of Linear filters, Random noise cancellation, Adaptive filters, LMS Algorithm, Applications. Decimation by a factor D, Interpolation by a factor I, Sampling conversion by a Rational factor I/D. Introduction to Multi-rate Digital Signal Processing.

### **LAB EXPERIMENTS:**

1. Generation of elementary signals
2. Study of sampling theorem, effect of under-sampling leading to Aliasing effect
3. Study of properties of Linear time-invariant systems,
4. Linear and Circular Convolution and Correlation
5. Study of Discrete Fourier Transform (DFT) and its inverse.
6. Study of Transform domain properties and its use
7. Study of Infinite Impulse Response (IIR) filter
8. Study of FIR filter design using the window method: Lowpass and high-pass filter
9. Study of Adaptive filter using LMS Algorithm.
10. Interpolation and Decimation.

### **Textbooks:**

1. “Digital Signal Processing, Principles, Algorithms and Applications,” John G. Proakis, Dimitris K Manolakis, Pearson education/PHI (4th Edition).
2. “Digital Signal Processing,” Tarun Kumar Rawat, Oxford University Press (16 December 2014).

**Reference Books:**

1. “Fundamentals of Digital Signal Processing,” Lonnie Ludeman, John Wiley & Sons; Wiley International 1st Edition, 1988.
2. “Discrete-Time Signal Processing,” Alan V. Oppenheim, Ronald W. Schaffer, John R. Buck, Prentice-Hall Signal Processing Series, 2nd Edition, 1999.
3. “Understanding Digital Signal Processing,” Richard G. Lyons, Prentice Hall, March 25, 2nd Edition 2004.
4. “Digital Signal Processing: Fundamentals and Applications,” Li Tan, Academic Press, 1st edition 2007.
5. “Schaum’s Outline of Digital Signal Processing,” Monson Hayes, McGraw-Hill, 1st edition, 1998.

**E-books:**

1. <https://nptel.ac.in/courses/117/102/117102060/>

**MOOCs:**

1. <https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/>



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>DIGITAL COMMUNICATION THEORY</b>				
<b>Course Code</b>	<b>22EC5PCDCT</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

**Prerequisites:** Knowledge of Digital Signal Processing, Principles of communications systems

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of various signal processing and coding techniques for digital communication systems.	1	1
CO2	<b>Analyse</b> the performance and design constraints of techniques learnt in the digital communication system.	2	1
CO3	<b>Design</b> and analyse digital modulation, spread spectrum and coding for Optimum receivers.	3	1

### Unit – I

Introduction to Block diagram of DCS with basic signal processing operations, Communication channel, Pulse code modulation, Uniform quantization and its SQNR, Robust quantization – A- and  $\mu$ -law companding, Differential PCM TR and RX, TDM-PCM, T1 and E1 digital Hierarchy. Line codes, ISI in band-limited channels, Zero-ISI condition - the Nyquist criterion, Solution for zero ISI - practical raised cosine filters.

### Unit – II

Optimum Receiver structures - correlator type receivers, Matched filter type receivers, Digital Modulations - Generation and detection of BASK, BPSK, and BFSK, Signal space constellations, Generation and detection of QPSK, waveforms and its Signal space constellation, Generation and detection of DPSK, waveforms, Probability of bit error expressions and Performance analysis of all the schemes in terms of probability of bit error, BW, and Power.

### **Unit – III**

Introduction to spread spectrum - Need for Spread Spectrum Modulation, PN sequence and its properties, Direct sequence SS system - DS/BPSK Transmitter & Receiver, Processing gain, Jamming margin, Frequency hop SS system - FH-FSK transmitter and Receiver, Fast and slow hop, Application of DS SS and FHSS, Introduction to OFDM.

### **Unit – IV**

Introduction to Information theory - Measurement of Information, Entropy and information rate, Communication channels, Shannon's Channel Capacity theorem and its trade-off Source coding - definition Various Properties of source codes, Shannon-Fano encoding algorithm, Huffman's coding algorithm, efficiency and variance computation.

### **Unit – V**

Introduction to Channel coding: Need for channel coding, Shannon's coding theorem. Linear Block codes – rate, encoding procedure. Error detecting and correcting capability. Syndrome calculation for error detection. Convolutional encoder representation, impulse response, transform domain representation, tree, trellis and state representation.

**Choice:** Unit-I and Unit-II

#### **Textbooks:**

1. "Digital Communications" By Simon Haykins – John Wiley, 2003.
2. "Digital communications" - Bernard Sklar: Pearson education, 2007.

#### **Reference Books:**

1. "Modern Analog and Digital Communications" - Lathi and Ding, Oxford Press.
2. "Concepts of Information theory and coding" - P.S. Satyanarayana, DYNARAM, 2005.

#### **MOOC course:**

1. NPTEL lecture series by Prof. Bikas Kumar Dey, IIT Bombay.
2. NPTEL lecture on Digital Communications by IIT Madras.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>ADVANCED COMMUNICATION LAB</b>				
<b>Course Code</b>	<b>22EC5PCACL</b>	<b>Credits</b>	<b>1</b>	<b>L – T – P</b>	<b>0:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>50 Marks (100% weightage)</b>	

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Understand</b> the importance of various concepts and techniques of digital communication.	–	–
CO2	<b>Apply</b> the knowledge of various signal processing and coding techniques for digital communication systems.	1	1
CO3	<b>Analyse</b> the performance and design constraints of techniques learnt in the digital communication system.	2	1
CO4	<b>Design</b> and analyse digital modulation, spread spectrum and coding for Optimum receivers.	3, 4, 5, 9, 10	1

### PART A (Hardware Experiments)

- Design a sample and hold circuit and verify sampling theorem for: (i)  $f_s \gg 2f_m$  (ii)  $f_s \ll 2f_m$  (Signal can be any generated or captured audio signal). Perform TDM of any two sampled signals and display the waveform.
- Design a circuit diagram for generating a BASK waveform for a given message with frequency \_\_\_Hz and carrier frequencies: (i) \_\_\_kHz (ii) \_\_\_kHz
- Design a circuit diagram for generating a BFSK waveform for a given message with frequency \_\_\_Hz and carrier frequencies: (i) \_\_\_kHz (ii) \_\_\_kHz
- Design a circuit diagram for generating a BPSK waveform for a given message with frequency \_\_\_Hz and carrier frequencies: (i) \_\_\_kHz (ii) \_\_\_kHz
- With the suitable measurement setup, perform measurements to compute directivity and gain of a microstrip patch antenna.
- With the suitable measurement setup, perform measurements to compute directivity and gain of a microstrip antenna array.

**PART B (Simulation using MATLAB/Octave)**

7. Demonstrate over and under sampling, quantization, and reconstruction of any given signal.
8. Demonstrate digital BASK modulation and demodulation.
9. Demonstrate a DS or FH spread spectrum system.
10. Demonstrate Huffman and Shannon Fano coding.
11. Demonstrate the BER performance of a digital communication system employing a BPSK modulation scheme with: (i) Block coding scheme (ii) Convolution coding. Assume an AWGN channel.
12. Plot the radiation plot of a microstrip antenna using the antenna design toolbox.





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

(Autonomous College under VTU)

Course Title	IMAGE PROCESSING				
Course Code	22EC5PE1IP	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** Basic knowledge of Digital Signal Processing

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> enhancement and restoration techniques to 2D-images in spatial and frequency domain for required visualization.	1	1
CO2	<b>Analyze, process</b> , and represent an image using various techniques in different domains.	2	1
CO3	<b>Evaluate</b> data manipulations and interpretations using various platforms for real time scenarios.	4	1

**UNIT – I**

**Introduction:** Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels – Neighbors and Connectivity of pixels in image, Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.

**Colour Image Processing:** Colour Fundamentals, Colour Models, Pseudo-colour Image Processing.

**UNIT – II**

**Image Enhancement:** Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

**Frequency Domain:** Preliminary Concepts, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening using Frequency Domain Filters.

### UNIT – III

**Restoration:** Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

### UNIT – IV

**Morphological Analysis:** Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

**Representation and Description:** Representation, Boundary descriptors.

### UNIT – V

**Image Segmentation:** Introduction, Detection of isolated points, Line detection, Edge detection, Edge linking, Region-based segmentation – Region growing, Split and merge technique, Local processing, Regional processing, Hough transform, Segmentation using Threshold.

**Choice:** Unit-I and Unit-II

#### Text Books:

1. “Digital Image Processing”, Rafael C G., Woods R E. and Eddins S L, Prentice Hall, 3rd Edition, 2008.

#### Reference Books:

1. “Image Processing, Analysis and Machine Vision”, Milan Sonka, Thomson Press India Ltd., 4th Edition.
2. “Fundamentals of Digital Image Processing”, Anil K. Jain, 2nd Edition, Prentice Hall of India.
3. “Digital Image Processing”, S. Sridhar, Oxford University Press, 2nd Edition, 2016.

#### E Books and Online Course Materials:

1. <https://bookboon.com/en/digital-image-processing-part-one-ebook>
2. <https://pakuni.info/download/digital-image-processing-by-jayaraman-pdf-book-free-download/>

#### MOOCs:

1. <https://www.coursera.org/learn/digital>
2. <https://www.classcentral.com/course/swayam-digital-image-processing-14005>

**NOTE:** This course content will be supplemented by practical experimentation in a simulator environment for clear understanding.



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

<b>Course Title</b>	<b>SATELLITE COMMUNICATION</b>				
<b>Course Code</b>	<b>22EC5PE1SC</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>		<b>SEE</b>	<b>100 Marks (50 % weightage)</b>	

**Prerequisites:** Communication Theory, Signals and Systems

#### Course Outcomes:

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> various concepts of mathematics and communication principles to Satellite communication.	1	1
CO2	<b>Analyze</b> the performance of various Satellite sub-systems for given parameters.	2	1
CO3	<b>Design</b> the satellite subsystems for the given specifications.	3	1

#### Unit-I

SATELLITE ORBITS: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geostationary and non-geostationary orbits – Look Angle Determination, Limits of visibility, eclipse-Sub-satellite point – Sun transit outage-Launching Procedures - launch vehicles and propulsion.

#### Unit-II

SPACE SEGMENT: Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

#### Unit-III

SATELLITE LINK DESIGN: Basic link analysis, Interference analysis, Rain-induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

#### **Unit-IV**

MODULATION AND MULTIPLEXING: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.

#### **Unit-V**

SATELLITE APPLICATIONS: INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

**Choice:** UNIT-III and UNIT-IV

#### **Textbooks:**

1. Dennis Roddy, "Satellite Communication", 4th Edition, McGraw Hill International, 2006.
2. Timothy Pratt, Charles Bostain, Jeremy Allnutt, "Satellite Communication", 2nd Edition, Wiley Publications, 2002.

#### **Reference Books:**

1. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications Handbook", Artech House, Boston, London, 1997.
4. Tri T. Ha, "Digital Satellite Communication", 2nd edition, 1990.
5. Emanuel Fthenakis, "Manual of Satellite Communications", McGraw Hill Book Co., 1984.
6. Robert G. Winch, "Telecommunication Transmission Systems", McGraw-Hill Book Co., 1983.
7. Brian Ackroyd, "World Satellite Communication and Earth Station Design", BSP professional Books, 1990.
8. G.B. Bleazard, "Introducing Satellite Communications", NCC Publication, 1985.
9. M. Richharia, "Satellite Communication Systems - Design Principles", Macmillan, 2003.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>INTRODUCTION TO AI</b>				
<b>Course Code</b>	<b>22EC5CE1AI</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** Knowledge of Calculus and Probability & Statistics

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Understand</b> the difference between cognitive and artificial intelligence	–	–
CO2	<b>Apply</b> the characteristics and architectures of various expert systems that differentiate it from the conventional systems.	1	2
CO3	<b>Analyze</b> knowledge of genetic algorithms and swarm intelligence with their principles and procedures.	2	2

**UNIT – I**

**Artificial Intelligence: History and Applications**

Introduction, Intelligence, Artificial Intelligence, Progress of Artificial Intelligence, Modeling, Simulation and AI, Intelligent Systems

**UNIT – II**

**Artificial Intelligence as Representation and Search**

The Predicate Calculus: Introduction, the propositional Calculus, the predicate calculus, Using Inference rules to produce predicate calculus expressions, Application: A logic-based financial Advisor

Structure and Strategies for State Space Search: Introduction, Graph Theory, Strategies for State Space Search, Using the state space to represent reasoning with predicate calculus

**UNIT – III**

**Heuristic Search and Stochastic Methods**

Heuristic Search: Introduction, Hill Climbing and Dynamic Programming, the best fit search

algorithm, admissibility, monotonicity, and Informedness, Using Heuristics in Games, Complexity Issues

Stochastic Methods: Introduction, the elements of counting, elements of probability theory, applications of stochastic methodology, Bayes theorem, Recursion-based search

## **UNIT – IV**

### **Expert Systems**

Introduction, expert systems, features, Characteristics, Architecture, Basic Activities, Advantages, Difference between Expert systems and conventional methods,

Stages in development of an expert system, building of a rule-based expert system, Machine learning expert system, Probability based expert system

## **UNIT – V**

### **Introduction to Genetic Algorithm and Swarm Intelligence**

Introduction, Genetic Algorithms, Procedure of Genetic Algorithms

Introduction to swarm intelligence, importance of ant colony paradigm, ant colony systems, development of ant colony system

**Choice:** Unit – III and Unit – IV

### **Text Books:**

1. Artificial Intelligence, Structures and Strategies for Complex Problem Solving, George F Luger, fifth edition, Pearson Education
2. Artificial Intelligence and Intelligent Systems, N P Padhy, 2017, Oxford Publication

### **Reference Books:**

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Pearson, 2014.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

### **E Books:**

1. [https://people.engr.tamu.edu/guni/csce421/files/AI\\_Russell\\_Norvig.pdf](https://people.engr.tamu.edu/guni/csce421/files/AI_Russell_Norvig.pdf)
2. [https://people.engr.tamu.edu/guni/csce421/files/AI\\_Russell\\_Norvig.pdf](https://people.engr.tamu.edu/guni/csce421/files/AI_Russell_Norvig.pdf)

### **MOOCs:**

1. [https://onlinecourses.nptel.ac.in/noc23\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc23_cs92/preview)



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

(Autonomous College under VTU)

Course Title	INTRODUCTION TO AR/VR				
Course Code	22EC5PE1VR	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** None

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Understand</b> the basics of Virtual Reality and the technology involved.	–	–
CO2	<b>Apply</b> the potential factors involved in implementing concepts of Virtual Reality.	1	1
CO3	<b>Analyse</b> VR Hardware and Software implementation and factors involved in rendering the process.	2	1

**UNIT – I**

Introduction, Fundamentals of Virtual Reality: What is Virtual Reality?, Virtual Reality as an Immersive Technology, Reality-Virtuality Continuum, Working Principle, Uses and Benefits, History of Virtual Reality, Application Domains.

**UNIT – II**

Virtual Reality Hardware and Software: Introduction, Field of View, Degrees of Freedom, Stereoscopy, Hardware: Input Devices, Output Devices, Virtual Reality Displays, Tracking - Magnetic, Electromagnetic, Ultrasonic, and Inertial, and Optical. Software: Platforms – Development and Deployment, VR Scripting, VRML, X3D, Web VR.

**UNIT – III**

Creating a Virtual Reality Experience – Design: Illusions of Presence, Perceptual Modalities: Sight, Hearing, Touch, Proprioception, Balance and Physical Motion, Smell and Taste, Multimodal Perceptions, Perception of Space and Time, Perceptual Stability, Attention, and

Action. Health Effect: Motion Sickness, Eye Strain, Seizures, After-effects, Factors Affecting Health. Design Guidelines: Hardware, System Calibration, Latency Reduction, General Design, Motion Design, Interaction Design, Usage, Measuring Sickness.

#### **UNIT – IV**

Factors involved in Implementation of VR-Rendering: Virtual Environments, Object Modeling, Geometric Transformation, Perspective Views, 3D Clipping, Stereoscopic Vision, Rendering, Texture Mapping, 360 degree Images and Videos. Navigation: Navigation in Virtual Reality Environment, Navigation Characteristics, Locomotion Techniques – Physical and Virtual, Wayfinding – Landmark, Signs and Maps. Interaction: Interacting with Virtual Objects, Direct and Indirect Interactions, Modes of Interactions, Multi-modal Interaction, Selection, Manipulation, Collaborative Virtual Reality.

#### **UNIT – V**

VR used for Training - Industry Case Studies: Transforming radiography training, VR for employees to practice presentation skills, Reality-based welding simulator: Significance, virtual training, and industrial correlation.

**Choice:** Unit-III and Unit-IV

#### **Text Books:**

1. “The VR Book: Human-Centered Design for Virtual Reality” by Jason Jerald (ACM Books).
2. “Understanding Augmented Reality, Concepts and Applications” by Alan B. Craig, Morgan Kaufmann, 2013.

#### **Reference Books:**

1. N/A

#### **E-books and online course materials:**

1. N/A

#### **MOOCs:**

1. <https://www.coursera.org/learn/introduction-virtual-reality>





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

(Autonomous College under VTU)

Course Title	OPERATING SYSTEM				
Course Code	22EC5PE1OS	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100 % weightage)		SEE	100 Marks (50 % weightage)	

**Prerequisites:** Understanding of Microprocessor / Microcontroller Architecture, Understanding of Memory and I/O system, Basic understanding of System Software.

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of different classes and structure of operating system for system security and protection.	1	2
CO2	<b>Analyze</b> process scheduling, synchronization, memory management and I/O management of operating systems.	1, 2	2
CO3	<b>Present</b> a case study on the advanced features of modern operating systems.	5, 9, 10	2

**UNIT – I**

Introduction and overview of Operating Systems: Computing environment and nature of computations, Operating System and its Operation, Classes of operating systems: Multi-programming systems, Time-sharing systems; Different Structures of an operating system, Virtual machine operating systems, Kernel-based operating systems.

**UNIT – II**

Process management: Processes and threads: Processes and Program, implementing processes: Process States and State transitions, Process Context & Process control Block, Context Save, Scheduling & Dispatching, Threads, POSIX Threads, Processes and Threads creation in Linux with Programming.

**UNIT – III**

Process Synchronization: Race conditions, Critical sections, Control Synchronization and

Indivisible operations, Deadlock condition, Process Synchronization Scheduling: Scheduling Concepts, Non-preemptive and Preemptive Scheduling Policies, Real-Time Scheduling: EDF, RMS, Program Examples.

#### **UNIT – IV**

Memory management: Memory allocation to a process, Heap Management: Reuse of Memory, Contiguous memory allocation, Non-contiguous memory allocation, Paging, Segmentation, Virtual Memory concept, Demand Paging and Page Replacement examples.

#### **UNIT – V**

File System and I/O Management: Overview of file processing, files and file operations, interface between file systems and IOCS, Layers of Input-output control system, overview of IO organization, I/O devices, Device level I/O.

**Choice:** Unit-III and Unit-IV

#### **Text Books:**

1. “Operating Systems: A Concept based Approach” by D. M. Dhamdhare, TMH.
2. “Modern Operating Systems” by Andrew S. Tanenbaum, Herbert Boss, 4th Edition.

#### **Reference Books:**

1. “Operating Systems Concepts” by Silberschatz and Galvin, John Wiley, 7th Edition, 2001.
2. “Operating System – Internals and Design Systems” by William Stallings, Pearson Education, 4th Edition, 2006.

#### **E-books:**

1. <http://www.freebookcentre.net/ComputerScience-Books-Download/Operating-System-Concepts>

#### **MOOCs:**

1. <https://www.mooc-list.com/tags/operating-systems>
2. <https://www.mooc-list.com/course/operating-systems-saylorg>



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

(Autonomous College under VTU)

Course Title	IOT AND ITS APPLICATIONS				
Course Code	22EC5PE1IT	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

### Prerequisites:

- Knowledge of microprocessor and controller hardware
- Knowledge of C and C++, and Python (can pick up during the course)
- Networking concepts and technologies

### Objectives of the course:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of various IoT aspects (sensors, actuators, processing, technologies) and characteristics to evolve solutions related to applications and architectures.	1	1, 2
CO2	<b>Analyze, compare, and Identify</b> Technologies, Protocols (including adaptations), Analytic Techniques, and review Risk Management methods.	2	1, 2
CO3	<b>Design Solutions</b> encompassing systems, hardware, and software aspects for various categories of problems with IoT in context.	3	1, 2
CO4	<b>Research</b> various domains of IoT application and provide analysis, interpret data where available, and provide recommendations.	4, 6, 9, 10	1, 2

### UNIT – I

Fundamentals of IoT: What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IoT Network Architecture and Design, Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects.

## **UNIT – II**

IoT Protocols: Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

## **UNIT – III**

IP and Application Protocols: IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

## **UNIT – IV**

Design and Development: IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - Raspberry Pi: Introduction to Raspberry Pi, About the Raspberry Pi Board: Hardware Layout, Operating Systems on Raspberry Pi, Configuring Raspberry Pi, Programming Raspberry Pi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to Raspberry Pi.

## **UNIT – V**

Applications: Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples. Transportation, Transportation Challenges, IoT Use Cases for Transportation, An IoT Architecture for Transportation.

**Choice:** Unit-II and Unit-III

### **Text Books:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Srinivasa K G, “Internet of Things”, CENGAGE Learning India, 2017

### **Reference Books:**

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014. (ISBN: 978-8173719547).
2. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224).

### **Online Resources:**

1. <https://www.youtube.com/watch?v=co2MLqkJVXs>
2. <https://www.youtube.com/watch?v=9znRbMTimvc>

**E-books:**

1. [http://alvarestech.com/temp/Industry4.0/2019/Dimitrios%20Serpanos,Marilyn%20Wolf%20\(auth.\)%20-%20%20Internet-of-Things%20\(IoT\)%20Systems\\_%20Architectures,%20Algorithms,%20Methodologies-Springer%20International%20Publishing%20\(2018\).pdf](http://alvarestech.com/temp/Industry4.0/2019/Dimitrios%20Serpanos,Marilyn%20Wolf%20(auth.)%20-%20%20Internet-of-Things%20(IoT)%20Systems_%20Architectures,%20Algorithms,%20Methodologies-Springer%20International%20Publishing%20(2018).pdf)
2. <https://www.oreilly.com/design/free/files/designing-for-the-internet-of-things.pdf>

**MOOCs:**

1. <https://nptel.ac.in/courses/106/105/106105166/>
2. <https://www.coursera.org/specializations/internet-of-things>

**NOTE:** The course can be supplemented by project-based learning.



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

(Autonomous College under VTU)

Course Title	ADVANCED DIGITAL LOGIC DESIGN				
Course Code	22EC5PE1AD	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** Fundamentals of VLSI and Concepts of Digital System Design using Verilog

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the concepts of Digital System design to create digital building blocks using Verilog.	1	3
CO2	<b>Analyze</b> the RTL for timing violations and Synthesize the RTL to generate gate-level netlist.	2	3
CO3	<b>Design</b> RTL using basic building blocks along with design optimizations.	3, 5	3

### UNIT – I

**Logic Design and Challenges in VLSI Industry:** Moore's law, Technology Scaling, Die size growth, Frequency, Power dissipation, Power density. Challenges in digital design, Design metrics, and Cost of Integrated circuits. Digital Combinational & Sequential circuits, Modules, Nets, Values, Comments, arrays in Verilog. Expressions, Operators, Operands, Arrays, memories, Strings, Delays, parameterized designs. Procedural blocks, Blocking and Non-Blocking Assignment, looping, flow Control, Task, Function. Basic test bench generation and Simulation, Verilog modeling of combinational and sequential logic.

### UNIT – II

**Principles of RTL Design:** Verilog Coding Concepts, Verilog coding guidelines: Combinational, Sequential, FSM. General Guidelines, Synthesizable Verilog Constructs, Sensitivity List, Verilog Events, RTL Design Challenges.

### **UNIT – III**

**RTL Timing Concepts:** Introduction to timing concepts. Setup and hold times. Setup and hold time equalities and inequalities, timing paths. Static timing delay calculation for basic flip-flop & sequential circuits.

### **UNIT – IV**

**Synthesis, Libraries, and Technology Mapping:** Introduction to synthesis, logical synthesis of basic combinational and sequential circuits. Synthesis Methodologies, Pre and post synthesis mismatch, Translation, mapping, and optimization. Overview of Libraries, design constraints, importance of wire load models.

### **UNIT – V**

**Design of Architectural building blocks using FSMs and Clock Domain Crossing:** FSM Design – overlapping and non-overlapping Mealy and Moore state machine design. Clock Domain Crossing design techniques.

**Unit Choice:** Unit-I and Unit-V

#### **Text Books:**

1. Digital Design by Morris Mano M, 4th Edition
2. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, 2nd Edition
3. Verilog HDL Synthesis A Practical Primer by J. Bhasker
4. Fundamentals of Digital Circuits by A. Anand Kumar, 2nd Edition
5. Principles of VLSI RTL Design: A Practical Guide by Sanjay Churiwala, Sapan Garg, 2011
6. Cliff Cummings: White paper (Clock Domain Crossing)

#### **Reference Websites:**

1. [www.asic-world.com](http://www.asic-world.com)
2. <http://www.vlsi-expert.com/2011/03/static-timing-analysis-sta-basic-timing.html>

#### **Online material:**

1. Seer Academy recordings

#### **E-books:**

1. <https://www.freebookcentre.net/Electronics/Logic-Design-Books.html>

#### **MOOCs:**

1. <https://nptel.ac.in/courses/117106092/>



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>INFORMATION THEORY FOR CYBER-SECURITY</b>				
<b>Course Code</b>	<b>22EC5PE1IC</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** None.

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	Apply the knowledge of Information security concepts to demonstrate the techniques for Information security, Information Security Policies, Standards and Indian Cyber Law.	1	1, 2
CO2	Analyse the encryption algorithms for their strengths and weaknesses.	2	1, 2
CO3	Design and Implement basic algorithms in cryptography which is ultimately used in developing a secure information system.	3	1, 2
CO4	Involve in Independent learning on contemporary issues in Information Security System, Cyber security and its mechanisms, communicate effectively and prepare a report.	5, 9, 10	1, 2

**UNIT – I**

Introduction to Information System: Introduction, Types, Developments of Information Systems, Introduction to information Security, Need for Information Security, Threats to Information Systems, Information Assurance.

**UNIT – II**

Developing Secure Information System: Secure Information System Development, Application Development Security, Information Security Governance and Risk Management, Security Architecture and Design, Security Issues in Hardware, Data Storage and Downloadable Devices, Physical Security of IT Assets, Backup Security Measures.



### **UNIT – III**

Information Security Policies, Standards and Cyber Law: Security Policies, Policy Review Process, Information Security Standards, Cyber Law in India, Intellectual Property Law, Semiconductor Law, Software Licenses.

### **UNIT – IV**

Cyber Security, Classification, Tools and Methods Used in Cyber Crime: Introduction to Cyber Security, Cyber Security Risk Analysis, Classifications of Cybercrimes, how Criminals Plan Them: How Criminals Plan the Attacks, Cyber Stalking, Botnets. Proxy, Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Trojan Horses and Backdoors, SQL Injection, Buffer Overflow.

### **UNIT – V**

Cybercrimes and Cybersecurity: The Legal Perspectives Introduction, Cybercrime and the Legal Landscape around the world, need for Cyber laws (Indian Context), Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of not addressing the weakness in the IT ACT, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cyber-crime and Punishment.

**Choice:** Unit-II and Unit-IV

#### **Textbooks:**

1. “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives” by Nina Godbole & Sunit Belapure.
2. “Cryptography and Network Security Principles and Practice” by William Stallings, Pearson.
3. “Cyber Security” by Dr. Krishan Kumar Goyal, Prof, Amith Garg, University Science Press.

#### **Reference Books:**

1. “Security in Computing, Fourth Edition” by Charles P. Pfleeger, Pearson Education.
2. “Modern Cryptography: Theory and Practice” by Wenbo Mao, Prentice Hall.
3. “Network Security Essentials: Applications and Standards” by William Stallings, Prentice Hall.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>OBJECT ORIENTED PROGRAMMING USING C++</b>				
<b>Course Code</b>	<b>22EC5PE1OP</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

**Prerequisites:** Logical thinking, Basic Programming Skills, C programming

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> C++ constructs and object oriented programming concepts to solve given problem statements	1	2
CO2	<b>Design</b> solutions to problems using generic programming efficient memory strategies and exception handling concepts	3	2
CO3	<b>Analyse</b> the given real-time problem/s and develop complete solution/s after carefully selecting one or more of OOP technique/s	2, 3, 5, 9, 10	2

**Unit-I**

Migration from C to C++ – Shortcomings of C and need for object-oriented programming, reference variables, structures, enum with their importance, manipulators, macros, functions – pass by: value, address, and reference, importance of default values in creating applications

**Unit-II**

Classes and objects: Class definition and declaration, member functions, static data members and member functions, Constructors, parameterized constructors, constructors with default values and its importance in applications, multiple constructors in a class and their working, copy constructor, dynamic constructors - realization and relevance, destructors, arrays of objects, pass and return of objects, Function overloading, friend functions

### **Unit-III**

Operator overloading: Overloading unary and binary operators, overloading using friend functions and its usage, rules for overloading. Inheritance: Single and multiple inheritances, public, private and protected inheritance. Pointers to objects, this pointer, pointers to derived classes, virtual functions, run-time polymorphism Inheritance: understand the need with real-time examples, types: single, multiple, hybrid, hierarchical, modes of inheritance: private, protected and public modes and its significance on data access with real-world examples

### **Unit-IV**

Templates and exceptions: Need for templates in real-life applications, developing container classes with and without template functions, non-member function templates: importance and realization, overloading template functions, member function templates and non-type template arguments. Exception handling: Basics, throwing and catching mechanisms

### **Unit-V**

IO streams: Managing console I/O operations: C++ streams, C++ stream classes, I/O operations, managing O/P with manipulators to realize solutions to given problems. Files: Need for file systems, classes for file stream operations, opening and closing a file, detecting end of file, more about open(): file modes, writing data onto file through any UI

**Choice:** Unit-II and Unit-III

#### **Text Books:**

1. “Object-Oriented Programming with C++”, E Balagurusamy, TMH Publications, 4th Edition.
2. “Object-Oriented Programming in Turbo C++”, Robert Lafore, GALGOTIA Publications.

#### **Reference Books:**

1. “Let Us C++”, Yashvanth P. Kanetkar, BPB Publications.
2. “Programming With C++-Schaum’s series”, TMH Publications.

#### **E-books:**

1. “Object-Oriented Programming with C++”, E Balagurusamy, TMH Publications, 4th Edition.
2. “Object-Oriented Programming in Turbo C++”, Robert Lafore, GALGOTIA Publications.

#### **Online Resources:**

1. [https://www.w3schools.com/cpp/cpp\\_oop.asp](https://www.w3schools.com/cpp/cpp_oop.asp)
2. <https://www.geeksforgeeks.org/object-oriented-programming-in-cpp/>

3. Video lectures on BMSCE Studio.

**MOOCs:**

1. <https://www.mooc-list.com/course/object-oriented-programming-edx>

**NOTE:** Header files and exception handlers will be developed as a part of the course. Also, applications will be developed as services using a modular approach to enrich the learning.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>PROJECT MANAGEMENT AND FINANCE</b>				
<b>Course Code</b>	<b>22EC5HSPMF</b>	<b>Credits</b>	<b>2</b>	<b>L – T – P</b>	<b>2:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

**Prerequisites:** Personality Development Course, Soft-skills

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of project management principles and to study the current market trends	1	–
CO2	<b>Implement</b> project management methodologies ethically for successful project completion	2, 8, 9	–
CO3	<b>Identify</b> the investment opportunities and to formulate the projects	11	–
CO4	<b>Choose</b> projects which benefit the society and organization and apply project phases and document them for future reference	6, 10, 12	–

### UNIT – I

**Concepts of Project Management:** Concepts of project, Categories of project, Project life cycle phases, Project management concepts, Tools and techniques for project management, The project manager, Need, Roles and responsibilities of project manager. Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects.

### UNIT – II

Establishing the Project - Scope, Time, Cost, and performance goals, Feasibility report, Financing Arrangements, Preparation of cost estimates, Finalization of project implementation schedule, Evaluation of the project profitability, Fixing the Zero date.

### **UNIT – III**

Organizing Human Resources and Contracting - Delegation, Project manager's authority, Project organization, Contract, Contract Planning, Tendering and Selection of Contractor, Team building.

### **UNIT – IV**

Organizing Systems and Procedures for Project Implementation – Working of Systems, Work breakdown structure, Planning, Scheduling and Monitoring, Critical Path Method, Gantt Chart/Time Chart, PERT, Project diary.

### **UNIT – V**

Financing of Projects - Capital structure, Menu of financing, Internal accruals, Equity capital, Preference capital, Debentures (or bonds), Methods of offering term loans, Working capital advances, Miscellaneous sources, Raising venture capital, Project financing structures, Financial closure, Financial institutions.

**Choice:** Unit-III and Unit-IV

#### **Text Books:**

1. "Project Management", S Choudhury, Tata McGRAW Hill Publishing Company Limited
2. "Project Planning, Analysis, Selection, Financing, Implementation and Review", Dr. Prasanna Chandra McGRAW Hill Publishing Company Limited
3. "Project Management Institute: A Guide to the Project Management Body of Knowledge", PMBOK Guide (Sixth Edition), Sept 2017

#### **Reference Books:**

1. "Fundamentals of Project Management", Dr. Vijay Kanabar
2. "Project Management", David I Cleland, McGraw Hill International edition
3. "Project Management", Gopalakrishnan, Mcmillan India Ltd
4. "Project Management", Harry Maylor, Pearson Publication

#### **E Books:**

1. <https://www.youtube.com/watch?v=5d16JwWwjKo>
2. NPTEL lecture on Introduction to Project Management by Prof. Arun Kanda <https://www.youtube.com/watch?v=5pwc2DY1KQU>

# **VI Semester Syllabus**



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>ELECTRONICS AND COMMUNICATION FOR SUSTAINABLE DEVELOPMENT</b>				
<b>Course Code</b>	<b>22EC6PCECS</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3-0-0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** Sensors and Sensor Networks

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	Apply the concepts of Electronics and Communication Engineering to solve societal issues.	1	1, 2, 3
CO2	Review and analyze the performance of the Electronic system for specific societal issues.	2	1, 2, 3
CO3	Able to identify and develop a process that meets specified needs with appropriate considerations for the environment.	3	1, 2, 3
CO4	Understand the impact of Electronics and Communication Engineering for sustainable development.	7	1, 2, 3

**UNIT – I**

**Agriculture:** A Review of Applications for Sensor Networks in Smart Agriculture, Wireless sensor networks with dynamic nodes for water and crop health management.

**UNIT – II**

**Environment:** Scaling Smart Environments, Localization of a wireless sensor network for environment monitoring using likelihood Estimation with negative Constraints, Reconfigurable Intelligent Space, and the mobile module for Flexible Smart Space.



### **UNIT – III**

**Energy:** Sensor Networks for Energy Sustainability in Buildings, Wireless Sensor and Actor Networks for monitoring and Controlling Energy use in Smart grid, Mobile monitoring application to support sustainable behavior change toward healthy lifestyle.

### **UNIT – IV**

**Healthcare:** Sensor networks in healthcare, Use of Body Sensor networks in Clinical settings and Medical Research.

### **UNIT – V**

**Transportation:** Social sensor networks for Transportation Management in smart cities, Applying RFID Techniques for the Next generation automotive services.

### **Reference Book:**

1. “Sensor Networks for Sustainable Development”, Mohammad Ilyas, Sami S. Alwakeel, Mohammed M. Alwakeel, el-Hadi M. Aggoune, June 25, 2014 by CRC Press, Reference - 568 Pages - 239 B/W Illustrations, ISBN 9781466582064 - CAT# K18915.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>COMPUTER COMMUNICATION NETWORKS</b>				
<b>Course Code</b>	<b>22EC6PCCCN</b>	<b>Credits</b>	<b>4</b>	<b>L – T – P</b>	<b>3:0:1</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>		<b>SEE</b>	<b>100 Marks (50 % weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	Understand the concepts of Computer Networks and Network Models for Data Communication.	–	–
CO2	Apply the knowledge of networking and concepts of TCP/IP protocol stack to deliver packets across Multiple Networks (links).	1	2
CO3	Analyze the issues of routing and congestion mechanism for independent and internetworking networks for wired and wireless links.	2	2
CO4	Design, calculate, and apply subnet masks and routing addresses to fulfill networking requirements.	3	2
CO5	Create Network for given specification and conduct experiments within a simulated networking environment.	4, 5	2
CO6	Involve in independent learning on contemporary issues in networking technologies, communicate effectively and prepare a report.	7, 9, 10, 12	2

**UNIT – I**

Introduction to Data Communication, Network Models, Transmission Media, Wireless Transmission, Switching, Telephone and Cable TV for data transmission.

**UNIT – II**

Data Link Layer: Data link Control, Error detection and correction: Cyclic Codes and Check-Sum.

### **UNIT – III**

Medium Access: Medium Access, Wired LANs: Ethernet, Wireless LANs. Connecting devices and Virtual LANs.

### **UNIT – IV**

Network Layer: Logical Addressing, Internet Protocol, Address Mapping, Delivery, Forwarding and Routing, Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. Multicast Distance Vector Routing.

### **UNIT – V**

Transport layer: Process to process Delivery, Congestion control and Quality of Service.

**Choice:** Unit-III & Unit-IV

#### **Text Books:**

1. “Data Communication and Networking”, B Forouzan, 4th Ed, TMH, 2006.
2. “Computer Networks”, Andrew S.Tanenbaum, 4th, EEE.
3. “Computer Communication and Networks”, J Frauzon
4. “Data and computer communication”, W. Stallings, PHI.

#### **Reference Books:**

1. “Computer Networks”, James F. Kurose, Keith W. Ross: Pearson education, 2nd Edition, 2003.
2. “Introduction to Data communication and Networking”, Wayne Tomasi: Pearson education 2007.
3. “An Engineering Approach on Computer Networking”, S. Keshav, Addison Wesley.
4. “Introduction to Data Communications and Networking”, Wayne Tomasi, Pearson.
5. “Computer Networks”, A.S. Tanenbaum, PHI.

#### **E-books:**

1. <https://www.phindia.com/Books/BookDetail/9788120349070/data-communications-and-computer-networks-singh>
2. <https://www.phindia.com/Books/BookDetail/9788120348646/data-communications-and-computer-networks-gupta>

#### **Online Resources:**

1. <http://nptel.ac.in/video.php?subjectId=106105081>
2. <http://freevidelectures.com/Course/2278/Data-Communication>

## **LIST OF LABORATORY EXPERIMENTS**

### **Part-A – Programming in C/C++**

1. Write a program to demonstrate Framing (Bit and Byte stuffing & destuffing).
2. Write a program to generate CRC code for checking error.
3. To study the Basic Networking Commands on Command Prompt: arp, ipconfig, host-name, tracert, route, ping etc.
4. Write a program to simulate Shortest Path Routing Algorithm using i) Dijkstra's Algorithm ii) Distance Vector Routing Algorithm.
5. Write a program to demonstrate Stop and Wait Protocol and Sliding Window Protocol.
6. Write a program for congestion control using leaky bucket algorithm.
7. Write a program to encrypt and decrypt a given message using substitution cypher method.

### **Part-B – Tool: Qualnet V9.3**

8. Create a Network and analyze the performance of a Network for different topologies and compare performance of the Network for Varying Network Size and topology/traffic change.
9. Configure and Analyze the throughput, packet delivery for an Ethernet LAN.
10. Construct a point to point network and determine the packets dropped in Network and Comment on its Performance.
11. Apply a multicast protocol and analyze the performance of Network for a Multicast traffic scenario. Compare Multicast and Multiple unicast traffic.
12. Simulate and Analyze the performance of Wireless Ad hoc Network for Stationary and Mobile Nodes.
13. Model a LAN Network connected by a Switch and Analyze the Subnet Performance.
14. Configure a router to connect two subnets and analyze the performance of Connecting Device.
15. Compare the performance of RIP and OSPF Routing Algorithms and analyze packet delivery, end to end delay and throughput.
16. Simulate and Analyze wireless infrastructure network.
17. Scrutiny of Traffic between wired and wireless network.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>MIXED SIGNAL DESIGN</b>				
<b>Course Code</b>	<b>22EC6PCMSD</b>	<b>Credits</b>	<b>4</b>	<b>L – T – P</b>	<b>3:0:1</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Prerequisites:** Analog Electronic Circuits, Linear Integrated Circuits, Fundamentals of VLSI

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> the knowledge of basic CMOS technology to analog integrated circuits	1	3
CO2	<b>Analyze</b> circuits featuring CMOS-based amplifiers, as well as Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC) and obtain the respective performance parameters.	2	3
CO3	<b>Design</b> analog CMOS integrated circuits and mixed signal circuits	3	3
CO4	<b>Conduct</b> experiments on Analog and mixed signal CMOS circuits using modern EDA tools	4, 5, 9, 10	3

**UNIT – I**

Review of Common-Source Stage and Source Follower, Cascode Stage.

Differential Amplifiers: Basic Differential Pair: Qualitative Analysis, Quantative Analysis, Common-Mode Response, Differential Pair with MOS loads.

**UNIT – II**

Basic Current Mirrors, Cascode Current Mirrors. Active Current Mirrors: Large-Signal and Small-Signal Analyses in Differential mode and Common-mode.

**UNIT – III**

Operational Amplifiers: General Considerations, One-Stage Op Amps, Two-Stage Op Amps, Gain Boosting.

## **UNIT – IV**

Switched-Capacitor Circuits: General Considerations, Sampling Switches, Switched Capacitor Amplifier Design.

Sample-and-Hold Characteristics, Digital-to-Analog Converter specifications, Analog-to-Digital Converter specifications, Mixed-Signal layout issues.

## **UNIT – V**

DAC Architectures: R-2R ladder DAC, Charge Scaling DACs, Pipeline DAC.

ADC Architectures: Integrating ADCs, Pipeline ADC, Successive Approximation ADC.

**Choice:** Unit-II and Unit-III

### **Text Books:**

1. “Design of Analog CMOS Integrated Circuits”, Behzad Razavi, McGraw Hill Edition, 2002, ISBN: 0-07-238032-2.
2. “CMOS Circuit Design, Layout and Simulation”, R. Jacob Baker, 3rd Edition, IEEE Press, 2010, ISBN: 978-0-470-88132-3.

### **Reference Books:**

1. “Analog Design Essentials”, Willy M. C. Sansen, Springer, 2006. ISBN-10 0-387-25747-0.
2. “Analysis and Design of Analog Integrated Circuits”, Gray, Hurst, Lewis and Meyer, 5th Edition, 2010, John Wiley & Sons.

### **E Books:**

1. [http://www.designinganalogchips.com/\\_count/designinganalogchips.pdf](http://www.designinganalogchips.com/_count/designinganalogchips.pdf)
2. <https://github.com/bmurmann/Book-on-MOS-stages/raw/main/book/Analysis%20and%20Design%20of%20Elementary%20MOS%20Amplifier%20Stages.pdf>

### **MOOCs:**

1. <https://nptel.ac.in/courses/117106030/>
2. <https://nptel.ac.in/courses/117106034/>

### LABORATORY EXPERIMENT LIST

Sl. No.	Title of the Experiment
<b>Conduction using Cadence tools</b>	
1.	Draw the schematic of a CMOS inverter and obtain the DC characteristics. Also perform the transient analysis and determine the delay of the inverter.
2.	Common Source amplifier: Transient, DC and AC analyses
3.	Common Drain amplifier: Transient, DC and AC analyses
4.	Differential Input, Single-ended output operational transconductance amplifier: Transient, DC and AC analyses. Find the CMRR.
5.	Fully Differential amplifier: Transient, DC and AC analyses. Find the CMRR.
6.	2-stage OpAmp: Transient, DC and AC analyses. Find the CMRR.
7.	Design R-2R ladder DAC using the OpAmp designed above and measure the DNL and INL of the DAC
8.	Draw the layout of CMOS inverter and verify DRC, LVS. Determine the impact of RC extraction on the delay of inverter.
9.	Draw the layout of Common Source amplifier and verify DRC, LVS.
10.	Draw the layout of Common Drain amplifier and verify DRC, LVS.
<b>Conduction using Verilog-AMS</b>	
11.	Modeling of Resistors, Capacitors, Ideal diode, Voltage & Current sources
12.	Modeling of SAR ADC



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>COMPUTER VISION</b>				
<b>Course Code</b>	<b>22EC6PE2CV</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>	<b>SEE</b>	<b>100 Marks (50 % weightage)</b>		

**Course outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> various segmentation, feature extraction, and representation techniques for a given pattern analysis problem.	1	1, 3
CO2	<b>Analyze</b> various pattern recognition and classification schemes to perform a specific computer vision task.	2	1, 3
CO3	<b>Design</b> 3D visualization models to process 3D objects for a specific visualization task.	3	1, 3

**Unit – I**

**Pattern Analysis:** Clustering: K-Means, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models.

**Unit – II**

**Feature extraction:** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners: Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH.

**Unit – III**

**Shape representation and segmentation:** Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors.

**Unit – IV**

**3D Image Visualization:** Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.



## **Unit – V**

**Modern Trends:** Biometrics – fingerprint, face, iris, digital signature; super resolution, Introduction to Augmented Reality.

**Choice:** Unit-II and Unit-IV

### **TEXT BOOKS:**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

### **REFERENCE BOOKS:**

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison-Wesley, 1992.

### **E Books:**

1. [http://szeliski.org/Book/drafts/SzeliskiBook\\_20100903\\_draft.pdf](http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf)
2. <https://www.amazon.in/Computer-Vision-Image-Processing-Virender-ebook/dp/B01GBMS78W>

### **MOOCs:**

1. <https://www.coursera.org/courses?query=computer%20vision>
2. <https://www.classcentral.com/subject/computer-vision>
3. <https://www.edx.org/course/computer-vision-and-image-analysis-2>
4. <https://digitaldefynd.com/best-computer-vision-courses/>



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

Course Title	RADAR SYSTEM				
Course Code	22EC6PE2RS	Credits	3	L – T – P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** Communication Theory and Signals & Systems

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of mathematics and communication principles to compute the parameters of the Radar system.	1	1
CO2	<b>Analyze</b> the performance of different types of Radar for a given application.	2	1
CO3	<b>Design</b> the different subsystems for implementing Radar system.	3	1

**Unit – I**

Basics of Radar, Radar Equation, SNR, Envelope Detector, Radar Cross Section of Targets, Transmitter Power, PRF, System Losses.

**Unit-II**

CW and Frequency Modulated Radar, Doppler Effect, CW Radar, FM-CW Radar.

**Unit-III**

MTI and Pulse Doppler Radar, Tracking Radar, Matched Filter Receiver, Radar Receivers, Phased Array Antennas.

**Unit-IV**

Detection Of Radar Signals In Noise, Radar Receivers, Phased Array Antennas.

**Unit-V**

Stealth Technology, Principles, Methods, and Radar stealth countermeasures and limits.

**Choice:** UNIT-III and UNIT-IV

**Textbook:**

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Edition, 2007.

**Reference Books:**

1. Introduction to Radar Systems – Merrill I. Skolnik, 3rd Edition, Tata McGraw-Hill, 2001.
2. Radar Principals, Technology, Applications – Byron Edde, Pearson Education, 2004.
3. Radar Principles – Peebles, Jr., P.Z. Wiley, New York, 1998.
4. Emanuel Fthenakis, “Manual of Satellite Communications”, McGraw Hill Book Co., 1984.
5. Robert G. Winch, “Telecommunication Transmission Systems”, McGraw-Hill Book Co., 1983.
6. Brian Ackroyd, “World Satellite Communication and Earth Station Design”, BSP professional Books, 1990.
7. G.B. Bleazard, “Introducing Satellite Communications”, NCC Publication, 1985.
8. M. Richharia, “Satellite Communication Systems - Design Principles”, Macmillan, 2003.

**E Resources:**

1. IET Digital Library: Principles of Modern Radar: Basic principles (theiet.org) [http s://www.phindia.com/Books/BookDetail/9788120348646/data-c ommunications-and-computer-networks-gupta](http://www.phindia.com/Books/BookDetail/9788120348646/data-communications-and-computer-networks-gupta)
2. IET Digital Library: Radar Principles for the Non-Specialist (theiet.org)
3. The beginnings of stealth technology — IEEE Journals & Magazine — IEEE Xplore <https://doi.org/10.1109/7.259548>
4. Effect of Componential Camouflage on Aircraft's IR Multiband Susceptibility — IEEE Journals & Magazine — IEEE Xplore [https://doi.org/10.1109/TAES.2 022.3200025](https://doi.org/10.1109/TAES.2022.3200025)
5. Online resources: Principles and Techniques of Modern Radar Systems online course video lectures by IIT Kharagpur (freevideolectures.com)
6. Simulation Tools: CST, HFSS



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

(Autonomous College under VTU)

Course Title	MACHINE LEARNING				
Course Code	22EC6PE2ML	Credits	3	L-T-P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

**Prerequisites:** Knowledge of Linear Algebra, Calculus, Probability & Statistics and Basic Programming.

### 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 mathematics and programming to structure datasets and algorithms to build machine learning models.	1	2
CO2	Analyze dataset features for different use cases and performance measures to evaluate the models.	2	2
CO3	Design and develop application models using supervised and unsupervised machine learning algorithms.	3	2

### UNIT - I

**Python for ML:** Data types: list, tuple, dictionary; writing functions, conditional and loop statements, Python libraries for ML, Data Preprocessing: EDA using Numpy and Pandas, Data visualization with Matplotlib.

**Introduction:** Artificial intelligence & Machine Learning, ML Types: Supervised, Unsupervised, Semi-supervised and Reinforcement learning, Challenges of ML, Problems ML can solve.

### UNIT - II

**Regression:** Simple & Multiple Linear regression, Gradient descent and regression model, Polynomial regression, regularization: L1 & L2, standardization and normalization, Model fitting, bias-variance trade off, Cross validation and performance evaluation, Evaluation Metrics: MAE, MSE, RMSE, RAE, RSE, R2-score, usecase & model building.

### UNIT - III

**Classification:** kNN classifier- algorithm flow and distance measures, kNN variants: k-radius and kD tree, Support vector machine, Building classifier using kNN and SVC.

**Decision tree:** Construction of decision tree, node splitting criteria: gini, chi-square, entropy and information gain; tree pruning and hyper-parameters, confusion matrix and classification report, AUC & ROC, Matplotlib annotations to visualize a tree, concept of ensembling, techniques: Bagging and Boosting, Random Forest.

### UNIT - IV

**Classifying with probabilistic models:** Naive Baye's algorithm, Variants of Naïve Baye's, Logistic Regression Algorithms, logit and sigmoid functions, Training and testing the classifier model, Performance measures: Log loss, Jaccard Index & Accuracy score.

### UNIT - V

**Unsupervised Learning:** Types of Unsupervised Learning, Challenges in Unsupervised Learning, Pre-processing and Scaling, Applying Data Transformation, K-Means Clustering, Case Study: Recommender system, Introduction to Artificial Neural Networks and Deep Learning.

**Choice:** Unit-II and Unit-III

#### Textbooks:

1. "Introduction to Machine Learning", Ethem Alpaydin, PHI Learning, 3rd edition 2015.
2. "Introduction to Machine Learning with Python: A Guide for Data Scientists", Andreas C Muller & Sarah Guido, O'Reilly Publication, 2019.

#### Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Edition 1, 2013.
2. "Machine Learning in Action", Peter Harrington, dreamtech press Indian Edition, 2017.
3. "Hands-on Machine Learning with ScikitLearn & Tensorflow" by Aurélien Géron, O'Reilly Publication, 2017.

#### E Books:

1. <https://www.pdfdrive.com/machine-learning-with-python-cookbook-practical-solutions-from-preprocessing-to-deep-learning-d176361144.html>

#### MOOCs:

1. <https://www.simplilearn.com/artificial-intelligence-masters-program-training-course>



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>SYSTEM VERILOG AND VERIFICATION</b>				
<b>Course Code</b>	<b>22EC6PE2SV</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>	<b>SEE</b>	<b>100 Marks (50 % weightage)</b>		

**Prerequisites:** Digital Design Fundamentals, ASIC Design Flow, HDL Programming.

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO-1	Understand the principles of verification, OOPs concepts of System Verilog, Layered test bench architecture and its components.	–	–
CO-2	Apply the knowledge of System Verilog to build a basic verification environment.	1	3
CO-3	Analyze a given design and come up with suitable test cases to achieve 100% coverage.	2	3
CO-4	Develop a full System Verilog layered test bench for a given design with a suitable verification plan.	3, 5	3

**Unit – I:**

**Verification Concepts:** Concepts of verification, importance of verification, Stimulus vs Verification, functional verification.

Test bench generation, functional verification approaches, typical verification flow.

Stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan.

**Unit – II:**

**System Verilog – 1:**

**System Verilog constructs** – Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, enumerated types.

Program blocks, module, interfaces, clocking blocks, modports.

### **Unit – III:**

#### **System Verilog – 2:**

**SV Classes:** Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism.

**Randomization:** Directed Vs Random Testing, Constraint Driven Randomization, Virtual Interface.

### **Unit – IV:**

**System Verilog – 3:** Assertions: Introduction to Assertion-based verification, Immediate and concurrent assertions.

### **Unit – V:**

**Coverage Driven Verification:** Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling. Layered test bench Architecture.

**Unit Choice:** Unit - III and Unit - V

#### **Text Books:**

1. “Writing Testbenches Using SystemVerilog” by Janick Bergeron
2. “SystemVerilog for Verification” by Chris Spear
3. “Verification Methodology Manual for SystemVerilog” by Janick Bergeron, Eduard Cerny, Alan Hunter, and Andy Nightingale

#### **Reference Websites:**

1. [www.asic-world.com](http://www.asic-world.com)
2. [www.testbench.in](http://www.testbench.in)
3. <http://www.vlsi-expert.com/2011/03/static-timing-analysis-sta-basic-timing.html>

#### **Online Material:**

1. Seer Academy recordings

#### **E-books:**

1. “System Verilog for Verification: A guide to learning the test bench language Features” by Chris Spear

#### **MOOCs:**

1. <https://verificationexcellence.in/online-courses/>



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>DATA ENCRYPTION AND COMPRESSION</b>				
<b>Course Code</b>	<b>22EC6PE2DE</b>	<b>Credits</b>	<b>3</b>	<b>L – T – P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

**OBJECTIVES:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Understand</b> the various Data Encryption Techniques and Compression Techniques	–	–
CO2	<b>Apply</b> the various Data Encryption Techniques and Compression Techniques	1	1
CO3	<b>Analyze</b> the Data Encryption Techniques and Compression Techniques	2	1
CO4	<b>Involve</b> in independent learning on contemporary issues on various Data Encryption Techniques and Compression Techniques, Communicate effectively and prepare a report.	9, 10, 12	1

**UNIT – I**

**Introduction to Security:** Need for security, Security approaches, Principles of security, Types of attacks. Encryption Techniques: Plaintext, Cipher text, Substitution and Transposition techniques, Encryption and Decryption, Types of attacks, Key range and Size.

**UNIT – II**

**Symmetric and Asymmetric Key Cryptography:** Algorithm types and Modes, DES, IDEA, Differential and Linear Cryptanalysis, RSA, Diffie Hellmann Key Exchange, Digital signature Authentication basics, Passwords, Authentication tokens, Certificate-based and Biometric authentication, Firewall

**UNIT – III**

**Confidentiality using conventional encryption:** Traffic confidentiality, key distribution,



random number generation, Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete algorithms.

#### **UNIT – IV**

Need for data compression, Fundamental concept of data compression and coding, Communication model, Compression ratio, Requirements of data compression, Classification. Methods of Data Compression: Data compression - Lossless and Lossy

#### **UNIT – V**

**Entropy encoding:** Repetitive character encoding, Run length encoding, Zero/Blank encoding; Statistical encoding - Huffman, Arithmetic and Lempel-Ziv coding; Source encoding - Vector quantization (Simple vector quantization and with error term); Differential encoding - Predictive coding, Differential pulse code modulation, Delta modulation, Adaptive differential pulse code modulation; Transform-based coding: Discrete cosine transform and JPEG standards; Fractal compression

**Choice:** Unit – III and Unit – V

#### **Text Books:**

1. Cryptography and Network Security by B. Forouzan, McGraw-Hill.
2. The Data Compression Book by Nelson, BPB.
3. Cryptography and Network Security by Atul Kahate, TMH.
4. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory," Pearson.

#### **Reference Books:**

1. W. Mao, "Modern Cryptography – Theory and Practice," Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger - Security in computing - Prentice Hall of India.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>DATA STRUCTURES &amp; APPLICATIONS</b>				
<b>Course Code</b>	<b>22EC6PE2DS</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100 % weightage)</b>	<b>SEE</b>	<b>100 Marks (50 % weightage)</b>		

**Prerequisites:** Basic logical thinking, C/C++ Programming.

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Apply</b> appropriate programming concepts to realize various data structures based on the understanding of various methods of realizing them.	1	1, 2
CO2	<b>Analyze</b> the suitability of a given data structure for a given application and realize solutions.	2	1, 2
CO3	<b>Develop</b> and demonstrate time and memory efficient data structure/s for given application/s.	1, 2, 5, 9, 10	1, 2

**Unit-I**

INTRODUCTION: Revision of OOP concepts: Templates, operator overloading, inheritance, Data Representation methods, Linear lists, Formula-based representation and linked representation, Analysis of different representation methods, Exercises on list manipulation.

**Unit-II**

ARRAYS AND MATRICES: Arrays, Overloading operators to add features, Realize 1D, 2D...nD arrays, Inherit classes to add features to existing basic classes Importance of mapping functions, Visualizing n-D matrices, Realization of matrices, perform matrix operations, Special matrices: Diagonal, triangular, tridiagonal, sparse matrices and their importance, space and time implication of realizing special matrices.

### **Unit-III**

STACKS and QUEUES (linear and circular): The abstract data type, Formula-based representation, Linked representation, Applications: Parenthesis match, Tower of Hanoi, machine shop scheduling (conversion and evaluation of prefix, postfix expressions).

### **Unit-IV**

BINARY TREES: Representation methods, Properties, Tree operations, Binary tree traversal methods and algorithms, Expression trees.

Binary search trees: Concept of dictionary, BST: representation, insertion and deletion (pseudo codes).

### **Unit-V**

Heaps – Min and Max heaps: representation, insertion and deletion, Heap sort, Machine scheduling, Huffman codes, AVL trees: representation, insertion and deletion. (All concepts through algorithms).

**Unit Choice:** Choose between Unit-II and Unit-III.

### **Textbooks:**

1. “Data Structures, Algorithms, and Applications in C++” by Sartaj Sahni, McGraw Hill, 2000.
2. “Data Structures and Algorithm Analysis in C++” by Mark Allan Weiss, Pearson, 2013.

### **Reference Book:**

1. “Data Structures Using C And C++” by Y. Langsam, M. Augenstein And A. M. Tenenbaum, Prentice-Hall Of India Pvt. Ltd., Edition 2, 2006.

### **E Books:**

1. Scilab Textbook Companion for “Data Structures Using C And C++” by Y. Langsam, M. Augenstein And A. M. Tenenbaum, Created by Dharmesh Majethiya, NIT Tiruchirappalli, 2013.

### **MOOCs:**

1. “Data Structures and Algorithms” - <https://nptel.ac.in/courses/106/102/106102064/>
2. “Programming Data Structures and Algorithms” - <https://nptel.ac.in/courses/106/106/106106133/>

**NOTE:** Header files and exception handlers will be developed as part of the course. Also, applications will be developed as services using a modular approach to enrich the learning.



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

(Autonomous College under VTU)

Course Title	MULTICORE COMPUTING				
Course Code	22EC6PE2MC	Credits	3	L-T-P	3:0:0
CIE	50 Marks (100 % weightage)		SEE	100 Marks (50 % weightage)	

**Prerequisites:** Knowledge of Processor Architecture, Operating System and Basic Programming.

**Course Outcomes:**

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> the knowledge of computer architecture to understand the concepts of multicore architecture.	1	2
CO2	<b>Analyze</b> multithreading, virtualization techniques and heterogeneous multi-core processors to evaluate the performance of multicore architecture.	2	2
CO3	<b>Present</b> a case study highlighting the state-of-the-art advancements in Multicore Architecture	5, 9, 10, 12	2

**Unit-I**

Introduction to Multi-Core Architecture, Motivation for Concurrency in Software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-Core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms, Understanding Performance.

**Unit-II**

System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization, memory hierarchy for multicore.

### **Unit-III**

Software Multi-threading: Threading APIs, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling.

### **Unit-IV**

Threading on Intel Multi-Core Processors Hardware-based Threading, Hyper-Threading Technology, Difference between Multiprocessor and Hyper-Threading Technology, Hyper-Threading Technology Architecture, Multi-Core Processors, Architectural Details, Comparison between Multiprocessors and Multi-Core Processors.

### **Unit-V**

Introduction to Heterogeneous Multi-Core Processors Introduction to Many cores Programming, GPU Hardware, Alternatives to CUDA, OpenCL, Direct Compute CPU alternatives, Directives and libraries, Understanding Parallelism with GPUs.

**Choice:** Unit-II and Unit-IV

### **Textbooks:**

1. “Multicore Programming” by Shameem A and Jason, Intel Press, 2006.
2. “Programming Massively Parallel Processors: A Hands-on Approach” by David B. Kirk and Wenmei W. Hwu, Morgan Kaufmann, 2010.

### **Reference Books:**

1. “CUDA Programming: A Developer’s Guide to Parallel Computing with GPUs” by Shane Cook, Morgan Kaufmann.
2. “Multicore Computing: Algorithms, Architectures, and Applications” by Sanguthevar Rajasekaran et al., 2013.

### **E Books:**

1. “Multicore Computing” - <https://link.springer.com/book/10.1007/978-1-4419-0263-4>

### **MOOCs:**

1. Multicore computer architecture course - [https://onlinecourses.nptel.ac.in/noc23\\_cs113/preview](https://onlinecourses.nptel.ac.in/noc23_cs113/preview)



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>WIRELESS SENSOR NETWORKS</b>				
<b>Course Code</b>	<b>22EC6PE2WN</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

**Prerequisites:** Basic understanding of Wireless Communication Technology, Electromagnetic spectrum, and Fundamental Networking Concepts.

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Understand</b> the basics of Ad-hoc and Sensor Networks.	–	–
CO2	<b>Apply</b> knowledge of wireless sensor node architectures for network planning.	1	1
CO3	<b>Analyze</b> protocols developed for ad hoc and sensor networks.	2	1
CO4	<b>Design</b> sensor networks for a given specification.	3	1
CO5	<b>Demonstrate</b> the knowledge of routing protocols developed for WSN.	4, 5	1
CO6	<b>Involve</b> in independent learning on contemporary issues in sensor networks, communicate effectively, and prepare a report.	7, 9, 10, 12	1

### Unit – I

**Introduction:** Fundamentals of wireless communication technology, the electromagnetic spectrum, radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

### Unit – II

**Introduction to ad hoc/sensor networks:** Key definitions of ad hoc/sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues

in ad hoc wireless networks, issues in the design of sensor networks, sensor network architecture, data dissemination and gathering.

### **Unit – III**

**MAC Protocols:** Issues in designing MAC protocols for ad hoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

### **Unit – IV**

**Routing Protocols:** Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power-aware routing protocols.

### **Unit – V**

**QoS and Energy Management:** Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

### **Text Books:**

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks”, Pearson Education - 2008.
2. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks - An Information Processing Approach”, Elsevier, 2007.

### **Reference Books:**

1. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier publication - 2004.
2. Jochen Schiller, “Mobile Communications”, Pearson Education, 2nd Edition, 2003.
3. William Stallings, “Wireless Communications and Networks”, Pearson Education – 2004.
4. Kazem Sohraby, Daniel Minoli & Taieb Znati, “Wireless Sensor Networks - Technology, Protocols, And Applications”, John Wiley, 2007.
5. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>DESIGN OF VIRTUAL REALITY</b>				
<b>Course Code</b>	<b>22EC6PE2VR</b>	<b>Credits</b>	<b>3</b>	<b>L-T-P</b>	<b>3:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>		<b>SEE</b>	<b>100 Marks (50% weightage)</b>	

**Course Outcomes:**

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

<b>Sl. No.</b>	<b>Course Outcomes</b>	<b>PO</b>	<b>PSO</b>
CO1	<b>Understand</b> and <b>apply</b> the concepts of VR to Explore the research venues in Augmented Reality and Virtual Reality (AR & VR).	1	1
CO2	<b>Analyze</b> the basic concepts in visual computation, interactive techniques of virtual reality, and applications of VR in the digital environment.	2	1
CO3	<b>Design</b> the frameworks for computer-human interaction for VR applications.	3	1

**Unit – I**

Concepts and Components of Virtual Reality – Primary Features and Present Development on Virtual Reality - Multiple Models of Input and Output Interface in Virtual Reality: Input - Tracker - Sensor - Digital Glove - Movement Capture - Video-based Input - 3D Menus & 3D Scanner – Output - Visual / Auditory / Haptic Devices.

**Unit – II**

Visual Computation in Virtual Reality: Fundamentals of Computer Graphics - Software and Hardware Technology on Stereoscopic Display - Advanced Techniques in CG: Management of Large Scale Environments & Real-Time Rendering.

**Unit – III**

Interactive Techniques in Virtual Reality: Body Track - Hand Gesture - 3D Manus - Object Grasp, Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega - MultiGen - Virtools.



## **Unit – IV**

Human-Centered Interaction- Intuitiveness, Norman's Principles of Interaction Design, Direct vs. Indirect Interaction, The Cycle of Interaction, The Human Hands VR Interaction Concepts- Interaction Fidelity, Proprioceptive and Egocentric Interaction, Reference Frames, Speech and Gestures, Modes and Flow, Multimodal Interaction (Ch-25/26-TB-3).

## **Unit – V**

Application of VR in Digital Entertainment: VR Technology in Film & TV Production - VR Technology in Physical Exercises and Games - Demonstration of Digital Entertainment by VR.

**Unit Choice:** Unit-III and Unit-IV

### **Text Books:**

1. Burdea, G. C., P. Coffet., "Virtual Reality Technology", Second Edition, Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.
3. The VR Book-Human centered Design for Virtual reality-ACM publications-Jason Jerald.

### **Reference Books:**

1. Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.



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

(Autonomous College under VTU)

Course Title	ANALOG AND DIGITAL CIRCUITS				
Course Code	22EC6OE1AC	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 students will be able to:

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Understand</b> the concepts of Electronic Devices and Circuits and realize the applications of Electronics.	–	–
CO2	<b>Apply</b> the basic principles of Electronics to solve Analog and Digital circuits.	1	1
CO3	<b>Analyze</b> the characteristics/performance parameters of Analog and Digital Electronic Circuits.	2	1
CO4	<b>Design</b> basic Analog and Digital Electronic Circuits for given specifications.	3	1

### Unit – I

Bipolar Junction Transistors: Introduction, BJT Voltages & Currents, BJT Amplification, Common Base Characteristics, Common Emitter Characteristics, Common Collector Characteristics, BJT Biasing: Fixed Bias circuit, DC Load line and Bias point, Transistor as a Switch, Feedback: Feedback Principle, Types of feedback: Positive and Negative Feedback, Advantages of negative feedback.

### Unit – II

Operational Amplifiers: Introduction, The Operational Amplifier, Block Diagram Representation of Typical Op-Amp, Schematic Symbol, Op-Amp parameters - Gain, input resistance, Output resistance, CMRR, slew rate, Bandwidth, input offset voltage, input bias Current and Input Offset Current, The Ideal Op-Amp, Open Loop Op-Amp configurations, Differential Amplifier, Inverting & Non Inverting Amplifier. Op-Amp Applications: Inverting configuration: Summing, scaling, averaging circuit, subtractor, Voltage Follower, Integrator and Differentiator, Oscillators: Principle of Oscillations, RC Phase Shift Oscillator, Crystal Oscillator.

### **Unit – III**

Introduction: Review of Boolean algebra, logic gates. Simplification of Boolean functions using Boolean Laws and K-maps. Three Variable K – Maps, Four Variable K – Maps, The Tabulation Method, Determination of Prime Implicants, Selection of prime implicants.

### **Unit – IV**

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

### **Unit – V**

Flip-Flops: The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master Slave Flip Flops, Shift Registers, Ripple Counters.

**Unit Choice:** Unit-II and Unit-IV

### **Text Books:**

1. “Basic Electronics: Devices, Circuits and IT fundamentals”, Santiram Kal, PHI, 2012.
2. “Op-amps and Linear Integrated Circuits”, Ramakanth A Gayakwad, Pearson Education, 4th Edition.
3. “Digital Logic and Computer Design”, M. Morris Mano, PHI Learning, 2008.

### **Reference Books:**

1. “Electronic Devices and Circuits”, David A Bell, 5th Edition, Oxford, 2016.



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

(Autonomous College under VTU)

Course Title	INTRODUCTION TO ROBOTICS				
Course Code	22EC6OE1IR	Credits	3	L-T-P	3:0:0
CIE	50 Marks (100% weightage)		SEE	100 Marks (50% weightage)	

### Prerequisites:

- Knowledge of basic statics and dynamics.
- Basic programming using C/C++ or Python.
- Linear Algebra.

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Apply</b> fundamental concepts of Robotics, sensors, actuators and components for developing Robotic Systems and Applications.	1	2
CO2	<b>Analyze</b> Robotic Systems using mathematics and engineering science for implementing systems.	2	2
CO3	<b>Design</b> solutions (subsystems or systems) for building Robotic System meeting the specifications for applications.	3	2
CO4	<b>Research</b> and <b>Investigate</b> methods and approaches for building controlled, semi-autonomous, and autonomous robotic systems.	4, 5, 6, 9, 10	2

### Unit I

Introduction to Robotics: History, Robots, Robot Usage, Industrial Robots and Their Applications: Robot Subsystems, Classification of Robots, Industrial Applications. Actuators and Grippers: Electric Actuators, Hydraulic Actuators, Pneumatic Actuators, Selection of Motors, Grippers.

## **Unit II**

Elements of Robotics – Sensors: Sensors, Vision and Signal Conditioning: Sensor Classification, Internal Sensors, External Sensors, Vision, Signal Conditioning, Sensor Selection.

## **Unit III**

Transformations & Position Analysis: Robot Architecture, Pose of a Rigid Body, Coordinate Transformation, Denavit and Hartenberg (DH) Parameters, A Variant of DH Parameters, DH Parametrization of Euler angles. Forward Position Analysis, Inverse Position Analysis.

## **Unit IV**

Aerial Robots: Types of UAV, Airplane, Control Surfaces, Rotary Wings, Motors and Propellers, Battery, Additional Equipment, Flight Control: Introduction, Architecture, Autopilot, Sensors Dedicated to the Flight controller, Sense And Avoid Technologies, Camera And Video, Radio Communications, Ground Control System, First Person View(Fpv), Data Fusion.

## **Unit V**

Robotic Operating System (ROS): ROS Architecture, Environment, Nodes, ROS Topics, Messages, Publisher, Subscriber, ROS Services and Actions, Simulation and Debugging Tools, Plotting and Data Visualization. Unified Robotic Description Format (URDF).

**Unit Choice:** UNIT-I and UNIT-II

### **Text Books:**

1. “Introduction to Robotics”, S K Saha, McGraw Hill Education (India) Private Limited, 2nd Edition, 2014
2. “Introduction to Robotics”, Mechanics and Control, John J. Craig, Third Edition, Pearson Education Inc, 2009
3. “Robot Operating System for Absolute Beginners”, Lentin Joseph, 2018, Apress
4. “A First Course in Aerial Robots and Drones”, Yasmina Bestaoui Sebbane, 2022, CRC Press

### **Reference Books:**

1. “Introduction to Robotics: Analysis Systems and Applications”, Saeed B Nikku, PHI Learning Private Limited, New Delhi, 2001.
2. “Learning Robotics using Python”, Lentin Joseph, 2nd Edition, PACKT Publishing, 2015



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

(Autonomous College under VTU)

<b>Course Title</b>	<b>INTELLECTUAL PROPERTY RIGHTS AND CYBER LAW</b>				
<b>Course Code</b>	<b>22ES6HSIPL</b>	<b>Credits</b>	<b>2</b>	<b>L – T – P</b>	<b>2:0:0</b>
<b>CIE</b>	<b>50 Marks (100% weightage)</b>	<b>SEE</b>	<b>100 Marks (50% weightage)</b>		

### Course Outcomes:

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

Sl. No.	Course Outcomes	PO	PSO
CO1	<b>Understand</b> and commit to professional ethics and responsibilities to obtain Intellectual Property Rights like Patents, Copyright & Trademarks	8	–
CO2	<b>Understand</b> the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context	7	–
CO3	<b>Use</b> IPRs and Cyber Law to access societal, health, safety & Cultural issues	6	–
CO4	<b>Work</b> in multiple teams to effectively communicate IP & Cyber Law	9, 10	–

### UNIT – I

**Basic principles of IP laws & Patents:** Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non – patentable inventions.

### UNIT – II

**Procedure for obtaining patent:** Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license.

Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment.

Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee.

Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.

### UNIT – III

**Copy Right:** Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies.

**Trade Marks:** Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement.

### UNIT – IV

**Cyber Law:** An introduction, Definition, why cyber law in India, Evolving cyber law practices - for corporates, privacy in Indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph act, Cyber Stalking.

### UNIT – V

**Indian Cyber law:** Protecting Indian children online, POCSO act, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India, Emerging trends in cyber law.

#### Text Books:

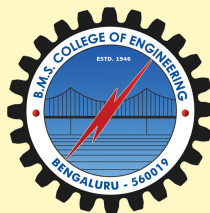
1. Dr. T Ramakrishna, “Basic principles and acquisition of Intellectual Property Rights”, CIPRA, NSLIU -2005.
2. Dr.B.L.Wadehhra, “Intellectual Property Law Handbook”, Universal Law Publishing Co. Ltd., 2002.
3. Cyberlaw-The Indian perspective by Pavan Duggal, 2009 Edition.

#### Reference Books:

1. Dr. T Ramakrishna, “Ownership and Enforcement of Intellectual Property Rights”, CIPRA, NSLIU -2005.

2. “Intellectual Property Law (Bare Act with short comments)”, Universal Law Publishing Co. Ltd. 2007.
3. “The Trade marks Act 1999 (Bare Act with short comments)”, Universal Law Publishing Co. Ltd., 2005.





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