ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

Department of Electronics and Instrumentation Engineering

Scheme & Syllabus:
III to VIII Semester
2019

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು–೫೬೦ ೦೧೯

B.M.S COLLEGE OF ENGINEERING

Bull Temple Road, Bangalore - 560 019

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

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 bring forth globally emerging competent professionals with high quality of Technical Education who meet the demands of the modern industrial world which seeks innovation and continuous improvement in performance

DEPARTMENT MISSION

- To accomplish excellence in curricular, co-curricular and R & D activities with active participation of students, faculty and staff.
- To impart quality education based on in-depth and thorough understanding of fundamentals.
- To prepare the students to meet the demands of the Instrumentation industry.
- To Motivate and inspire young engineers to contribute to the development of the society

PROGRAM EDUCATIONAL OBJECTIVES

The Program Educational Objectives (PEOs) describe the professional accomplishments of our graduates about three-five years after having completed the under-graduate program in Instrumentation Engineering. We describe the progress of our graduates through four PEOs. The first PEO reflects their professional career pursued through the knowledge acquired either as employees or as entrepreneurs, the second PEO is focussed on their desire to upgrade their technical skills, the third PEO describes their communication skills and team skills.

PEO1:	Excel in professional career in Electronics Engineering, Instrumentation Engineering and Allied industries.
PEO2:	Adapt to modern technological advancement by upgrading knowledge.
PEO3:	Exhibit leadership, team spirit and communication skills with a commitment towards the requirements of society.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

PROGRAM OUTCOMES (POs)

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, are identical to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA), and are common across all branches of engineering. 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, and help in the attainment of the PEOs.

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	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.
PO 4	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.
PO 5	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.
PO 6	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.
PO 7	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.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO 10	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.
PO 11	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.
PO 12	Life-long learning: Recognise the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The Program Specific Outcomes (PSOs), are defined by the stakeholders of the program, and describe the skills in addition to the POs (defined by NBA), expected by the Electronics and Instrumentation Engineering student at the time of graduation. Similar to the POs, they are addressed through the outcomes of the courses, however, they are exclusive to the branch. The PSOs are developed through the teaching-learning process of various courses of the curriculum.

PSO 1	Graduate will apply the concepts of data acquisition, signal conditioning, control and communication in the field of Electronics and Instrumentation.
PSO 2	Graduate will simulate, analyse and interpret analog / digital circuit designs, related to applications of automation and control using modern engineering tools
PSO 3	Graduate will comprehend the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

III SEMESTER SCHEME

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
19MA3BSEM3	Engineering Mathematics - 3	BS	3:1:0	4	5	50	50	100
19ES3CCECA	Electrical Circuit Analysis	PC	3:1:0	4	5	50	50	100
19ES3CCAEC	Analog Electronic Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCSAM	Sensors and Measurements	PC	3:0:1	4	5	50	50	100
19ES3CCDEC	Digital Electronic Circuits	PC	3:0:1	4	5	50	50	100
19EI3PCLOI	Laser and Optical Instrumentation	PC	3:0:0	3	3	50	50	100
19EI3PCCSL	Circuit Simulation Lab	PC	0:0:1	1	2	50	50	100
19IC3HSEVS	Environmental Studies	HS	1:0:0	1	1	50	50	100
19EI3NCPYA	Physical Activity	NC	-	-	2	-	-	PP/NP
	Total		**19:2:4**	**25**	**33**	**400**	**400**	**800**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

IV SEMESTER SCHEME

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
19MA4BSEM4	Engineering Mathematics -4	BS	3:1:0	4	5	50	50	100
19ES4ESCST	Control Systems	ES	3:1:0	4	5	50	50	100
19ES4CCLIC	Linear Integrated Circuits	PC	3:0:1	4	5	50	50	100
19ES4CCMCS	Microcontrollers	PC	3:0:1	4	5	50	50	100
19ES4CCSAS	Signals and Systems	PC	3:1:0	4	5	50	50	100
19EI4PCEMF	Electro Magnetic Field Theory	PC	2:1:0	3	4	50	50	100
19IC4HSCPH	Constitution of India, Professional Ethics and Human Rights	HS	1:0:0	1	1	50	50	100
20HS4ICSAK/ 20HS4ICBAK	Samskruthika Kannada/ Balake Kannada	HS	1:0:0	1	1	50	50	100
19EI4NCCLA	Cultural Activity	NC	-	-	2	-	-	PP/NP
	Total		**19:4:2**	**25**	**33**	**400**	**400**	**800**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

V SEMESTER SCHEME

Course Code		Course Title	Type	L:T:P	Credits	Hours	Marks		
							CIE	SEE	Total
19EI5PCTNI		Transducers & Instrumentation	PC	3:0:1	4	5	50	50	100
19EI5PCPCS		Process Control Systems	PC	3:0:1	4	5	50	50	100
19ES5CCDSP		Digital Signal Processing	PC	3:0:1	4	5	50	50	100
19EI5PCCST		Communication Systems	PC	3:0:0	3	3	50	50	100
19EI5PE1 (Program Elective –I)	DS	Digital System Design using FPGA*	PE	3:0:0	3	3	50	50	100
	CD	C++ & Data Structures*							
	PY	Python Programming & Applications *							
	MB	Elective based on identified MOOCs							
19EI5PE2 (Program Elective – II)	PE	Power Electronics*	PE	3:0:0	3	3	50	50	100
	AL	Analytical Instrumentation							
	AR	Aircraft Instrumentation							
	PT	Product Design Technology *							
19ES5HSIFE		Innovation For Entrepreneurship	HS	2:0:0	2	2	50	50	100
19EI5PWMP1		Mini Project -I	PW	0:0:2	2	4	50	50	100
19EI5NCDTA		Documentary & Theatre Activity	NC	-	-	2	-	-	PP/NP
		Total		**20:0:5**	**25**	**32**	**400**	**400**	**800**

* This course has an L-T-P of (2-1-0)

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

VI SEMESTER SCHEME

Course Code		Course Title	Type	L:T:P	Credits	Hours	Marks		
							CIE	SEE	Total
19EI6PCAPC		Automation in Process Control	PC	3:0:1	4	5	50	50	100
19EI6PCESD		Embedded System Design	PC	3:0:1	4	5	50	50	100
19EI6PCIDN		Industrial Data Networks	PC	3:0:1	4	5	50	50	100
19GC6HSPMT		Product Management Techniques	HS	2:0:0	2	2	50	50	100
19EI6PE3 (Program Elective –III)	DP	Digital Image Processing*	PE	3:0:0	3	3	50	50	100
	MC	Modern Control Theory*							
	ID	Industrial Instrumentation							
	BM	Biomedical Instrumentation*							
19EI6CE1 (Cluster Elective- I)	IN	Industrial Internet of Things	PE	3:0:0	3	3	50	50	100
	AD	Algorithms and System Design *							
19EI6OE1 (Open Elective-I)	SM	Sustainable Solutions for Smart Cities	OE	3:0:0	3	3	50	50	100
	MD	Multi-Domain System Modelling*							
19EI6PWMP2		Mini Project -II	PW	0:0:2	2	4	50	50	100
19EI6NCPDC		Personality Development and Communication	NC	-	-	2	-	-	PP/NP
		Total		**20:0:5**	**25**	**32**	**400**	**400**	**800**

* This course has an L-T-P of (2-1-0)

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

VII SEMESTER SCHEME

Course Code		Course Title	Type	L:T:P	Credits	Hours	Marks		
							CIE	SEE	Total
19ES7BSBFE		Biology for Engineers	PC	2:0:0	2	2	50	50	100
19EI7PCVID		VLSI Design	PC	3:0:1	4	5	50	50	100
19EI7PCTRA		Technological Trends in Automation	PC	1:0:0	1	2	50	50	100
19EI7CE2 (Cluster Elective –II)	ME	MEMs	PE	3:0:0	3	3	50	50	100
	VA	Vision Technology and Applications							
19EI7OE2 (Open Elective – II)	IA	Instrumentation for Food Processing and Agriculture	OE	3:0:0	3	3	50	50	100
	BA	Building Automation							
19EI7PWPW1		Project Work- 1	PW	0:0:3	3	6	50	50	100
19ES7HSPMF		Project Management and Finance	HS	3:0:0	3	3	50	50	100
19EI7NCMOC		MOOCs Courses	NC	-	-	2	-	-	PP/NP
		Total		**15:0:4**	**19**	**26**	**350**	**350**	**700**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

VIII SEMESTER SCHEME

Course Code		Course Title	Type	L:T:P	Credits	Hours	Marks		
							CIE	SEE	Total
19ES8HSIPL		Intellectual Property Rights and Cyber Law	HS	2:0:0	2	2	50	50	100
19EI8OE3 (Open Elective – III)	SA	Smart Sensors and Analytics	OE	3:0:0	3	3	50	50	100
	AU	Automotive Instrumentation							
19EI8PWPW2		Project Work- 2	PW	0:0:9	9	18	50	50	100
19EI8SRSMR		Seminar on Internship	SR	0:0:2	2	4	50	50	100
19EI8NCVTL		Virtual labs	NC	-	-	2	-	-	PP/NP
		Total		**5:0:11**	**16**	**29**	**200**	**200**	**400**

Note: Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VI and VIII semesters. The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like:

1 Successful completion of Value Added Programs/Training Programs/ workshops organized by academic Institutions and Industries
2 Soft skill training by the Placement Cell of the college
3 Active association with incubation/ innovation /entrepreneurship cell of institute
4 Participation in Inter-Institute innovation related competitions like Hackathons
5 Working for consultancy/ research project within the institutes
6 Participation in activities of Institute"s Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests
7 Internship with industry/ NGO"s/ Government organizations/ Micro/ Small/Medium enterprises
8 Development of a new product/ business plan/ registration of a start-up Long term rural internship

For complete details refer: AICTE Internship Policy: Guidelines and Procedures

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Course Total
Humanities and Social Sciences, Management Course (HS)			1	2	2	2	3	2	**12**
Basic Science Course (BS)	9	9	4	4				2	**28**
Engineering Science Course (ES)	11	11		4					**26**
Professional Core Course (PC)			20	15	15	12	5		**67**
Professional Elective Course (PE)					6	6	3		**15**
Open Elective Course (OE)						3	3	3	**9**
Project/ Mini-Project (PW)					2	2	3	9	**18**
Seminar -Internship (SR)								2	
Non-Credit Mandatory Course (NC)	**NC1**	**NC2**	**NC3**	**NC4**	**NC5**	**NC6**	**NC7**	**NC8**	**–**
Total Credits	**20**	**20**	**25**	**25**	**25**	**25**	**19**	**16**	**175**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

The Program Articulation Matrix (PAM) of core courses

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19ES3CCECA	3	2	2						2	2					
19ES3CCAEC	3	3	3	2						2			2		
19ES3GCSAM	3	3	3	2	2				2	2			1		
19ES3CCDEC	3	3	3	2	2					1			1		
19EI3PCLOI	3	3				2	2						2		
19EI3PCCSL		3	3		3				3	3				2	
19IC3HSCPH						2	2	3							
19EI3NCPYA								2	2			1			
19ES4ESCST	2	3	1	3	2								2	2	
19ES4CCLIC	3	3	3	3		2				2			2		
19ES4CCMCS	3	3	3	3	3				2	2		2		3	
19ES4CCSAS	3	2	3		3				2						
19EI4PCEMF	3	2	2		3	2	2			2				2	
19IC4HSEVS						2	3	2							
19EI4NCCLA						2		2	2						
19EI5PCTNI	2	3	3	2		2	2		2	2					
19EI5PCPCS	3	2	3	3	3	2									
19ES5CCDSP	3	3	3	3	3				2	2		2		3	
19EI5PCCST	3	3	2		3					2			2	2	
19ES5HSIFE	2					2	2	1	3	3					
19EI5PWMP1	2	3	2	2	3	2	2	2	3	3	2	2	3	2	2
19EI5NCDTA								2	2	2					
19EI6PCAPC	2	3	3	3	3	2	2		2	2				3	3
19EI6PCESD	3	3	3	2	3		1		3	2		2		2	2
19EI6PCIDN	3	2	2		3	3			3	3			2	2	3
19GC6HSPMT	2					2	2	1	2	2					

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
19EI6PWMP2	3	3	3	2	3	2	2	2	2	3	2	2	2	3	2
19EI6NCASD	2	2							2			1			
19ES7BSBFE						3	2								
19EI7PCVID	3	2	3	2	3					3					
19EI7PCTRA				2				2	2			2	2		
19EI7PWPW1	3	3	3	2	3	2	2	2	3	3	2	2	3	3	2
19ES7HSPMF	2					2		3	2	2	3				
19EI7NCMOC									2	2					
19ES8HSIPL	2					3	2	2	2	2					
19EI8PWPW2	3	3	3	3	3	3	3	3	3	3	2	2	3	3	2
19EI8SRSMR	2	2	2			2	2	1	3	3		1			
19EI8NCVTL					2					2		1			

III Semester

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**ENGINEERING MATHEMATICS - 3**				
COURSE CODE	**19MA3BSEM3**	**Credits**	**4**	**L-T-P**	**3-1-0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
(Common to AS/CV/EEE/ECE/EIE/IEM/ME/ML/TCE)					

Prerequisites: Basic concepts of Trigonometry, methods of differentiation, methods of integration, solution of ordinary differential equations.

UNIT -I **09 Hours**

Matrices

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of a system of linear equations and solution. Solution of a system of non-homogenous equations: Gauss elimination method, Gauss-Seidel method, LU decomposition method, eigenvalues and eigenvectors of matrices, reduction of a matrix to diagonal form. **(7L + 2T)**

UNIT -II **09 Hours**

Fourier Series

Introduction: Dirichlet"s conditions, Fourier series of periodic functions of period 2*l*, Fourier series of functions having points of discontinuity. Applications: Fourier series of typical waveforms like saw toothed waveform, triangular waveform, square waveform, half-wave rectifier, full wave rectifier and modified saw tooth waveform, exponential Fourier series, practical harmonic analysis. **(7L + 2T)**

UNIT -III **09 Hours**

Fourier Transforms

Infinite Fourier transform: Fourier Sine and Cosine transforms, properties, Inverse transforms. Convolution theorem, Parseval"s identities. **(6L + 3T)**

UNIT -IV **10 Hours**

Numerical Methods

Solution of algebraic and transcendental equations: Newton-Raphson method. Finite Differences and interpolation: Forward differences, backward differences. Newton- Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Lagrange"s interpolation formula, Lagrange"s inverse interpolation. Numerical integration: Simpson"s $1/3^{rd}$ rule, Simpson"s $3/8^{th}$ rule, Weddle"s rule. Numerical solution of ordinary differential equations: modified Euler"s method, Runge-Kutta method of fourth order**.** **(8L + 2T)**

UNIT -V **11 Hours**

Calculus of Variations

Variation of a functional, Euler"s equation, variational problems. Applications: Hanging cable problem, Brachistochrone problem. Definition, Properties, Transforms of standard functions, Inverse transforms. Solution of difference equations using Z- transforms. **(8L + 3T)**

Text books:

1.Higher Engineering Mathematics, B.S. Grewal, 43^{rd}edition, 2014, Khanna Publishers.

2.Advanced Engineering Mathematics, 4th edition, 2011, Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Reference books:

1. Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.

E-References

1. https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/lecture-notes/
2. https://www.pdfdrive.com/calculus-of-variations-e34313748.html

e–Learning :

1. https://nptel.ac.in/courses/111103021/22(Fourier series and Transforms, Heat and Wave Equations)
2. https://nptel.ac.in/courses/122104018/2(Numerical Methods)
3. https://nptel.ac.in/courses/111104025/(Calculus of variation)

Internal choice: Unit – III & V

Course outcomes

At the end of the course on **Engineering Mathematics-3**, the student will have the ability to

CO1: Apply Numerical techniques to solve problems arising in engineering

CO2: Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.

CO3: Apply the concepts of calculus to functionals.

COURSE TITLE	ELECTRICAL CIRCUIT ANALYSIS				
COURSE CODE	19ES3CCECA	Credits	4	L-T-P	3:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT -I 12 Hours

Basic Concepts:

Practical sources, Source transformations, Network reduction using Star to Delta transformation, vice versa. Loop and node analysis with linearly dependent and independent sources for DC and AC circuits, Analysis of network involving concepts of super node, super mesh.

UNIT -II 10 Hours

Network Topology:

Graph of a network, Concept of tree and Co-tree, Incidence matrix, tie-set, tie-set schedule & cutset, cut-set schedule, Formulation & solution of equilibrium equations, Principle of duality. Resonant Circuits: Series and parallel resonance, Frequency response of series and parallel circuits, Q factor, Bandwidth

UNIT- III 10 Hours

Network Theorems:

Superposition, Reciprocity, Millman's, Thevenin's and Norton's theorems; Maximum power transfer theorem.

UNIT-IV 10 Hours

Transient Behavior and Initial Conditions:

Behavior of circuit elements under switching condition and their

representation, Evaluation of Initial and Final conditions in RL, RC and RLC circuits. Review of Laplace transforms, Waveform Synthesis, Initial and Final value theorems, Step, Ramp and Impulse responses, Convolution theorem, solution of simple R-L, R-C, R-L-C networks for AC and DC excitations using Laplace transforms.

UNIT- V **10 Hours**

Two Port Network Parameters:

Definition of Z, Y, T, h parameters, modeling, relationship between parameters sets.

Text books:

1. "Network Analysis", M.E.Vanvalkenburg, PHI/ Pearson Education, 3rd Edition. Reprint 2002.
2. "Network and systems ", Roy Choudhury, 2nd edition, 2006 reprint, New Age International Publications.
3. Theory and Problems of Electric Circuits", Schaum's Series, 2nd Edition McGraw Hill

Reference books:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, TMH 6th 2002. Hill.
2. "Network analysis and Synthesis", Franklin F. Kuo, Wiley Edition.
3. "Analysis of Linear Systems", David K. Cheng, Narosa Publishing House, 11th reprint, 2002.
4. "Circuits", Bruce Carlson, Thomson learning, 2000. Reprint 2002.
5. Network analysis and Synthesis", D. Anand Kumar, PHI Learning, 2019.

E-References

1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur.
2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
3. www.electrodiction.com/circuit-theory.

e–Learning :

1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. https://elearning.vtu.ac.in/06ES34.html
3. https://www.coursera.org/course/circuits

Internal choice: Unit – I & IV

Course outcomes

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

CO1: Understand the basic concepts related to various types of Electrical networks

CO2: Apply the suitable network theorem /topology for the given Electrical circuit to obtain the desired electrical parameters

CO3: Analyse the switching conditions of the given electrical circuit to obtain time domain response

CO4: Interpret the given electrical network and obtain the quality parameter with reasoning

CO5: Investigate two port network to represent the parameter in different forms

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**ANALOG ELECTRONIC CIRCUITS**				
COURSE CODE	**19ES3CCAEC**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT I — 08 Hours

Diode applications:- Introduction, load line analysis, Series diode configurations, Parallel and series–parallel configurations, clippers, Clampers.

Bipolar Junction Transistor (BJTs):- DC biasing– Introduction, operating point, voltage divider Bias configuration

BJT AC Analysis:-Introduction, Application in the AC Domain, BJT Transistor Modeling Transistor model, Voltage Divider Bias

UNIT II — 08 Hours

BJT Frequency Response :- Introduction, Logarithms, Decibels , Low frequency Response-BJT Amplifier, Miller effect Capacitance, High Frequency response – BJT Amplifier

Feedback concepts: - Feedback connection types- Voltage series, Voltage-shunt, Current Series and Current Shunt Feedback.

Practical feedback Circuits: - Voltage series, Current series feedback and voltage Shunt feedback.

UNIT III — 08 Hours

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 IV **08 Hours**

MOSFETS: Introduction ,**Device structure and physical operation -** Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the id – VDS relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub-threshold region .

Current voltage Characteristics---Circuit symbol, id – VDS 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 VGS, Biasing by fixing VG and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source

UNIT V **08 Hours**

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 signal analysis,small signal equivalent circuit models, the trans conductance gm, the T equivalent circuit model.

Single stage MOS amplifiers-The basic structure, characterizing

amplifiers, The CS amplifier, The CS amplifier with a source resistance. Common gate (CG) Amplifier, The common Drain or source follower Amplifier.

IC Biasing: – **Current sources, current mirror and current steering circuits-** The basic MOSFET current source, MOS current steering circuits

Current mirror circuit with improved performance --- The Wilson MOS mirror

Lab Experiments:

1. Performance analysis of Transistor as a switch
2. Zener diode characteristics and Zener as regulator
3. Diode clipping circuits- Single/Double ended
4. Diode clamping Circuits – Positive clamping/negative clamping
5. Performance analysis BJT as RC coupled amplifier
6. Design and analysis of BJT as RC phase shift oscillator
7. Design and analysis of Crystal Oscillators
8. To obtain the characteristics of MOSFET (using simulation tool/hardware)
9. To study MOSFET as an amplifier (using Multisim/hardware)
10. To study voltage series feedback amplifier using BJT (using simulation tool/hardware)
11. Performance analysis of class – B Power Amplifier

Text books:

1. Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky-10thedition (Pearson Education)

2. Microelectronic Circuits-Theory and applications by Adel s. Sedra and Kenneth C.Smith Fifth edition (Oxford International Student Edition)

Reference books:

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

E-References

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

e–Learning :

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

Internal choice: Unit – I & V

Course outcomes

At the end of the course on **Analog Electronic Circuits**, the student will have the ability to

CO1: Understand the structure and characteristics of Analog Electronic Devices.

CO2: Apply the Knowledge of KVL & KCL to obtain Voltage, wave form in Analog Electronic Circuits

CO3: Conduct investigation on Analog Electronic Circuits for various application of electronic devices.

CO4: Design clippers, clampers & amplifier for wave shaping of signals.

CO5: Experiment with electronic components & instruments to demonstrate switching function.

CO6: Engage in independent learning on Analog electronic component.

COURSE TITLE	SENSORS AND MEASUREMENTS				
COURSE CODE	19ES3GCSAM	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT I 06 Hours

Measurements: Introduction, Significance of measurements, instruments and measurement systems, Functional elements of measurement system. Performance Characteristics of measuring instruments-Static & Dynamic**.** Measurement Errors: Gross and systematic.

UNIT II 08 Hours

Physical Principles of Sensing: Capacitance, magnetism, Induction, Resistance, Piezoelectric Effect, Hall effect, Thermoelectric effect, Sound waves, Temperature and thermal properties of materials, Heat transfer.

Displacement and Level Sensors: Inductive, Magnetic and Optical, Acceleration: Accelerometers – Seismic Sensors. Force and Strain: Strain Gauge, Pressure sensors.

UNIT III 08 Hours

Acoustic sensor: Resistive and Fiber-optic microphones, Humidity and Moisture sensor: Concept of Humidity, Thermal conductivity and Optical, Hygrometers, Light Detectors: Photodiode, Phototransistor, Photoresistor Radiation Detectors: Scintillating Detectors and Ionization Detectors

UNIT IV **07 Hours**

Temperature sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, Optical Temperature sensor, Multi sensor arrays

UNIT V **07 Hours**

Measuring Instruments: Interface Electronic Circuits, Signal conditioners, Sensor connections, excitation circuits, Data transmission, Noise in sensors and circuits, Battery for low power sensors.

Lab Experiments:

Application of following sensors using electronic components

1. Light sensor
2. Linear variable position transducer
3. Temperature dependence of diodes
4. Microphone to speaker amplifier circuit
5. Water level indicator
6. IR sensor and Photodiode
7. Piezo Electric sensor
8. Heat sensor
9. Strain gauge
10. Thermistor
11. Mini project to build an instrument on Multisim platfor.m Verify few parameters from the data sheet of sensors

Text books:

1. Measurement Systems, Ernest O Doebelin, Dhanesh N Manik, TMH, Sixth edition
2. Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden , Sringer Publications, Fifth Edition (Chapter 1,4,5,6, 8,9,10,13,15,17,19)

Reference books:

1. "Electronics & Electrical Measurements", A K Sawhney, Dhanpat Rai & sons, 9th edition
2. "Electronic 1Instrumentation and Measurements", David A Bell, PHI / Pearson Education,2006

E-References

1. https://electronicsforu.com/resources/7-free-instrumentation-engineering-ebooks
2. https://www.azosensors.com/book-index.aspx
3. https://doc.xdevs.com/doc/_Metrology/introduction-to-instrumentation-and-measurements-2-edition-byrobert-b-northrop.pdf
4. https://www.realtechsupport.org/UB/SR/sensors/Fraden_ Sensors_2010.pdf

e–Learning :

1. https://www.convergencetraining.com/measurement-methods-and-sensors-courses.html
2. https://nptel.ac.in/courses/112103174/3

Internal choice: Unit – II & III

Course outcomes

At the end of the course on **Sensors and Measurements**, the student will have the

CO1: Understand the concepts of sensing and building blocks of measuring systems

CO2: Integrate the knowledge of physics behind sensors and electronics conversion in a measurement system

CO3: Analyse the performance of measurement system and sensor characteristics

CO4: Conduct investigation to provide solution to specific measurement needs

CO5: Interpret the analog circuits for signal conditioning to the given physical or chemical measuring parameters

CO6: Involve independently and demonstrate concept of sensing and measuring system.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	DIGITAL ELECTRONIC CIRCUITS				
COURSE CODE	19ES3CCDEC	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT-I 08 Hours

Introduction: Review of Boolean algebra, logic gates

Simplification of Boolean functions: Three Variable, Four Variable and FiveVariable K – Maps, The Tabulation Method, Design with Basic gates, NAND gates and NOR gates.

UNIT-II 08 Hours

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).

UNIT-III 08 Hours

Sequential Logic Circuits:

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

UNIT-IV 05 Hours

Sequential systems:

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

UNIT-V 06 Hours

Logic Families: Characteristic of Digital ICs, Transistor – Transistor Logic, Complementary MOS (CMOS) Logic, Comparison of TTL and CMOS families.

Lab Experiments:

1. Applications of IC 7483 (Adders, Subtractors and Comparators)(Unit-II)
2. Multiplexers (using Gates and IC) and their applications(Unit-II)
3. Decoders/DeMultiplexers (using Gates and IC) and their applications(Unit-II)
4. BCD to Decimal decoder using 7-segment display(Unit-II)
5. Verification of MSJK Flip-flop (using Gates and IC 7476)(Unit-III)
6. Asynchronous counters (using ICs 7476,7490,7493)(Unit-III)
7. Synchronous Counters (using ICs 7476, 74190/74192) (Unit-III)
8. Shift registers and their applications (using ICs 7476, 7495) (Unit-III)
9. Verification of few parameters of TTL (Unit-V)
10. Verification of few parameters of CMOS (Unit-V)
11. Build and verify the specified Gate/Flip-Flop using suitable analog electronic components on the Multisim platform
12. Implement the specified mini-project (like ALU, digital clock, Sequence generator, PRBS generator)

Text books:

1. Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education
2. Digital Principles and Design- Donald Givone, Tata Mc Graw Hill

Reference books:

1. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education
3. Modern Digital Electronics-R PJain-TMH

E-References

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/

e–Learning :

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

Internal choice: Unit – II & III

Course outcomes

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

CO1: Apply the knowledge's Boolean algebra, K- Map, Quine– Mc Cluskey methods for computation of time delay and power consumption.

CO2: Analyze combinational circuits and sequential circuits based on universal gates.

CO3: Design sequential circuits such as synchronous counters, shift registers and state machine models using Flip-Flops

CO4: Engage in independent study of simple digital system like seven display, LCD display, Code converters.

CO5: Communicate effectively to demonstrate the importance of Integrated Chips and digital devices used in Electronic Gadgets.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	LASER AND OPTICAL INSTRUMENTATION				
COURSE CODE	19EI3PCLOI	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT-I10 Hours

Fundamentals of Laser, Types and Characteristics: Laser characteristics, Einstein's coefficients- its significance, population inversion, three levels, four level laser, Principles, classification, construction of Ruby, He-Ne, Nd-YAG, semiconductor, Argon and Carbon dioxide lasers. Characteristics of stabilization, Q-switching and mode locking, frequency stabilization, line shape function.

UNIT-II07 Hours

Laser Instrumentation: Measurement of distance - Interferometric methods, beam modulation telemetry, pulse echo techniques. Laser Doppler velocimetry- Holography-principle, applications of holography, holographic computer memories, laser welding, laser machining, laser printing and laser spectroscopy

UNIT-III 08 Hours

Optical Fibers And Their Properties: Introduction to Optical Fibers - principles of light propagation through a fiber – Different types of fibers and their properties –Transmission characteristics of optical fiber –Absorption losses – Scattering losses – Dispersion- advantages and disadvantages of optical fibers. Light sources for fiber optics: photo detectors, source

coupling, splicing and connectors. light Modulation schemes, optical fibers, intermodal dispersion, graded index fiber, low dispersive fibers Fiber losses, fiber materials.

UNIT-IV **05 Hours**

Optical Fiber Sensors: Multimode passive and active fiber sensors, phase modulated sensors, optical fiber flow sensors, optical displacement sensors microbend optical fiber sensors, intrinsic fiber sensors measurement, current measurement by single-mode optical fiber sensors, fluro-optic temperature sensors, photo elastic pressure sensors, polarization fiber sensors, rotation sensors, integrated optics

UNIT-V **07 Hours**

Optical Fiber Instrumentation: Fiber optic Instrumentation system - Interferometric method of measurement of length - Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain. Fiber optic gyroscope – polarization maintaining fibers – applications

Text books:

1."Optoelectronics", Wilson & Hawkes, Prentice Hall of India.

2.Optoelectronics and Fiber Optics Communication – C.K.Sarkar and D.C. Sarkar, New Age Int. Pub., 2004

3."Laser principles and applications", Wilson and Hawkes, Prentice Hall of India

Reference books:

1. John and Harry, Industrial Lasers and their Applications, McGraw Hill, 1974.
2. Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985.
3. Keiser G., Optical Fiber Communication, McGraw Hill, 1991

E-References

1. https://easyengineering.net/optoelectronics-an-introduction-by-john-wilson/
2. https://www.sciencedirect.com/book/9780750653701/optoelectronics-and-fiber-optic-technology
3. https://www.sciencedirect.com/book/9780125839617/industrial-applications-of-lasers
4. https://gsundar.weebly.com/uploads/5/4/5/6/54560163/optical_fiber_communication_by_gerd_keiser.pdf

e–Learning :

1. https://nptel.ac.in/courses/117/101/117101002/
2. https://nptel.ac.in/courses/115/107/115107122/
3. https://nptel.ac.in/courses/108/104/108104113/

Internal choice: Unit – I & IV

Course outcomes

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

CO1: Understand the working of Lasers in an Instrumentation system.

CO2: Apply the knowledge of engineering principles in Laser and optical fibre Instrumentation.

CO3: Analyse the characteristics of Lasers in different applications.

CO4: Comprehend the working of optical fibre sensors and detectors for measurement of various parameters.

CO5 : Assess the usability of the laser and optical fibre sensors in the fields of societal, health and safety issues.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	CIRCUIT SIMULATION LAB				
COURSE CODE	19EI3PCCSL	Credits	1	L-T-P	0:0:1

Lab Experiments:

SCILAB:

1. Simulation of transient response of RC circuit with voltage (in time domain) for different values of capacitor
2. Simulation of transient response of RC circuit with current (in time domain) for different values of capacitor
3. Simulation of step response of first order system for different values of capacitor
4. Simulation of transient response of RLC network – second order (showing overdamped, under damped, critically damped and undamped waveforms)
5. Simulation of transient response of RC circuit using XCOS for different values of capacitor
6. Simulation of transient response of RLC circuit using XCOS (showing overdamped, under damped, critically damped and undamped waveforms)

PCB lab:

1. Transient response of RC circuit using PSPICE for different values of capacitors
2. Transient response of RLC circuit using PSPICE, (showing overdamped, under damped, critically damped and undamped waveforms)

3. Simulation for studying characterization of practical Battery Source in Single sweep, DC sweep and Parametric sweep
4. Simulation of Unregulated power supply with and without filter
5. Simulation of Regulated power supply using zener diode
6. Simulation of Regulated power supply using IC7805, IC7812
7. Simulation of Regulated power supply using IC7905, IC7912
8. Simulation of Dual power supply +/-5v or +/-12v
9. Simulation of Variable power supply using ICLM317K
10. Design and Simulation of Instrumentation Amplifier with inputs
    a. V1=10mv; V2=5mv
    b. V1=5mv; V2=10mv
    c. V1=10mv; V2=10mv
11. Design and Simulation of Instrumentation Amplifier whose input is taken from Wheatstone's bridge
12. Simulation of buck converter for LED lighting system

Course outcomes

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

CO1: Analyse the transient response of electric circuits using Pspice.

CO2: Design basic electric and electronic circuits using cadence tool.

CO3: Comprehend the working of different electric and electronic circuit using modern tools.

CO4: Engage in independent study and communicate effectively.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**ENVIRONMENTAL STUDIES**				
COURSE CODE	**19IC3HSEVS**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT-I 06 Hours

Introduction to Environment:

Definition about Earth, atmosphere, hydrosphere, lithosphere and biosphere.Structure of Atmosphere : Troposphere, Stratosphere, Mesosphere,Ionosphere, Exosphere. Internal structure of the Earth: Crust, Mantle, Core. Ecosystem, types of Ecosystem: Land, Forest, Water, Desert, Marine. Effects of Human activities on Environment: Agriculture, Housing, Industries, Mining and Transportation.

UNIT-II 06 Hours

Natural Resources:

Water resources: availability, use and consequences of over utlisation, water conflicts. Case studies Mineral resources: Definition, types, environmental impact of mining Forest resources: Uses, effects of deforestation, remedial measures Energy resources: renewable and non-renewable, growing needs, types of energy resources: hydroelectric, wind power, fossil, solar, nuclear and bio gas. Hydrogen as an alternate future source of energy

UNIT-III 06 Hours

Environmental pollution:

Introduction, causes, effects and control measures. Water pollution, land

pollution, noise pollution, air pollution and marine pollution-case studies. Environmental management: Solid waste, hazardous waste, e-waste, bio medical waste

UNIT-IV **06 Hours**

Social issues and Environment

Population growth. Climatic changes: Global warming, acid rain, ozone layer depletion. Water conversation: rain water harvesting and ground water recharging. Disaster management: floods, earthquakes, landslides-case studies Environmental Protection Acts: Air, Water, land and Noise (Prevention and Control of pollution), Forest conservation, Wildlife protection.

Text books:

1. Environmental studies by - Dr. Geethabalakrishanan (Revised Edition)
2. Ecology by – Subramanyam (Tata McGraw Hill Publication)
3. Environmental studies by – Dr. J.P.Sharma (Third edition)
4.Environmental studies by – SmritiSrivastav

Reference books:

1. Joseph. A.Edminister, 'Theory and Problems of Electromagnetics', Second edition, Schaum , Series, Tata McGraw Hill,1993.
2. William .H.Hayt, 'Engineering Electromagnetics', Tata McGraw Hill edition,2001.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 1999. GE 2211 ENVIRONMENTAL SCIENCE ANDENGG.

4. Clayton R Paul, ' Introduction to Electromagnetic compatibility', 2nd edition, Wiley IndiaPvt,Ltd.
5. Environmental studies by – Benny Joseph
6. Environmental studies by – Dr. D.L.Manunath

E-References

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

e–Learning :

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

SEE PAPER PATTERN:

SEE Question paper consist of two parts, Part –A consists of 40 MCQ'S, one mark each. Whereas Part – B consist of 5 main questions of 20 marks each.

Student should answer Part – A compulsory and any three full questions from Part-B, covering all units.

Course outcomes

At the end of the course on **Environmental Studies**, the student will have the

CO1: Understand the components and impacts of human activities on environment.
CO2: Apply the environmental concepts for conservation and protection of natural resources.
CO3: Identify and establish relationship between social, economical and ethical values from environmental perspectives.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**PHYSICAL ACTIVITY**				
COURSE CODE	**19ET3NCPYA**	**Credits**	**-**	**L-T-P**	**-**

The college provides opportunity for students to associate with a large number of physical activities.

Sample activities are listed below:

- Civil Defense/ Self-defense through Karate
- NCC
- Sports for Beginners

Badminton/ Kho-Kho/ Chess/ Net Ball/ Football/ Table Tennis/ Handball/ Cricket/ Hockey/ Volleyball/ Kabaddi/ Basket Ball/Throw Ball

- Sports for Regular Players:

Tennis / Athletics / Ball Badminton / Baseball / Billiards & Snookers / Body Building/ Roller Skating / Rugby / Softball / Swimming / Yachting / Gymnastic / Archery / Cycling / Equestrian / Fencing / Golf / Karate / Kayaking & Canoeing / Power-lifting / Rowing / Shooting / Squash / Weight Lifting / Boxing/ Wrestling / Judo

Students regularly associated with ANY one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in the events organized by the department:

- Yoga for Beginners
- Full/Half-Marathon

IV Semester

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	ENGINEERING MATHEMATICS - 4				
COURSE CODE	19MA4BSEM4	Credits	4	L-T-P	3:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
(Common to AS/CV/EEE/ECE/EIE/ML/TCE)					

Prerequisites: Complex numbers, multivariate calculus and basic concepts of Statistics and Probability.

UNIT -I **10 Hours**

Statistics and Probability

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of exponential curve of the form $y = ab^x$. Correlation and regression. Probability distributions: Discrete distribution - Poisson distribution. Continuous distribution- Normal distribution. **(8L + 2T)**

UNIT -II **09 Hours**

Joint Probability and Markov Chain

Joint Probability Distributions: Discrete random variables, Mathematical expectations, Covariance and Correlation.

Markov Chain: Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chain. **(7L + 2T)**

UNIT -III **09 Hours**

Numerical Solution of Partial Differential Equations

Finite-Difference formulas to partial derivatives. Applications: Solution of one-dimensional heat equation using 2-level formula and Schmidt explicit

al formula and Crank-Nicolson two-level implicit formula. Solution of one-dimension wave equation using explicit three level formula and implicit scheme. **(7L + 2T)**

UNIT -IV **10 Hours**

Complex Analysis – 1

Functions of a complex variable, limits, continuity and differentiability of a complex valued function, Analytic functions, properties of analytic functions, Cauchy-Riemann equations in Cartesian and polar form, construction of analytic functions by Milne-Thomson method.

Conformal mapping: $w = z^2$ and Bilinear transformations.

$w = z + \frac{a^2}{z}$ $z \neq 0$ **(7L + 3T)**

UNIT -V **10 Hours**

Complex Analysis - 2

Complex integration: Line integral, Problems on line integral, Cauchy"s theorem, Cauchy"s integral formula.

Complex series: Taylor"s, Maclaurin"s and Laurent"s series (without proof)-examples.

Zeros, Poles and Residues, Cauchy"s residue theorem (without proof)-examples. **(7L + 3T)**

Text books:

1. Advanced Engineering Mathematics, R.K. Jain, S. R. K. Iyengar, 4th edition, 2014,Narosa Publishers.

2. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2013,

Khanna Publishers.

Reference books:

1. Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition, vol.1, vol. II, 2014, Wiley-India.
3. Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc.Graw Hill.
4. Numerical methods for Scientific and Engineering Computation, M. K. Jain, S.R. K Iyengar,R. K. Jain, 5th edition, 2008, New Age International (P) Limited Publishers.

E-References

1. https://www.coursera.org/learn/basic-statistics
2. https://wiki.stat.ucla.edu/socr/index.php/Probability_and_ statistics_EBook
3. https://ocw.mit.edu/courses/mathematics/18-112-functions-of-a-complex-variable-fall- 2008/lecture-notes/
4. https://www.math.ubc.ca/~peirce/M257_316_2012_Lecture_8.pdf

e–Learning :

1. https://nptel.ac.in/courses/111105090/ (Probability & statistics-Joint distribution, testing of hypothesis)
2. https://nptel.ac.in/courses/111103070/ (Complex Analysis - Analytic functions, Mobius transformation & Residue theorem)
3. https://nptel.ac.in/courses/111107056/ (Complex Analysis -

Complex integration, conformal mapping)

Internal choice: Unit – IV & V

Course outcomes

At the end of the course on **Engineering Mathematics-4**, the student will have the ability to

CO1: Demonstrate an understanding of concepts of statistical analysis and probability distributions.

CO2: Apply Numerical techniques to solve partial differential equations arising in engineering.

CO3: Demonstrate an understanding of analytic functions and their application to evaluate integrals.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**CONTROL SYSTEMS**				
COURSE CODE	**19ES4ESCST**	**Credits**	**4**	**L-T-P**	**3:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Linear Circuit Analysis, Engineering Mathematics I & II, Advanced Mathematics preferred.

UNIT-I **10 Hours**

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

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

UNIT-II **10 Hours**

Controllers & 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 **10 Hours**

Stability Analysis:

Concept of stability, RH criterion, applications of RH criterion with limitations.

Root locus technique:

Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot

UNIT-IV **10 Hours**

Frequency Response Analysis:

Frequency domain specification, Polar plots, Nyquist plot, Stability Analysis using Nyquist criterion, Bode plots, GM and PM, Relative stability,

UNIT-V **08 Hours**

State Variable Analysis:

Concept of state variables, physical variable model, phase variable model, canonical model, obtaining transfer function from state model.

Text books:

1.Control Engineering - Nagrath & Gopal, New Age International Publishers

2.Engineering control systems – Norman S. Nise, John WILEY & sons, fifth Edition

Reference books:

1.Modern control Engineering- Ogata, Prentice Hall

2.Automatic Control Systems -B.C Kuo, John Wiley and Sons

E-References

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

e–Learning :

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

Internal choice: Unit – I & IV

Course outcomes

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

CO1: Understand the concepts related to control systems

CO2: Apply the knowledge of engineering fundamentals to obtain transfer function of a system

CO3: Analyse the behaviour of a given LTI system

CO4: Investigate the stability and/or design a given system using time/ frequency domain techniques.

CO5 : Interpret the response of a linear system using modern tools and communicate effectively.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**LINEAR INTEGRATEDCIRCUITS**				
COURSE CODE	**19ES4CCLIC**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT I 07 Hours

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

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

UNIT II 07 Hours

Comparators and waveform Generators: Introduction, comparator, Regenerative comparator (Schmitt Trigger), Square wave generator (Astable Multivibrator), Monostable Multivibrator, Triangular wave generator (RC and Weinbridge oscillators only).

UNIT III 07 Hours

Voltage Regulators: Introduction, Basics, Linear voltage regulator using Op-Amps, IC voltage regulator – 78XX, 79XX, LM317, LM723. Switch mode power supplies. Comparison between linear and switched mode power supplies.

Active Filters: Introduction, RC Active Filters, First order low pass filter, second order active filter, Higher order low pass filter, High pass active filter, All pass filter-phase shift lead and lag circuit.

UNIT IV **08 Hours**

D-A and A-Dconverters: Introduction, Analog and Digital data converter, specifications of D/A and basic DAC techniques-weighed resistor DAC, R-2R ladder DAC,A-D Converters:

Specifications of A/D converter, classification of ADCs- The parallel Comparator

(Flash)ADC, counter type ADC, Successive Approximation Converter, single slope type ADC and Dual slope type ADC, Sigma– delta ADC.

UNIT V **07 Hours**

Timers and Phase locked loops (PLLs): Functional block diagram of 555, Applications - Astable and Monostable multivibrators, Ramp generator.

PLL: Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO), PLL in frequency multiplication/Division.

Lab Experiments:

1. Inverting and non-inverting amplifier, voltage follower
2. Inverting and non-inverting summing Amplifier (Voltage/Current/Power)
3. Precision half wave and full wave rectifier
4. Zero crossing detector and Schmitt trigger
5. Weinbridge Oscillator
6. First order active low- pass filter
7. First order active high-pass filter
8. IC 723 as low voltage and high voltage regulators

9. D to A converter
10. A to D converter
11. 555 as Astable multivibrator
12. 555 as Monostable multivibrator

Text books:1.

1. Linear Integrated Circuits--S.Salivahanan&V.S.KanchanaBhaskaran (Tata McGraw - Hill Publication)
2. Linear Integrated circuits- D Roy Choudhury &Shail B Jain (New Age Publication)

Reference books:

1. **Op-amps and Linear ICs-David A.Bell (Prentice-Hall Publications) (New age** Publication)
2. Op-amps and Linear Integrated Circuits Ramakanth A.Gayakwad,4th ed, PHI

E-References1.

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

e–Learning :

1. https://swayam.gov.in/nd1_noc19_ee39/preview–Op amp practical applications: design, simulation and implementation by Dr. Hardik J. Pandya , IISc Bangalore

2. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware|Reviews and Ratings

3. http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/

Internal choice: Unit – I & IV

Course outcomes

A At the end of the course on **Linear Integrated Circuits**, the student will have the

CO1: Understand and explain concepts of linear integrated circuits

CO2: Apply the concepts of linear Integrated Circuits to obtain the desired parameter like output voltage, current, waveform

CO3: Conduct investigation of linear integrated circuits for various specification and application.

CO4: Design summer, comparators, filters for various signal conditioning requirements

CO5: Conduct experiments to demonstrate the specified concept/ application of LIC

CO6: Engage in independent learning on application of linear Integrated circuits to various problems.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**MICROCONTROLLERS**				
COURSE CODE	**19ES4CCMCS**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT-I 07 Hours

Fundamentals of Microprocessors: Block diagram approach for Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems

Overview of the 8051 family: The 8051 Architecture Internal Block Diagram, ,address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Memory architecture-Harvard and Princeton. Data and Program Memory, Timing diagrams and Execution Cycles, Pipelining.

UNIT-II 08 Hours

Instruction Set and Assembly Language Programming: Introduction, Instruction syntax, assembler directives, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, bit inherent and bit direct addressing, 8051 Instruction set - Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions, Assembly language programs.

UNIT-III **08 Hours**

Embedded C Programming: C Data Types, Timer and counter programming, Basics of Serial communication, Programming UART for serial communication, 8051 Interrupt programming

UNIT-IV **08 Hours**

Memory and I/O Interfacing: 8051 interfacing to external memory-memory address decoding, 8051 interfacing with external ROM, 8051 data memory space, accessing external data memory in 8051 C, interfacing with 8255.

UNIT-V **08 Hours**

Interfacing Applications: Interfacing 8051 to LCD, Stepper motor, DC Motor, ADC and DAC, Sensor interfacing for control applications.**Lab Experiments:**

PART A: The experiments here can be implemented on a simulator using KEIL IDE.

1. Assembly Language Programs to
   - (i) Data Transfer Operations
   - (ii) Arithmetic, Logical Operations
   - (iii) Conditional Operations
   - (iv) Bit Manipulations
   - (v) Port Functioning
   - (vi) Delay operations using Timers
2. Embedded 'C' programs for Arithmetic, Logical, Port operations on simulator

PART B: Interfacing of hardware modules to microcontrollers such as

(i) Stepper motor
(ii) Key Board
(iii) LCD
(iv) ADC, DAC
(v) Serial Communication
(vi) Temperature sensor interface for monitoring and control
(vii) Sensing of humidity and Co2 for control applications

The experiments may be implemented using KEIL IDE with embedded 'c' programming. The application examples may be modified on similar lines as mentioned in PARTB (vi) and (vii)

Text books:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.

2. R S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

Reference books:

1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.

2. R. Kamal, "Embedded System", McGraw Hill Education,2009.

3. D.A. Patterson and J.H. Hennessy,"Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.

4. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991

E- References:

1.https://onlinecourses.nptel.ac.in/noc21_ee18/preview

2.8051-Microcontroller-Applications-Based-Introduction-ebook/dp/B001073ULS

e–Learning :

1.https://onlinecourses.nptel.ac.in/noc21_ee18/preview

2.https://nptel.ac.in/courses/106/105/106105193/

Internal choice: Unit – II & III

Course outcomes

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

CO1: Apply the knowledge of digital electronic devices and memory concepts to understand the architecture of Microcontroller.

CO2: Apply logical reasoning to develop algorithm for a given task and code in assembly language.

CO3: Build embedded C codes to develop hardware coding using an integrated development environment.

CO4: Conduct experiments on hardware interfacing for ADC,DAC, Keyboard to Microcontroller using flash programming.

CO5 : Engage in Independent study by building Microcontroller based system for health, safety, environment and society.

CO6: Interface experiments using Microcontroller Programming and engage in learning.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**SIGNALS AND SYSTEMS**				
COURSE CODE	**19ES4CCSAS**	**Credits**	**4**	**L-T-P**	**3:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT-I **11 Hours**

INTRODUCTION TO SIGNALS: Definitions of a signal, elementary signals, classification of signals, and basic operations on signals. **(9L+2T)**

UNIT-II **10 Hours**

INTRODUCTION TO SYSTEMS: Definitions of a system, properties of systems, systems viewed as Interconnections of operations, Differential and difference equation representations and block diagram representations of LTI systems. **(8L+2T)**

UNIT-III **12 Hours**

IMPULSE RESPONSE REPRESENTATION OF LTI SYSTEMS: Introduction to impulse response representation, Convolution Sum and Convolution Integral, relation with system properties, Interconnection of LTI systems (properties of convolution).**(9L+3T)**

UNIT-IV **7 Hours**

APPLICATION OF FOURIER ANALYSIS: Fourier representation for Four classes of signals, properties of Fourier transform (proof excluded), frequency response of LTI systems, solution of difference and differential equations. **(5L+2T)**

UNIT-V **10 Hours**

APPLICATIONS OF Z-TRANSFORMS: Introduction to bilateral and unilateral Z-transforms, Properties (proof excluded), Analysis of LTI Systems: Transfer function and structures for implementing LTI system, Causality and stability, frequency response, and solution of difference equations**. (7L+3T)**

Text books:

1. Simon Haykin and BarryVan Veen " Signals and Systems", John Wiley & Sons, 2001, Reprint 2002.
2. Alan V Oppenheim, Alam.S, Willsky A Hamid Nawab, " Signals and Systems", Pearson Education Asia PHI, 2nd edition, 1997, Indian Reprint 2002.

Reference books:

1. H.P.Hsu, R.Ramjan, Signals and Systems", Scham's outlines,TMH, 2006
2. B.P.Lathi, " Linear Systems and Signals", Oxford University Press, 2005.
3. Ganesh Rao and Satish Tunga, " Signals and Systems",Sanguine Tech 2004.

e–Learning :

1. NPTEL lecture video on Signals and Systems by Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-andhtml

2. NPTEL lecture video on Signals and Systems by Prof TK Basu, IIT, Kharaghpur, http://www.nptel.ac.in/courses/108105065
3. NPTEL online course modules-IIT Bombay-Signals and Systems http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signalsand%20System/TOC-M1.htm

Internal choice: Unit – I & III

Course outcomes

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

CO1: Understand the basic principles of signals/system .

CO2: Apply the knowledge of mathematics to obtain desired parameters of a given signals/system.

CO3: Analyze the given system in time domain and frequency domain to arrive at a valid conclusion .

CO4: Design an impulse response of a linear time invariant system to obtain the desired response.

CO5 : Investigate using open source software to model continuous and discrete time systems.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)
OPEN ELECTIVE

COURSE TITLE	**ELECTRO MAGNETIC FIELD THEORY**				
COURSE CODE	**19EI4PCEMF**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

UNIT-I **08 Hours**

INTRODUCTION

Sources and effects of electromagnetic fields – Vector fields – Different coordinate systems- vector calculus – Gradient, Divergence, and Curl - Divergence theorem – Stoke's theorem. Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's law and application.

UNIT-II **10 Hours**

ELECTROSTATICS

Electric potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric -Dielectric polarization - Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations –Capacitance- Energy density

UNIT-III **09 Hours**

MAGNETOSTATICS

Lorentz Law of force, magnetic field intensity – Biot–savart Law - Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization – Magnetic field in multiple media – Boundary conditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density –Magnetic circuits.

UNIT-IV **06 Hours**

ELECTRODYNAMIC FIELDS

Faraday's laws, induced emf – Transformer and motional EMF – Forces - Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

UNIT-V **06 Hours**

Effects of Electromagnetic Fields

Electromagnetic Interference and Compatibility (EMI/EMC), EMI, Sources, Effects of EMI, Methods to eliminate EMI, EMC Standards,Advantages of EMC standards, Biological effects of EMI/EMR (Electromagnetic Interference,Electromagnetic radiation)

Text books:

1.Mathew N. O. SADIKU, 'Elements of Electromagnetics', Oxford University press Inc. First India edition, 2007.

2.AshutoshPramanik, 'Electromagnetism – Theory and Applications', Prentice-Hall of India , Private Limited, New Delhi, 2006.

Reference books:

1.Joseph. A.Edminister, 'Theory and Problems of Electromagnetics', Second edition, Schaum , Series, Tata McGraw Hill,1993.

2.William .H.Hayt, 'Engineering Electromagnetics', Tata McGraw Hill edition,2001.

3.Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 1999. GE 2211 ENVIRONMENTAL SCIENCE ANDENGG.

4. Clayton R Paul, ' Introduction to Electromagnetic compatibility', 2nd edition, Wiley IndiaPvt,Ltd.

E-References

1. https://easyengineering.net/elements-of-electromagnetics-sadiku/
2. https://fdocuments.in/document/engineering-electromagnetics-6th-edition-william-h-hayt-55848fad824b3.html
3. https://www.abebooks.co.uk/book-search/title/electromagnetics/author/kraus/

e–Learning :

1. https://nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/115/101/115101005/
3. https://nptel.ac.in/courses/117/103/117103065/

Internal choice: Unit – II & III

Course outcomes

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

CO1: Apply the knowledge of mathematics and engineering fundamentals in Electro- Magnetic field theory.
CO2: Analyze the concepts of Electrostatics, Magneto-statics and Electro-dynamic fields.
CO3: Identify the given conditions of static and dynamic Electro-Magnetic fields to solve engineering problems.
CO4: Carry out the impact analysis of Electro Magnetic Interference and Electro Magnetic Compatibility in the context of engineering solutions and environmental sustainability.
CO5: Demonstrate the knowledge of field theory using modern simulation tools.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS				
COURSE CODE	19IC4HSCPH	Credits	1	L-T-P	1:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT I — 03 Hours

Introduction to Indian Constitution

Historical Background of the 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 — 02 Hours

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 & Rajya Sabha. The Supreme Court of India.State Executive – The Governors, The Chief Ministers and The Council of Ministers. The State Legislature – Legislative Assembly and Legislative Council. State High Courts.

UNIT III — 02 Hours

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 **03 Hours**

Special Constitutional Provisions/ Local Administration/ Human Rights

Special Constitutional Provisions for Schedule Castes, Schedule Tribes & Other Backward Classes. Women & Children. Case Studies. Local Administration : Powers and functions of Municipalities and Panchyats System. Co – Operative Societies and Constitutional and Non-constitutional Bodies. Human Rights/values – Meaning and Definitions, Legislative Specific Themes in Human Rights and Functions/ Roles of National Human Rights Commission of India. Human Rights (Amendment Act)2006.

UNIT V **03 Hours**

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" by Merunandan K.B. and B.R. Venkatesh, Meragu Publications, 3rd edition, 2011.

2. "Constitution of India & Professional Ethics & Human Rights" by Phaneesh K. R., Sudha Publications, 10th edition, 2016.

Reference books:

1. "V.N. Shukla's Constitution of India" by Prof (Dr.) Mahendra Pal Singh (Revised), Eastern Book Company, Edition: 13th Edition, 2017, Reprint 2019.

2. "Ethics in Engineering" by Martin, W. Mike.,Schinzinger, Roland., McGraw-Hill Education; 4th edition (February 6, 2004) .

E-References

1. https://books.google.co.in/books/about/Constitution_of_India_and_Professional_E.html?id=VcvuVt-d88QC Constitution of India and Professional Ethics, by G.B. Reddy and Mohd Suhaib, I.K. International Publishing House Pvt. Ltd., 2006.

2. http://www.scribd.com/doc/82372282/Indian-Constitution-M-Raja-Ram-2009#scribd Indian Constitution, by M. Raja Ram, New Age International Pvt. Limited, 2009.

Internal choice: Unit –

Course outcomes

At the end of the course on **Constitution of India, Professional Ethics and Human Rights**, the Student will have the ability to

CO1: Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land.

CO2: Analyse the concepts and ideas of Human Rights.

CO3: Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**Samskruthika Kannada (Karnataka Students)**				
COURSE CODE	**20HS4ICSAK**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡದಲ್ಲಿ ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನಗಳ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಹಲವಾರು ವಿಷಯಗಳನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು

ಭಾಗ –1

ಕನ್ನಡ ನಾಡು, ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು (6 **Hours**)

ಅಧ್ಯಾಯ – 1 ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟ ಸುಬ್ಬಯ್ಯ

ಅಧ್ಯಾಯ – 2 ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ–ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ್ & ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)

ಅಧ್ಯಾಯ – 3 ವಚನಗಳು:

ಜೇಡರ ದಾಸಿಮಯ್ಯ (ಹರಿದ ಗೋಣಿಯಲೊಬ್ಬ)

ಅಲ್ಲಮ ಪ್ರಭು (ಕಳ್ಳಗಂಜಿ ಕಾಡ ಹೊಕ್ಕಡೆ)

ಬಸವಣ್ಣ (ಕರಿ ಘನ ಅಂಕುಶ ಕಿರಿದೆನ್ನ ಬಹುದೆ)

ಅಕ್ಕಮಹಾದೇವಿ (ಗೂಗೆ ಕಣ್ಣ ಕಾಣಲರಿಯದ ರವಿಯ ಬಯ್ಯುವುದು)

ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ (ಅಂಗಕ್ಕೆ ಬಡತನವಲ್ಲದೆ ಮನಕ್ಕೆ ಬಡತನವುಂಟೇ)

ಅಧ್ಯಾಯ – 4 ಕೀರ್ತನೆಗಳು:

ಪುರಂದರ ದಾಸರು (ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ)

ಕನಕ ದಾಸ (ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೆ)

ಅಧ್ಯಾಯ – 5 ತತ್ವ ಪದಗಳು:

ಶಿಶುನಾಳ ಷರೀಫ (ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು)

ವಿಜ್ಞಾನ & ತಂತ್ರಜ್ಞಾನ

ಅಧ್ಯಾಯ – 6 ಕನ್ನಡ ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ

ಅಧ್ಯಾಯ – 7 ತಾಂತ್ರಿಕ ಪದಕೋಶ : ತಾಂತ್ರಿಕ ಹಾಗೂ ಪರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

ಭಾಗ – 2 **(6 Hours)**

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ)

ಅಧ್ಯಾಯ – 1 ಕುರುಡು ಕಾಂಚಾಣ – ದ. ರಾ. ಬೇಂದ್ರೆ

ಅಧ್ಯಾಯ – 2 ಹೊಸ ಬಾಳಿನ ಗೀತೆ – ಕುವೆಂಪು

ಅಧ್ಯಾಯ – 3 ಹೆಂಡತಿಯ ಕಾಗದ – ಕೆ.ಎಸ್.ನರಸಿಂಹಸ್ವಾಮಿ

ಅಧ್ಯಾಯ – 4 ಮಬ್ಬಿನಿಂದ ಮಬ್ಬಿಗೆ – ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ

ಅಧ್ಯಾಯ – 5 ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು – ಸಿದ್ದಲಿಂಗಯ್ಯ

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ, ಕಥೆ & ಪ್ರವಾಸ ಕಥನ

ಅಧ್ಯಾಯ – 6 ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ–ವ್ಯಕ್ತಿ & ಐತಿಹ್ಯ – ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್

ಅಧ್ಯಾಯ – 7 ಯುಗಾದಿ – ವಸುದೇಂದ್ರ

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**Balake Kannada (Non-Karnataka Students)**				
COURSE CODE	**20HS4ICBAK**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

Course Learning Objectives:

The course will enable the non-Karnataka students to understand speak read and write Kannada language and communicate (converse) in Kannada language in their daily life with Kannada speakers.

Table of Contents:

Part-I **(6 Hours)**

Lesson – 1 ವೈಯುಕ್ತಿಕ, ಸ್ವಾಮ್ಯಸೂಚಕ / ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಥಗಳು – Personal Pronouns, Possessive Forms, Interrogative words

Lesson – 2 ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು

Qualitative, Quantitative and Colour Adjectives, Numerals

Lesson – 3 ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ. ಅದು, ಅವು, ಅಲ್ಲ) Preductive Forms, Locative Case

Lesson – 4 ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals

Lesson – 5 ನ್ಯೂನ / ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು

Defective Negative Verbs and Colour Adjectives

Lesson – 6 ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು – Permission, Commands, Encouraging and Urging words (Imperative words and sentences)

Lesson – 7 **"**ಇರು ಮತ್ತು ಇರಲ್ಲ**"** ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು

Helping Verbs "iru and iralla". Corresponding Future and Negation Verbs

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Part-II **(6 Hours)**

Lesson – 1 ಹೋಲಿಕೆ (ತರತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ Comparative, Relationship, Identification and Negation words

Lesson – 2 ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು

Different Types of forms of **Tense, Time and Verbs**

Lesson – 3 ದ್, ತ್, ತು, ಇತ್ತು, ಆಗಿ, ಅಲ್ಲ, ಗ್, ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ

Formation of Past, Future and Present Tense Sentences with Verb Forms

Lesson – 4 ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮತ್ತು ರಾಜ್ಯದ ಬಗ್ಗೆ ಕುರಿತಾದ ಇತರೆ ಮಾಹಿತಗಳು

Karnataka State and General Information about the State

Lesson – 5 ಕನ್ನಡ ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯ

Kannada Language and Literature

Lesson – 6 Kannada Language Script Part - 1

Lesson – 7 Kannada Vocabulary List : ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು – Kannada Words in Conversation

BMS COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	CULTURAL ACTIVITY				
COURSE CODE	19EI4NCCLA	Credits	-	L-T-P	-

The college provides opportunity for students to associate with a large number of Cultural activities.

Sample Affinity groups are listed below:

- Ninaad- Indian Music Team
- The Grove House- The Western Music Team
- Paramva- The Contemporary DanceTeam
- Danz Addix- The Western Dance Team
- Panache- The Fashion Team
- Pravrutti- The Theatre Team
- Photography Club
- Chirantana- Kannada Sangha
- Fine Arts Club
- Inksanity- The Literary Club
- Samskrithi Sambhrama – The Folk Dance Club
- VAK- The MCeeing Club
- Rotaract
- Bullz Racing
- TEDx BMSCE
- Quiz Club

Students regularly associated with ANY one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in cultural events organized by the department.

BMS COLLEGE OF ENGINEERING, BANGALORE-19
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COURSE TITLE	ADDITIONAL MATHEMATICS-I				
COURSE CODE	19MA3IMMAT	Credits	-	L-T-P	3-1-0

Prerequisites:

UNIT-I **09 Hours**

DIFFERENTIAL AND INTEGRAL CALCULUS

List of standard derivatives including hyperbolic functions, rules of differentiation. Taylor's and Maclaurin"s series expansion for functions of single variable. List of standard integrals, integration by parts. Definite integrals – problems. **(7L+2T)**

UNIT-II **10 Hours**

POLAR COORDINATES AND PARTIAL DERIVATIVES

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit function s. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT-III **10 Hours**

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES

Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof). Cylindrical and Spherical polar coordinate systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in orthogonal curvilinear coordinates. **(7L+3T)**

UNIT-IV **09 Hours**

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

Introduction to first order differential equations. Linear equation and its solution. Bernoulli"s equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories. **(7L+2T)**

UNIT-V **10 Hours**

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS

Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the type $f(x) = e^{ax}$, $\sin(ax)$, $\cos(ax)$, x^n, method of variation of parameters, Cauchy"s and Legendre linear differential equations. **(8L+2T)**

Text books:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers

2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.

2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

E-References

1. Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001

2. http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.

3. Advanced Engineering Mathematics, P. V. O"Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

4. http://ocw.mit.edu/courses/mathematics/(online course material)

e–Learning :

1.https://www.khanacademy.org/Math

2.https://www.class-central.com/subject/math(MOOCS)

Internal choice: Course outcomes

At the end of the course on **Additional Mathematics-I**, the student will have the

CO1: Understand the basic concepts of differentiation and integration.

CO2: Apply the concepts of polar curves and multivariate calculus.

CO3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.

CO4: Apply techniques of vector calculus to engineering problems.

CO5: Comprehend the generalization of vector calculus in curvilinear coordinate system.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	ADDITIONAL MATHEMATICS-II				
COURSE CODE	19MA4IMMAT	Credits	-	L-T-P	3-1-0

Prerequisites: Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration.

UNIT-I **09 Hours**

LAPLACE TRANSFORMS

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting, unit step function and dirac-delta function. (**7L+2T)**

UNIT-II **10 Hours**

INVERSE LAPLACE TRANSFORMS

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE- Initial Boundary value Problems. **(7L+3T)**

UNIT-III **11 Hours**

DOUBLE INTEGRALS

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area. **(8L+3T)**

UNIT-IV **09 Hours**

TRIPLE INTEGRALS AND IMPROPER INTEGRALS

Evaluation of triple integral. Application: Volume. Beta and Gamma functions-definition, relation between Beta and Gamma functions, properties and problems. (**7L+2T)**

UNIT-V **10 Hours**

VECTOR INTEGRATION

Line integral, Green"s theorem, Stokes" theorem and Gauss divergence theorem. **(7L+2T)**

Text books:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers

2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.

2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

E-References

1. Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001

2. http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.

3. Advanced Engineering Mathematics, P. V. O"Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

4. http://ocw.mit.edu/courses/mathematics/ (online course material)

e–Learning :

1. https://www.khanacademy.org/Math
2. https://www.www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in

Internal choice: Course outcomes

At the end of the course on **Additional Mathematics-II**, the student will have the

CO1: Use Laplace transforms to solve differential equations.

CO2: Apply multiple integrals of plane figures to compute areas and volume.

CO3: Use Gamma and Beta functions to evaluate integrals.

CO4: Ability to understand the use of integral calculus in scalar and vector fields.

V Semester

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	TRANSDUCERS AND INSTRUMENTATION				
COURSE CODE	19EI5PCTNI	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Sensors and Measurements					

UNIT-I 8 Hours

Introduction to Sensor based Measurement System

General concepts and terminologies, Measurements of moisture, viscosity, speed and vibration. Materials for sensors. Applications of Sensors (Sensors for Aerospace, Automobile, home and office automation, medical diagnostic sensors. Healthcare Sensors, manufacturing & environmental monitoring).

UNIT-II 8 Hours

Flow Measurement

Purpose of measuring Flow, Newtonian and non-Newtonian Fluids, Reynolds's number, Laminar and turbulent flows, Velocity profile, Bernoulli's equation for incompressible flow. Variable head type flow meters – Orifice plate, Venturi tube, Flow nozzle, Pitot tube. Variable area type: Rotameter, Other Flow meters: Turbine, Electromagnetic, Ultrasonic (Doppler, Transit time i.e. Cross correlation, Anemometers).

UNIT-III 8 Hours

Temperature Measurement

Temperature Scales: Units and relations, Classification of temperature Sensors, Mechanical: Bimetallic Thermometer. Resistance type temperature sensors, Resistance Temperature Detectors - Types and comparison, Circuits for lead wire compensation, thermistors (principle,

types & characteristics and Measuring Circuits). Thermocouple: Terminology, Types (J, K, R, S, T), Characteristics, Laws of thermoelectricity, Study of thermocouple tables, Cold junction compensation techniques, Protection (Thermo well), Thermopiles. Applications.

UNIT-IV **8 Hours**

Pressure Measurement

Units of pressure –pressure transducers and its working, Manometers, Different types – Elastic type pressure gauges – Bourdon type- Bellows, capsules, diaphragms, Measurement of vacuum – McLeod gauge. Performance and installation criteria of pressure transmitter, Comparison of different types of pressure transmitters, Smart pressure transmitters and their calibration, Dead weight tester.

UNIT-V **7 Hours**

Measurement of Force and Torque

Principle of Measurement of force. Load cell, Column type devices, proving rings, cantilever beam, shear type load cell. Hydraulic load cell, electronic weighing system.

LAB EXPERIMENTS

1. Data Acquisition System
   a) Optical Fiber Sensors
   b) Thermal Sensor
   c) Electrochemical Gas Sensors
   d) Data acquisition using Bio sensors and amplification
   e) Pressure measurement (Bellows, Bourdon Gauge, Diaphragm)

f) Design of Orifice and Venturi for Flow Measurement.
g) Vibration Sensors.
h) Speed Measurement using magnetic pick up for motor speed sensor.

2. IOT and Sensors –Virtual lab
   a) Simulate the performance of Biosensor& to simulate Biopotential Amplifier
   b) Flow Through Pipes
   c) Flow measurement by orificemeter and venturimeter
      * To find the coefficient of discharge for venturi meter.
      * To find the coefficient of discharge for orifice meter.
   d) Simulate the performance of chemical sensor(PH)

Text books:

1. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
2. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
3. Jacob Fraden, Handbook of Modern sensors, physics design and applications, Springer , Fourth edition.
4. Instrument transducers, H.K.P. Neubert, Oxford University press.
5. Ernest O. Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.

Reference books:

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.

2. K Padma raju, Y J Reddy, Instrumentation and control systems, Tata McGraw Hill Publishing Ltd .
3. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation–Dhanpat Rai and Sons, New Delhi, 1999.
3. P.Holman, Experimental Methods for Engineers International Student Edition, McGraw Hill Book Company, 1971. 4. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.
4. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi, 1995
5. Neubert H.K.P, "Instrument Transducers - An Introduction to their Performance and Design", 2nd Edition, Oxford University Press, Cambridge, 1999.
6. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.

E- References:

1. https://physicsinstrumentation.files.wordpress.com/2015/03/measurement_systems_application_design.pdf
2. https://global.oup.com/academic/product/electronic-instrumentation-and-measurements-9780968370520?q=Electronic%20Instrumentation%20and%20Measurements&lang=en&cc=in

e-Learning:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/
3. https://www.youtube.com/watch?v=q8UuRkOQ9A0

4. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Bombay/Electrical%20and%20Electronic%20Measurements.htm
5. http://onlinevideolecture.com/?course_id=385&lecture_no=32
6. http://nptel.ac.in/courses/112103174/pdf/mod2.pdf

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of transducer /sensors.

CO2: Apply fundamentals of fluid flow and their applications to flow through pipes and hydraulic machines.

CO3: Analyze various techniques used for measuring parameters of temperature measurement in Industries.

CO4: Conduct investigation to provide solutions to industrial processes & process in pressure measurement.

CO5 : Interpret the different types of force & level measurements adopted in industries.

CO6: Involve independently and as a team to demonstrate concept of sensing and transducers Systems.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PROCESS CONTROL SYSTEMS				
COURSE CODE	19EI5PCPCS	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Linear Integrated Circuits					

UNIT-I 8 Hours

Introduction to Process Control:
Introduction, Types of processes, Process Control- principles, block diagram, Control systems evaluation, sensor time response, analog and digital processing, problems.

Final Control: Objectives, Elements of final control operation, Electric actuators, pneumatic actuators, hydraulic actuators, control elements, mechanical control element, electrical control element, fluid valves, principles, control valve types, control valve sizing, and Basic Instrumentation P&ID diagrams.

UNIT-II 8 Hours

Analog Signal Conditioning: Principles, Signal level and bias changes, Linearization, Filtering and impedance matching concept of loading. Op-Amps in Instrumentation, Design Guide lines.

Controller Principles: Process characteristics, control system parameters, discontinuous controller modes, continuous controller modes, composite controller modes.

UNIT-III 8 Hours

Analog Controllers: General features, Electronic controllers, Error detector, Single mode, composite controller modes, Pneumatic controllers, Design considerations.

Digital Controllers: Digital electronic methods, Simple alarms Two position control, Multivariable alarms, Data loggers, Direct digital and Supervisory control.

UNIT-IV **8 Hours**

Control-Loop Characteristics

Control system quality, Process loop tuning, Open - loop transient response method, Ziegler -Nichols method.

Paradigm of Process Control: Cascade control systems, Selective control systems, Split- range control systems.

UNIT-V **7 Hours**

Introduction to Process Safety:

Introduction to process control safety systems. Need for power to energize in a safety process inputs. Concept of high availability Vs high reliability systems. The different between control system vs emergency shutdown system. Classification of safety hazard. Dual redundant and triple redundant shut down systems, their architecture and working principle.

LAB EXPERIMENTS:

Simulation and experimentation of Analog signal conditioning circuits, linearization, calibration concepts. Design and implementation of discrete, continuous and composite controllers using discrete analog components. Design and implementation of Digital controllers using discrete components. Determination of characteristics of different types of valves and experiments on it. Tuning of controllers by different methods.

Case Study: Process Flow diagrams, Process Safety in various plants.

Text books:

1. Process Control Instrumentation Technology by C.D .Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002.
2. Chemical Process Control – George Stephanopoulos, 4th Indian reprint, PHI Ltd., 1997.

References:

1. Process/ Industrial Instruments and Control Handbook, D.M. Considine, McGraw Hill International, 4th Edition, 1993.
2. Computer Based Industrial Control by Krishna Kant, PHI, New Delhi 1997.
3. Process dynamics and control by S.S.Bhagade and G.D.Nageshwar PHI publications New Delhi, 2011.
4. Lessons in Industrial Instrumentation by Tony R. Kuphaldt, Creative Commons Attribution License (open source textbook), Sept. 2008

E-References

1. https://www.amazon.in/Process-Control-Instrumentation-Technology-Johnson/dp/0131194577
2. https://www.amazon.in/Chemical-Process-Control-Introduction-Practice/dp/8120306651

e-Learning:

1. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv689-Page1.html
2. http://nptel.ac.in/courses/103105064/

Internal choice: Unit – II & III

Course outcomes: The course outcomes will be attained through theory and laboratory assessments.

At the end of the course, the student will have the

CO1: Understand the basic principles, blocks in the design of process control systems

CO2: Apply the knowledge of Process Instrumentation Diagrams devise simple but effective plant wide control strategies using appropriate heuristics.

CO3: Analyse and Select proper controller for feedback control of process

CO4: Design, interpret and implement tuning of the controllers.

CO5 : Investigate and find a solution to a complex problem.

CO6: Engage in independent study and communicate effectively.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**DIGITAL SIGNAL PROCESSING**				
COURSE CODE	**19ES5CCDSP**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Signals and systems					

UNIT-I 8 Hours

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 8 Hours

Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap add and save methods. Relation between DFT and other transforms. Direct computation of DFT. Necessity for efficient computation of DFT. Radix 2 Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation in time algorithm, decimation in frequency algorithms. Radix 2 FFT algorithm for computation of Inverse Discrete Fourier Transform. (IDFT).

UNIT-III 8 Hours

Introduction to realization of digital systems, block diagrams representation, Realization of Infinite Impulse Response (IIR) systems: parallel form, cascade form. 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.

UNIT-IV **8 Hours**

Realization of Finite Impulse Response (FIR) systems: Direct Form, Linear Phase Form. 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.

UNIT-V **7 Hours**

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:

Generation of elementary signals, Study of sampling theorem, Study of properties of Linear time-invariant systems, Linear and Circular Convolution, Correlation , Study of Discrete Fourier Transform (DFT)and its inverse. Study of Transform domain properties and its use, Study of Infinite Impulse Response (IIR) filter, Study of FIR filter design using window method: Low-pass and high-pass filter, Study of Adaptive filter using LMS Algorithm. Interpolation and Decimation.

Text books:

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.

References:

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. Schafer, 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-References:

1. https://www.pearson.com/us/higher-education/program/Proakis-Digital-Signal-Processing-4th-Edition/PGM258227.html
2. https://global.oup.com/academic/product/digital-signal-processing-9780198081937?cc=nz&lang=en

e-Learning:

- https://nptel.ac.in/courses/117/102/117102060/
- https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/

Internal choice: Unit – I & III.

Course outcomes:

The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Understand signal properties, sampling theorem and represent Analog signals in Digital form

CO2: Apply the analytical tools such as Discrete Fourier Transform and Fast Fourier Transform to obtain frequency domain representation of digital signals

CO3: Analyse and obtain the Power Spectral Density of digital signals to arrive at specifications for digital filters

CO4. Design IIR and FIR filters for linear filtering and use simulation tools to demonstrate convolution in frequency domain

CO5 : Use modern tools to Design and write software modules for digital filters and digital signal processing techniques/operations

CO6: Investigate and conduct experiments to appreciate requirement of multi rate digital signal processing and adaptive filtering in digital signal processing applications.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**COMMUNICATION SYSTEMS**				
COURSE CODE	**19EI5PCCST**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Advanced Engineering Mathematics, Signals and Systems					

UNIT-I 8 Hours

Amplitude Modulation:

Time-Domain Description, Frequency domain description, Generation of AM waves, Hilbert Transform, Detection of AM waves, AM/DSB, Time-Domain Description, Frequency domain description Generation of DSBSC waves, Coherent Detection of DSBSC Modulated waves. Costas loop, Quadrature Carrier multiplexing, Comparison of amplitude modulation techniques, frequency translation, FDM.

UNIT-II 8 Hours

Angle Modulation:

Basic Concepts, Frequency Modulation, Spectrum Analysis of sinusoidal FM wave, NBFM, WBFM, Constant Average power, Transmission bandwidth of FM waves, Generation of FM waves, Direct FM, demodulation of FM waves, frequency discriminator, ZCD, phase locked loop (1st order) comparison of AM and FM.

UNIT-III 7 Hours

Noise In Analog Modulation Systems:

Signal-to-noise ratios, AM receiver model, DSBSC receiver, noise in AM receivers using envelope detection, threshold effect, FM receiver model, noise in FM reception, FM threshold effect, pre-emphasis and de-emphasis in FM systems

UNIT-IV **8 Hours**

Pulse Modulation: Sampling theorem for low-pass and band-pass signal, statement and proof, PAM, Channel Bandwidth for a PAM signal, natural sampling, flat-top sampling, signal recovery through holding, quantization of signals, quantization error, PCM, electrical representations of binary digits, PCM systems, DPCM, delta Modulation, Adaptive delta modulation.

UNIT-V **8 Hours**

Digital Modulation:

Introduction, Binary Shift Keying, DPSK, QPSK, QPSK transmitter, QPSK receiver, signal-space representation, BFSK, spectrum, receiver for BFSK, line codes, TDM. Application of analog/digital communication in Instrumentation and Automation. Introduction to concept of FDMA,TDMA,CDMA

Simulation Experiments:

1. AM modulator and Demodulator.
2. DSB-SC modulator and Demodulator.
3. FM modulator and Demodulator.
4. PAM modulator and Demodulator.
5. TDM Multiplexer and Demultiplexer.
6. AM Modulation using Matlab
7. FM Modulation using Matlab.

Text books:

1. "Analog and Digital communication ",Simon Haykin, John Willey.
2. "Principles of communication systems",Taub and Schilling, Tata McGrawHill.

Reference books:

1. "Electronic Communication Systems", 2nd Edition,Blake, Thomson publishers.
2. "Electronic Communication Systems",George Kennedy.
3. "Process Control: Instrument Engineers' Handbook ", Béla G. Lipták
4. "Communication Systems" 2nd Edition, R. P. Singh, S. D. Sapre, Tata McGraw-Hill Education

E-References

1. https://www.wiley.com/enus/An+Introduction+to+Analog+and+Digital+Communications%2C+2nd+Edition-p-9780471432227
2. https://archive.org/details/PrinciplesOfCommunicationSystemsByTaubAndSchilling/page/n15/mode/2up

e–Learning :

1. http://nptel.ac.in/courses/117102059/
2. http://nptel.ac.in/courses/117101051/

Internal choice: Unit – I & V

Course outcomes

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

CO1: Understand the concept of analog and digital communication system.

CO2: Apply the concept of modulation and demodulation in AM & FM system.

CO3: Analyse the various parameters in analog and digital communication system.

CO4: Design the different digital modulation and demodulation systems.

CO5: Simulate the modulator and demodulator for the given analog /digital communication system using modern tools.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**DIGITAL SYSTEM DESIGN USING FPGA**				
COURSE CODE	**19EI5PE1DS**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Digital Electronics					

UNIT-I 9 Hours

Introduction: VHDL description of combinational networks, Modelling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modelling a sequential machine, Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL model for a counter.

Additional Topics in VHDL: Attributes, Transport and Inertial delays, Operator overloading, Multi-valued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and Text IO.

UNIT-II 8 Hours

Designing With Programmable Logic Devices: Read-only memories, Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner.

UNIT-III 7 Hours

Designing With Programmable Gate Arrays And Complex Programmable Logic Devices: Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10Kseries CPLDs.

UNIT-IV **8 Hours**

Design of Networks For Arithmetic Operations: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider.

UNIT-V **7 Hours**

Digital Design with SM Charts: State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines

Internal choice: Unit -I & IV

Text books:

1. Charles H. Roth. Jr:, Digital Systems Design using VHDL, Thomson Learning, Inc, 9th reprint, 2006**.**

2. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic Design with VHDL,Tata McGraw-Hill, New Delhi, 2nd Ed., 2007.

References:

1. Mark Zwolinski, Digital System Design with VHDL, 2 Ed, Pearson Education., 2004

2. Volnei A Pedroni, Digital electronics and Design with VHDL. Elsevier

E- References:

1. http://ebook.pldworld.com/_eBook/FPGA%EF%BC%8FHDL/-Eng-/Digital%20Systems%20Design%20Using%20VHDL%20(Charles%20Roth).pdf
2. https://www.bookdepository.com/Fundamentals-Digital-Logic-with-VHDL-Design-with-CD-ROM-Stephen-Brown/ 9780072499384?ref=grid-view&qid=1597044192627&sr=1-16

e-Learning:

1. https://nptel.ac.in/courses/117/105/117105080/
2. https://nptel.ac.in/courses/117/108/117108040/

Course outcomes

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

CO1: Use of advanced programming concepts of VHDL and develop VHDL code to model and simulate basic combinational networks and sequential machines.

CO2: Design combinational networks and sequential machines for PLA, PAL, FPGAs and CPLD variants using SM chart based representation.

CO3: Design of functional blocks for arithmetic operations (adders, multipliers and dividers) using the knowledge of combinational networks and sequential machines.

CO4: Develop VHDL models for functional representation of memory element, memory interfaces, communication bus and floating point operations.

CO5: Use of advanced programming concepts of VHDL and develop VHDL code to model and simulate basic combinational networks and sequential machines.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	C++ AND DATA STRUCTURES				
COURSE CODE	19EI5PE1CD	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Basic C Programming					

UNIT-I 7 Hours

Principles of Object Oriented Programming - Basic Concepts of OOPS, OOP Languages, Pre-processors directives and header files, structure of C++ program, compiling and linking, Tokens, keywords, identifiers and constants, datatypes, symbolic constants, variables, Storage Classes, operators, manipulators, control and statement loops.

Functions in C++: Introduction, Main function, function prototype, call by reference, return by reference, inline functions.

UNIT-II 8 Hours

Classes and objects: Specifying a class, member functions, arrays within a class, static data members and member functions, arrays of objects, functions returning objects.

Constructors and Destructors: Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors and destructors.

Operator overloading and type conversions: Overloading unary and binary operators, overloading using friends, rules of overloading, function overloading, friend functions.

UNIT-III 8 Hours

Inheritance - Introduction, defining derived classes, Types of inheritance: Single, multilevel, multiple, hierarchical, hybrid.

Pointers, Virtual and Polymorphism: Pointers, pointers to objects, this pointer, pointers to derived classes, virtual functions.

Templates : Class templates, Function templates.

Exception handling: Basics, Throwing and catching mechanisms, rethrowing an exception.

UNIT-IV **8 Hours**

Managing console I/O operations: C++ streams, C++ stream classes, unformatted and formatted I/O operations.

File operations: Introduction, classes for file stream operations, Opening and closing a file using constructors, detecting end-of-file.

Data structures

Data Representation, Introduction, Linear lists, Formula-based representation, linked representation, Indirect addressing, Arrays.

UNIT-V **8 Hours**

Stacks: The abstract data types, Derived classes, Formula-based representation, Linked representation, Applications.

Queues: The abstract data types, Derived classes, Formula based representation, Linked representation, Applications

Trees, Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, Binary Search Trees.

Text books:

1. "Object Oriented Programming with C++", E Balagurusamy ,TMH Publications, 4th edn

2. Data structures, Algorithms, and applications in C++, Sartaj Sahni, McGraw Hill.2000.

References:

1. "Programming: Principles and Practice Using C++", Bjarne Stroustrup, 2014

2. "Borland C++ Builder: The Complete Reference", Herbert Schildt, Gregory L. Guntle, (Osborne/McGraw-Hill Publications, 2001)

3. "Let Us C++", Yashavanth P. Kanetkar, BPB Publications

4. "Object oriented Programming with turbo C++", Robert Lafore, GALGOTIA Publications, 2007.

5. "Data Structures using C++", D.S. Malik, Thomson 2003.

E-References:

1. https://www.mheducation.co.in/object-oriented-programming -using-c-and-java-9781259006494-india

2. https://books.google.co.in/books/about/Data_Structures_ Algorithms_and_Applicati.html?id=dqg3twAACAAJ&redir_esc=y

e-Learning:

1. https://swayam.gov.in/nd1_noc20_cs07/preview
2. https://www.programiz.com/cpp-programming
3. https://nptel.ac.in/courses/106/106/106106133/

Internal choice: Unit – IV & V

Course outcomes: The course outcomes will be attained through theory and laboratory assessments.

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

CO 1: Apply the fundamental concepts and benefits of OOPS to develop programming skills.

CO 2: Develop programs using OOP concepts to provide solutions to an engineering problem.

CO 3: Understand and explain the benefits of operator overloading, inheritance, pointers and templates in the development of a program.

CO 4: Understand and discuss storing, retrieving data from files, file and exception handling.

CO 5: Identify and apply C++ programming concepts to realize various data structures for a given application.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PYTHON PROGRAMMING & APPLICATIONS				
COURSE CODE	19EI5PE1PY	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Basic Computer programming					

UNIT-I 8 Hours

Programming Fundamentals:

Computer hardware architecture, building blocks of programs, variables, expressions and statements.

UNIT-II 8 Hours

Flow Control and Functions:

Boolean expressions, logical operators, conditional execution, alternative executions, chained conditionals, nested conditional and exceptions.

Function calls, build in functions, type conversion function, Math functions, random numbers, parameter and arguments, fruitful and void function.

Updating variables, while statement, infinite loops, finishing iteration with continue, definite loops using for, loop patterns.

UNIT-III 8 Hours

Strings and Files:

String length, string slices, looping and counting, in operator, string comparison and methods, parsing string, format operators.

Persistence, Opening files, text files and lines, file name, try-except-open, writing files.

UNIT-IV **8 Hours**

List, Dictionaries and Tuples

Traversing the list, list operation, list slices, list methods, function and string in list, objects and values, aliasing, list arguments.

Dictionary as set of counters, dictionaries and files, dictionaries and loop, text parsing

Tuple assignment and comparing, dictionaries with tuple, multiple assignment, sequences.

UNIT-V **8 Hours**

Object Oriented Programming

Classes and objects, Classes and functions, Classes and methods

Text books:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Create Space Independent Publishing Platform, 2016.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, GreenTeaPress, 2015.

References:

1. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition,Wiley India Pvt Ltd. ISBN-13: 978-8126556014
2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705
3. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition)
4. Eric Matthes, Head-First Python: A Brain-Friendly Guide (2nd Edition)

E- References:

1. http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.
2. http://greenteapress.com/thinkpython2/thinkpython2.pdf

e-Learning:

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://nptel.ac.in/courses/106/106/106106145/

Internal choice: Unit – II & IV.

Course outcomes: The course outcomes will be attained through theory and assessments.

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

CO1: Apply the knowledge of python programming syntax and semantics

CO2: Analyse the python flow control and functions

CO3: Develop python programs by handling files and strings

CO4: Engage in independent study of python programs using core data structure like list, dictionaries and tuples

CO5: Communicate effectively and demonstrate basic concepts of object oriented programming in python

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**POWER ELECTRONICS**				
COURSE CODE	**19EI5PE2PE**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Analog Electronics Circuits					

UNIT-I 8 Hours

Introduction: Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches.

Power Diodes: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Diode Switched RL Load, Freewheeling Diodes with Switched RL Load.

Diode Rectifiers: Introduction, Single-Phase Full-Wave Rectifiers, Single-Phase Full-Wave Rectifier with RL Load, Single-Phase Full-Wave Rectifier with a Highly Inductive Load.

UNIT-II 8 Hours

Power Transistors: Introduction, Power MOSFETs– Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers.

UNIT-III 8 Hours

Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of

Thyristor, Thyristor Turn-On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection, DIACs, Thyristor Firing Circuits, Unijunction Transistor

UNIT-IV **8 Hours**

Controlled Rectifiers: Introduction, Single-Phase Full Converters, Single-Phase Dual Converters.

AC Voltage Controllers: Introduction, Single-Phase Full-Wave Controllers with Resistive Loads, Single-Phase Full-Wave Controllers with Inductive Loads.

UNIT-V **7 Hours**

DC-DC Converters: Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.

DC-AC converters: Introduction, principle of operation single phase bridge inverters, three phase bridge inverters, voltage control of single phase inverters, Harmonic reductions, Current source inverters.

Text books:

1. "Power Electronics – Circuits, Devices and Applications", Muhammad H Rashid, Third Edition, Prentice – Hall India

2. "Power Electronics", M.D.Singh, K B Khanchandani, Second edition, TMH

References:

1. "Power Electronics – Converters, Applications and Design", Ned Mohan, Tore M. Undeland and William P Robbins, 3rd Edition, John Wiley & sons

2. "Power Electronics – Principles and Applications", Joseph Vithayathil, TATA McGraw-hill Edition.

E-References

1. https://www.pearson.com/us/higher-education/product/Rashid-Power-Electronics-Circuits-Devices-and-Applications-3rd-Edition/9780131011403.html

2. https://books.google.co.in/books/about/Power_Electronics.html?id=7BdrnQAACAAJ&redir_esc=y

e-Learning:

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

2. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/

- **Internal choice: Unit II & IV**

Course outcomes: The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Identify the need for efficient conversion and control of electrical energy to match the load requirements

CO2: Comprehend the characteristics of practically available Power Electronics devices.

CO3: Analyze different types of converters such as AC to DC, DC to AC, DC to DC and comprehend their steady state behaviour.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	ANALYTICAL INSTRUMENTATION				
COURSE CODE	19EI5PE2AL	Credits	4	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Basic electronics, laser and optical instrumentation					

UNIT-I 8 Hours

Introduction:

Types of instrumental methods for analysis, electromagnetic spectrum, properties of electromagnetic radiation and its interaction with matter, emission of radiation.

Molecular Spectroscopy: Measurement of transmittance and absorbance, Beer Lambert's law, instrumentation, single and double beam spectrometers, application of UV- Visible spectroscopy for qualitative and quantitative analysis. Colorimeters, IR absorption spectrometry, IR instruments- dispersive and non dispersive, application for quantitative analysis.

UNIT-II 8 Hours

Atomic Absorption and Emission Spectroscopy:

Principles, sample atomization techniques, atomic absorption instrumentation, interferences

In atomic spectroscopy, standard addition and internal standard methods of evaluation.

Principles, arc, spark and plasma sources, emission based on plasma sources, emission Spectroscopy based on arc and spark sources

UNIT-III **8 Hours**

Analysis using Electrical Properties and X-Ray Spectroscopy

Electrical Conductivity analyze- Introduction and applications, Methods of measurement of conductance :- null method,- direct reading method, Conductivity cell - Temperature compensation in conductivity measurement, Principle of pH measurement, electrode for pH measurement, Electronics circuit for pH measurement, Calibration.

X-ray spectroscopy - Fundamentals, instrumentation, X-ray absorption methods, X-ray fluorescence methods, X-ray diffraction and its applications

UNIT-IV **8 Hours**

Chromatography:

Classification of chromatographic Methods, Gas Chromatographs, Function Components of a Gas Chromatograph , Sample Handling System, Gas Chromatographic Columns, Liquid Phases and Column Selection, chromatogram-response factor, Detectors for Gas chromatography.

Liquid chromatography, basic concepts, types of liquid chromatography, HPLC, Principle and Instrumentation.

UNIT-V **7 Hours**

Mass Spectroscopy

Features of mass spectroscopy, Basic mass spectrometer, types of mass spectrometer,

Components of mass spectrometer, ion sources, sample inlet systems, mass analyzers – single beam, double beam and quadruple instruments, applications.

Text books:

1. "Principles of Instrumental Analysis-6th Edition", Douglas A. Skoog, James Holler, Stanley R. Crounch. Thomson Learning
2. "Instrumental Methods of Analysis", Willard H.W Merritt, L.L Dean J A Settie FA, 7th Edition, CBS Publishers

Reference books:

1. Khandpur. R.S, "Handbook of Analytical Instruments", Tata McGraw Hill Publishing Co. Ltd., 2003.
2. "Fundamentals of Analytical Chemistry" ,Douglas A Skoog, Donald M West Holler Thomson Learning
3. "Instrumental Methods of Chemical Analysis", Galen W. Ewing, McGrawHill
4. "Instrumental methods of analysis by H.H Willard, L.L. Meritt & A. Dean, CBS Publications 7th Edn., 1988
5. Principles of Instrumental analysis by S.J. Holler & T. A. Nilman Saunders college publications, 5th Edn, 1998.

E- References:

1. https://www.cengage.co.in/category/higher-education/science-mathematics/chemistry/instrumentation/principles-of-instrumental-analysis-4j
2. https://www.eduport-global.com/product/instrumental-methods-analysis

e-Learning:

1. https://nptel.ac.in/courses/103/108/103108100/
2. https://nptel.ac.in/courses/103/108/103108124/

Internal choice: Unit – I & III

Course outcomes

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

CO1: Acquire knowledge about the interaction of electromagnetic radiations with matter and apply analytical techniques to accurately determine the elements present in the given sample and various phenomenon related to it.

CO2: Apply and analyze the basic engineering principles in understanding the basic instrumentation principle behind various spectroscopic methods.

CO3: Identify and comprehend the working of various transducers in various spectroscopic methods.

CO4: Ability to engage in effective written and Oral communication through the report/poster by taking a case study/literature paper review/ICT videos of analytical instrument in the Industrial/environmental applications.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**AIRCRAFT INSTRUMENTATION**				
COURSE CODE	**19EI5PE2AR**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Measurements and Instrumentation, Sensors and Transducers, Control Systems					

UNIT-I 7 hours

Introduction: Basics of Aircraft, Aircraft Instrumentation, Instrument displays, qualitative and quantitative display, Electronic display, instruments grouping, cockpit layout, modern computerized glass-cockpit layout, navigation and pilot assistance system.

Integrated Display Systems: Head up display, attitude heading reference system

UNIT-II 8 hours

Introduction and working principle of Air data Instruments:

Standard atmosphere, basic air data system, pitot static probe, heating circuit arrangement, air speed indicator, square law characteristics, Mach/airspeed indicator.

Vertical Airspeed Indicators:

Vertical Airspeed indicator, Instantaneous vertical speed indicator, air temperature indicator, air data alerting system, Mach warning system, altitude alert system.

UNIT-III 8 hours

Introduction and working Principle of Gyroscopic Flight instruments: The Gyroscope and its properties, determining direction of

precession, limitations of gyroscopes, operating gyroscopic flight instruments, gyro horizon, Erection systems for gyro horizons, errors due to acceleration and turning, Direction Indicator, Turn and bank indicator.

UNIT-IV **8 hours**

Introduction and working Principle of Engine Instruments:

Pressure measurement, Indicating systems, Pressure switches, Temperature measurement, Indicating systems: variable resistance systems, sensor units, Wheatstone bridge systems.

Fuel quantity and Indicating systems:

Quantity indicative system, capacitance type system, basic indicating system, effects of fuel temperature changes, Measurement of fuel quantity by weight: compensated indicating systems, Densitometers, Construction of probes, location and connection of tank probes.

UNIT-V **8 hours**

Introduction and working principle of Engine Power and control instruments:

RPM Measurement, Generator and indicating system, Tacho probe and in dicator system, torque monitoring, Exhaust gas temperature (EGT) indicator,Engine pressure ratio measurement (EPR), fuel flow measurement, Integrated flow meter system.

Text books:

1.Aircraft instrumentation and Integrated systems, EHJ Pallet, Longman Scientific and Technical, 1992.

2.Aircraft instrumentation, 2nd edition EHJ Pallet, Longman Scientific and Technical, 1992.

References:

1.Aircraft Instrumentation and systems ,S. Nagbhushana and L.K Sudha, L.K International Publishing House Pvt.Ltd. 2010.
2.Aircraft Instrumentation C A Willams, Golgatia Publishions, New Delhi

E- **References:**

1. https://www.pearson.ch/HigherEducation/Pearson/EAN/9780582086272/Aircraft-Instruments-and-Integrated-Systems

e-Learning:

1. https://www.freeengineeringbooks.com/AeroSpace/Aircraft-Design-Books.php
2. https://www.abebooks.com/servlet/BookDetailsPL?bi=965050996&searchurl=tn%3Daircraft%2Binstruments%26sortby%3D17

Internal choice: Unit II & IV

Course outcomes

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

CO1: Define, Understand qualitative and quantitative display as per the basic T grouping and by giving importance to the aesthetics view of the front panel of an aircraft.

CO2: Apply the knowledge of aircraft instrumentation concepts and analyze the complexity and high functionality of air data instruments.

CO3: Analyze and Design a match warning system, Altitude alerts systems, Airspeed warning systems.

CO4: Describe and understand the operation of flight instruments incorporating gyroscopes, basic flight indicators, sensors and its operating principles and types of displays.

COURSE TITLE	PRODUCT DESIGN TECHNOLOGY				
COURSE CODE	19EI5PE2PT	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Linear Integrated Circuits, Analog Electronics, Digital Electronics					

UNIT-I 8 Hours

Introduction to PCB Design, CAD and design Flow: Computer aided design and ORCAD design suite, PCB board Fabrication, PCB cores and layer stack up, PCB Fabrication process, Photolithography and chemical etching, Mechanical milling , layer registration, design files created by layout, overview of design flow, Creating a circuit design with capture, designing the PCB layout, design rule check

UNIT-II 8 Hours

Project structures, Layout Environment and introduction to industry standards:

Project setup and schematic entry details, understanding the layout environment and toolset,

Introduction to the standards organization, EIA, ANSI, IEEE, classes and types of PCB, standard fabrication allowances, PCB dimensions and tolerances, standard finished PCB thickness , copper tracing, etching and solder mask tolerances, standard hole dimensions

UNIT-III 8 Hours

Design for manufacturing and signal integrity:

Introduction to PCB assembly and soldering Process, Assembly process,

soldering process, component placement and spacing for through hole devices, noise , distortion, Frequency response, issues related to PCB layout, EMI and Crosstalk, loop inductance, Electric fields and capacitive coupling, Ground planes and bounce, PCB electrical characteristics, Trace width and spacing considerations.

UNIT-IV **7 Hours**

Making And Editing capture parts, Layout footprints

Capture part libraries, types of Packaging, part editing tools, constructing parts using tools menu, generate parts with the PSpice model editor, Layout footprints library, naming conventions, composition of footprints, footprint design process, working with pad stacks,
Footprint design examples.

UNIT-V **8 Hours**

PCB Design Examples.

Overview of the design flow, dual power supply, analog design, mixed analog/digital design using split power and ground planes, Multi page, Multipower and Multi ground mixed A/D, The circuit design with ORCAD, Fabricating the boardSimulation of design examples using PCB bundle-ORCAD PCB bundle suite

Text books:

1. "Complete PCB design using ORCAD capture and Layout" , Kraig Mitzner, Newnes-imprint of Elsevier

2. "Printed circuit Board; Design and Technology" Walter C Bosshart, TATA McGraw- Hill

Reference books:

1."Printed Circuit board: Design, fabrication, Testing and Assembly", DR R S Khandpur, TATA McGraw- Hill.

2."Printed Circuit Board Designer's Reference Basics", Christopher T Robertson, Prentice Hall, Modern Semiconductor Design series

3."Printed Circuit Board Design Using AutoCAD",Chris Schroeder ,newnes

4."Signal Integrity Issues and Printed Circuit Board Design", Douglas Brooks, prentice hall

E-References

1. https://www.amazon.com/Complete-Design-Using-Capture-Layout/dp/0750682140
2. https://books.google.co.in/books?id=6OwRb7N3j14C&printsec=frontcover&dq=pcb+design+books&hl=en&sa=X&ved=2ahUKEwicq-zkj_LqAhUFlEsFHR29 Bm4Q6AEwAHoECAEQAg#v=onepage&q=pcb%20design%20books&f=false

e-Learning:

1. https://nptel.ac.in/courses/108/108/108108031/
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-682-prototyping-avionics-spring-2006/syllabus/

Internal choice: Unit – II & III

Course outcomes

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

CO1: Understand and explain the concept of PCB design, CAD, Design flow, Layout, Manufacturing, Signal Integrity

CO2: Apply the knowledge of basic systems to articulate the building blocks of the given analog/digital schematics to obtain layout.

CO3: Analyze interaction among various blocks of a given analog/digital schematic to asses manufacturability of the design and to issues relating to amalgamation of signals.

CO4: Capture the parts and extract the footprint for a design considered.

CO5: Simulate the design examples using ORCAD PCB Bundle

CO6: Submit report for the design examples with appropriate design considerations

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	INNOVATION FOR ENTREPRENEURSHIP				
COURSE CODE	19ES5HSIFE	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Passion/ Willingness to learn, Enthusiasm to become an entrepreneur.					

UNIT-I 6 Hours

Ideation and Innovation

Problems and Pain Points, Ideation and Problem Solving, Design Thinking, Team importance and Leadership, Market Segmentation, Beachhead Market, Building End User Profile, Total Addressable Market (TAM) Size for the Beachhead Market, Profile the Persona, Full Lifecycle Use Case, High-Level Product Specification, Quantify the Value Proposition, Identify Your Next 10 Customers, Define Your Core, Chart Your Competitive Position

UNIT-II 5 Hours

Product Acquisition by customer:

Determine the Customer's Decision Making Unit (DMU), Process to Acquire a Paying Customer, Mapping sale process, Total Addressable Market Size for Follow-on Markets

UNIT-III 5 Hours

Business from Product :

Design a Business Model, Set your Pricing Framework, Calculate the Lifetime Value (LTV) of an Acquired Customer, Map the Sales Process to Acquire a Customer, Calculate the Cost of Customer Acquisition (COCA)

UNIT-IV **4 Hours**

Designing, building and scaling of the product:

Identify key Assumptions, Test Key Assumptions, Define and build Minimum Viable Product (MVP), Test with Customer, Repeat Cycle to Reach Product Market Fit.

UNIT-V **6 Hours**

Startup and Entrepreneurship in India

Starting company in India, IP landscape, Incubation, Government support, Taxation, Startup culture and leadership, Open innovation, Social Innovation, Intrapreneurship, entrepreneurship abroadSimulation of design examples using PCB bundle- ORCAD PCB bundle suite

Text books:

1. Disciplined Entrepreneurship: 24 Steps to a Successful Startup (Wiley, 1st Edition) Bill Aulet, ISBN: 1118692284, 2013
2. The Startup Owner's Manual: The Step-by-Step Guide for Building a great company by Steve Blank K&S Ranch Publishers, K&S Ranch, 2016

Reference books:

1. Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Christensen, Harvard Business Review Press, 2011

E-References

e-Learning:

1. https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring-2013/assignments/assignment-12/

2. https://www.edx.org/course/entrepreneurship-101-who-customer-mitx-15-390x
3. https://segera-wisuda.blogspot.in/2016/05/46-ebooks-entrepreneurship-download-free.html

· **Course outcomes**

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

CO1: Apply new ideas of design thinking, methods and ways of thinking.

CO2: Formulate goals as entrepreneur for a start up.

CO3: Identify business opportunities by performing market research and choosing target customer

CO4: Engage with a range of stakeholders to deliver creative and sustainable solutions to specific problems communicate effectively both orally and in writing.

CO5: Work effectively with peers with diverse skills, experiences and be able to critically reflect on own practice.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**MINI PROJECT -I**				
COURSE CODE	**19EI5PWMP1**	**Credits**	**2**	**L-T-P**	**0:0:2**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

General Instructions:

1. A team of maximum three students shall be permitted to work on a single mini project.
2. The mini project shall comprise of hardware component. However, the software component is advisable but not mandatory.
3. Students shall be evaluated on regular and continuous basis as per the prevailing rubrics
4. The team shall ensure that the project is in working condition during final demonstration.
5. The student is required to submit a report based on the project work carried out.
6. The team needs to demonstrate their mini project developed at the end of semester (Poster presentation will be recognized)
7. Projects having scope to be taken to next higher level in next semester will be encouraged.

CO1: Enhance the skills and competency of students by hands on experience for troubleshooting, maintenance and fabrication.

CO2: Inculcate innovative thinking and thereby preparing students for main project.

CO3: Promote presentation, record keeping and documentation of technical reports towards concept of entrepreneurship.

CO4: Disseminate the technical knowledge on recent technological trends and applications by demonstration of working prototype.

CO5 : Demonstrate with ethics, effective communication skills and relate engineering issues to broader societal context.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	DOCUMENTARY & THEATRE ACTIVITY				
COURSE CODE	119EI5NCDTA	Credits		L-T-P	

Documentary theatre is a form of drama, related to epic theatre, which is propagandist and didactic, and may make use of relatively recent history and documentary evidence of the kind provided by newspapers, governmental reports, archives, official histories.
In Documentary Theatre as a performance style, real documents and even the words or testimony of involved in a situation or event are used to construct a script or a performance piece.

The college provides opportunity for students to associate with a large number of Cultural activities.
Sample Affinity groups are listed below:

- Pravrutti- The Theatre Team
- Photography Club
- Fine Arts Club
- Rotaract

Students regularly associated with any one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.
Students who are not associated with the above affinity groups, shall participate in documentary and theatre activity organized by the department.

VI Semester

COURSE TITLE	AUTOMATION IN PROCESS CONTROL				
COURSE CODE	19EI6PCAPC	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Process Control, Basic Programming					

UNIT-I 7 Hours

Introduction to Automation: Evolution, Components of automation in process control, Types of processes, Data loggers – Data Acquisition Systems (DAS), Introduction to Direct Digital Control (DDC), Distributed Control Systems (DCS).

Basic architecture of PLC, Types of PLC, PLC operation, I/O Modules: Discrete, Analog, Special types, I/O Specifications, CPU, Processor memory organization, Program scan, Introduction to programming standards of PLC. Industrial Networks of PLCs: Star, Ring, Bus topology.

UNIT-II 8 Hours

PLC Programming

Instruction: branch, Modes of Operation, Developing fundamental PLC wiring diagrams and ladder logic programs. Manually operated switches, Mechanically operated switches, Sensors, Output Control Devices, Latching Relays, Related programming and practice examples, Programming timers - Applications.

Programming using counters: Up counter, Down Counter, Cascading counters, Incremental encoder, Applications.

UNIT-III 8 Hours

Control and Data Manipulation Instructions : Master Control Reset instruction.

Data Manipulation Instructions: Data Manipulation, Data Compare, Numerical data I/O Interfaces.

PLC intermediate functions: Arithmetic functions - comparison functions, logic functions, Data handling instructions.

UNIT-IV **8 Hours**

Distributed Control Systems: Functional components of DCS, Architecture of a simple DCS, Hierarchy Of Plant Operations, i/o subsystems, Remote IO Bus, Bus connected IOs, Diagnostics in IOs, Controllers, Workstations, Functional Features of DCS, Integration: OPC, Profibus and Foundation FieldBus, Serial Communication.

Functional Safety : Introduction, Safety Functions and Safety-Related Systems,

Functional safety standards- IEC 61508/IEC 61511, The overall Safety Life Cycle (SLS), safety requirements and safety functions, functional safety management, layers of protection

UNIT-V **8 Hours**

HMI in automation:

Introduction to HMI, Architecture Of HMI, Human Interface subsystem, Operator Panel, Construction of the panel, Interfacing with control subsystem, Types of mimic panels, Advance Human Interface System, Intelligent Operator Panel, Operator Station, Data logging Station.

SCADA

Introduction, Brief history of SCADA, elements of SCADA. Client/Server architecture, Features of SCADA, MTU- functions of MTU, RTU- Functions of

RTU, Protocol Detail SCADA as a real time system Communications in SCADA- types & communications SCADA Development for any one typical application Programming for GUI development using SCADA software.

LAB EXPERIMENTS:

Implementation of basic gates, timer, counter and data manipulation instruction of PLC, Ladder programming: Bottle filling, Elevator system, Water Level control ,Sorting based on weight, height of objects, Star to delta converter, Stepper motor control, DC motor speed control, VFD , HMI interface and SCADA

Text books:

1. "Programmable Logic Controllers, fourth edition", Frank D. Petruzella, McGraw Hill, India, 2016.
2. "Industrial Process Automation Systems- Design and Implementation" , B.R. Mehta Y. Jaganmohan Reddy, 1st Edition, Elsevier, 2014

References:

1. "Programmable Logic Controllers – Principles and Applications", John W. Webb & Ronald A Reis, 5th edition, Pearson, 2015
2. "PC Based Instrumentation and Control", 1. Mike Tooley, Third Edition, Elsevier, 1995
3. "Introduction to Industrial Automation", Stamatios Manesis, George Nikolakopoulos, CRC Press
4. "PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation and Control", Kevin James, Elsevier, 2011.

5. "Practical SCADA for Industry", David Bailey, Edwin Wright Newnes, an imprint of Elsevier,2003.
6 "Practical Data Acquisition for Instrumentation and Control Systems", John Park and Steve Mackay, 1st Edition,Newnes,2003.
7. "Mitsubishi FX Programmable Logic Controllers_ Applications and Programming" John Ridley - 2004, Newnes

E-References:

1. https://www.abebooks.com/servlet/SearchResults?an=frank%20petruzella&bsi=30&sortby=17&tn=programmable%20logic%20controllers
2. https://www.elsevier.com/books/industrial-process-automation-systems/mehta/978-0-12-800939-0

e-Learning:

1. https://nptel.ac.in/courses/108/105/108105062/#

Internal choice : Unit –IV & V.

Course outcomes: The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Apply the knowledge of control systems and computer networking for process automation.
CO2: Analyze and develop appropriate algorithms to design automation solutions.
CO3: Investigate the requirement of PLC, DCS, SCADA in various scenarios.
CO4: Apply reasoning as per general standards for assessing functional safety in industrial environment.
CO5 : Implement the solutions to automate a process control system using modern tools.
CO6: Engage in independent study and communicate effectively through presentations and reports.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	EMBEDDED SYSTEM DESIGN				
COURSE CODE	19EI6PCESD	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Microcontrollers, Sensors and Measurements, Control System					

UNIT-I 8 Hours

Fundamentals of Embedded System: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware , Concept of RTOS, Drivers, Application programs, Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net.

UNIT-II 8 Hours

Embedded Hardware and Design: Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them, ARM CortexM3 Instruction sets and programming: Assembly basics, Instruction lists and description, Useful instruction, Memory Mapping, Bit- Band operations, Assembly and C language programming.

UNIT-III 8 Hours

Embedded Serial Communication: Study of basic communication protocols like SPI, SCI (RS232, Rs485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network.

UNIT-IV **8 Hours**

Embedded Software, Firmware Concepts and Design: Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming

UNIT-V **8 Hours**

Basic embedded C Applications: for ARM-v7, using ARM-GCC- tool-chain, Emulation of ARM-v7 (e.g. using QEMU), and Linux porting on ARM-v7 (emulation) board.

LAB EXPERIMENTS:

1) GPIO can be configured in alternate function mode to have USART operation and display a string of "Welcome to BMSCE, department of EIE". The program may be written using peripheral library functions.
2) GPIO configuration in alternate function mode to have ADC operation and display the ADC output in IAR workbench.
3) ADC operation and display the ADC output on a serial display using USART.
4) Configure a GPIO pin as an input, to illustrate operation of a switch, using peripheral library functions and show the switch operation ON/OFF by configuring GPIO output pin connected to an LED.
5) Configure GPIO pins PC8 and PC9 as outputs in BSRR mode, connected to two LEDs on the discovery board, using register level programming. There is a 1000ms delay in between ON and OFF of LEDs. This delay may be generated using register level programming of Timer.
6) Configure the Timer 3 in PWM mode to have different Duty Cycles. Show

the operation of PWM using intensity change of LED connected to a Port pin, by configuring GPIO pin in output mode.

7) Controlling the speed of a Gate using digital encoder and Master-Slave operation of ST Microcontroller(STM32F4XXX)
8) Controlling Oven temperature using IoT based setup , with Telemon, IOTA module and RTD as a temperature sensor
9) IoT based Battery monitoring system with tele-monitoring option with Bluetooth connectivity
10) An IoT based Temperature monitoring with industrial temperature sensor setup and MODBUS protocol
11) Timer programming in ST Microcontroller for Distance measurement using IR sensors interfaced.
12) Study of MODBUS and RS232 C and RS 485 protocols for communication using ethernet .iple

Text books:

1. Introduction to Embedded Systems : Shibu K. V. (TMH).
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)

References:

1. Embedded System design : S. Heath (Elsevier)
2. The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, Joseph Yiu 3 Edition, EPUb
3. Embedded microcontroller and processor design: G. Osborn (Pearson)
4. Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W. Valvano; Cengage Learning; Third or later edition.

E-References:

1. https://books.google.co.in/books/about/INTRO_TO_EMBEDDED_SYSTEMS_1E.html?id=mp_neOX_uEEC
2. http://esd.cs.ucr.edu/

e-Learning:

1. https://nptel.ac.in/courses/106/105/106105159/

Internal choice Units: Unit – I & II

Course Outcomes:

The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Apply the knowledge of microcontroller to understand the definition of Embedded Systems and Real time operations.

CO2: Analyse the hardware requirements of 32 bit microcontroller with necessary Input/Output and memory operations to build simple Embedded system.

CO3: Design a simple Embedded system using higher level programming to have PORT operation in general as well as alternate function modes accommodating inbuilt peripherals.

CO4: Conduct experiments to differentiate wired and wireless serial communication protocols based on USART operation in ST Microcontrollers.

CO5 : Build Embedded Applications using input and output devices with ARM core and ST controller.

CO6: Engage in independent study to learn applications based on Microprocessor architecture such as Raspberry PI.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**INDUSTRIAL DATA NETWORKS**				
COURSE CODE	**19EI6PCIDN**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Control System, Process control.					

UNIT-I **8Hours**

DATA NETWORK FUNDAMENTALS

Introduction, Network hierarchy and switching, Open System Interconnection model of ISO, Data link control protocol: HDLC, Media access protocol, Command/response, Token passing, CSMA/CD, TCP/IP.

UNIT-II **8 Hours**

INTER NETWORKING

Bridges, Routers, Gateways, Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232 and RS 485

UNIT-III **8 Hours**

HART AND FIELDBUS

Introduction, Evolution of signal standard, HART communication protocol, Communication modes, HART networks, HART commands, HART applications.

Fieldbus: Introduction, General Fieldbus architecture, Basic requirements of Field bus standard, Fieldbus topology, Interoperability, Interchangeability, Introduction to OLE for process control (OPC). CAN Bus.

UNIT-IV **8 Hours**

MODBUS AND PROFIBUS PA/DP/FMS AND FF

MODBUS protocol structure, function codes, troubleshooting

Profibus: Introduction, profibus protocol stack, profibus communication model communication objects, system operation, troubleshooting, review of foundation field bus.

UNIT-V **7 Hours**

INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION

Industrial Ethernet: Introduction, 10Mbps Ethernet, 100Mbps Ethernet. Radio and wireless communication: Introduction, components of radio link, the radio spectrum and frequency allocation, radio modems.

Text books:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, 'Practical Industrial Data networks Design, Installation and Troubleshooting', Newnes publication, Elsevier First edition, 2004.
2. William Buchanan 'Computer Busses', CRC Press, 2000.

Reference books:

1. Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall of India Pvt. LTD, 2003
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.
4. Behrouz Forouzan , Data Communications and Networking ,3RD edition, Tata McGraw hill,2006.

E- References:

1. https://www.elsevier.com/books/practical-industrial-data-networks/mackay/978-0-7506-5807-2

2 https://www.elsevier.com/books/computer-busses/buchanan/978-0-340-74076-7

e-Learning

1. https://nptel.ac.in/courses/108/105/108105062/

2 https://swayam.gov.in/nd2_cec20_cs16/preview

Internal choice Units: Unit – II & IV

LABORATORY EXPERIMENTS:

Implement a point – to – point network with four nodes and duplex links between them- network performance by setting the queue size and vary the bandwidth and find the number of packets dropped- TCP and UDP, changing the parameter and determine the number of packets sent by TCP / UDP- Ethernet LAN compare the throughput by changing the error rate and data rate- Ethernet LAN using n nodes and assign multiple traffic nodes and plot congestion window for different source / destination. ESS with transmitting nodes in wire-less LAN and obtain the performance parameters- HDLC frame to perform Bit stuffing and Character stuffing-star topology, bus topology- hybrid topology-CRC-CCITT polynomial to obtain CRC code, protocols.

Course outcomes:

The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Apply the concepts of network and communication protocol to models in Industrial Data Networking.

CO2: Analyze inter-networking principles using standards and protocols.

CO3: Implement HART, MODBUS and Profibus protocol in field devices.

CO4: Engage in independent study to select protocol for industrial applications.

CO5 : Communicate effectively to demonstrate the importance of standards with case studies or literature paper in industrial automation.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PRODUCT MANAGEMENT TECHNIQUES				
COURSE CODE	19GC6HSPMT	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: **Course Description:**

The product management techniques elective course is aimed exactly at bringing the time-tested industry best practices and trends in product creation to the engineering students, so that they can apply the learning in their final year project. In the longer term, they can contribute effectively with a good understanding of the real-world ecosystem and stakeholders in the product creation journey.

UNIT-I **6 Hours**

Introduction: What is product management? Key functions of a product manager, Hard skills needed, Product manager vs product owner vs program manager, Career insights

UNIT-II **5 Hours**

Business model canvas: Building blocks of BMC, Value proposition part1: Opportunity-Target segment, Insight, Competition, Net promoter score (NPS), Value proposition part2: Offering- Benefit, Reason to win, Differentiator,Value statement,

Product roadmap: Significance, Generating product roadmaps, Communication of roadmap

UNIT-III **5 Hours**

Finance for decision making: Product cost built up, Cost drivers, Pricing strategy, Revenue models, Business case, NPV, cashflow, payback

UNIT-IV **5 Hours**

New Product Introduction: Make or Buy, Product development and release process Waterfall Vs Agile, UI/UX, Software Vs Hardware product development, Product documentation

Product lifecycle management: Product lifecycle, Product performance analysis Phase in / phase out, Day-Day challenges

UNIT-V **5 Hours**

Trends: Design thinking, Hackathon, Co-creation

Text books: Course material created by the course Instructor

1. Principles of Managerial Finance (14th Edition) (Pearson Series in Finance), Lawrence J Gitman
2. Monetizing innovation, Madhavan Ramanujam and Georg Tacke

Reference books:

1. Jugaad innovation,Navi Radjou, Jaideep Prabhu, Simone Ahuja
2. The Venture Imperative, Heidi Mason and Tim Rohner
3. Strategic management,Fred R. David
4. Value proposition design,Author: Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith

Internal choice: Unit -III and IV

Course outcomes

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

CO1: Understand the principles of product management and apply them to conduct market research.

CO2: Develop template for value proposition creation and business case.

CO3: Create tools to measure success of products and utilize the process for product development.

CO4: Apply pricing strategies, revenue models and checklist for deciding the make or purchase of products.

CO5: Comprehend appropriate methods and resources of different case studies through individual or team work.

CO6 : Develop decision making skills in real life as a product manager.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**DIGITAL IMAGE PROCESSING**				
COURSE CODE	**19EI6PE3DP**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Digital Electronics, Signals and Systems, Digital Signal Processing					

UNIT-I 8 Hours

Fundamentals: Introduction, Fundamental steps in Digital Image Processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, color images and color models. Implementation of algorithms.

UNIT-II 8 Hours

Image Enhancement In Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient. Implementation of algorithms.

UNIT-III 8 Hours

Image Enhancement In Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal low-pass filters, Butterworth low-pass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homo morphic filtering. Implementation of algorithms.

Image Transforms: Walsh , Haar, Hadamard , Slant , DCT

UNIT-IV **7 Hours**

Image Restoration: Image degradation and restoration models, noise models, restoration using spatial filtering – mean filter, geometric mean filter, harmonic mean filter, median filter, max & min filters, midpoint filter. Inverse filter, Wiener filter. Implementation of algorithms.

UNIT-V **8 Hours**

Image Segmentation: Introduction, thresholding: threshold detection methods, optimal thresholding, multi-spectral thresholding, edge based segmentation: edge image thresholding, border tracing, Hough transform, region-based segmentation: region merging, region splitting, splitting & merging. Matching: matching criteria.

Text books:

1.Digital Image Processing - Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.

2.Digital Image Processing, analysis and computer Vision- First edition, Milan Sonka, Cenage Learning, 2008.

Reference books:

1.Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.

2.Digital image processing, First edition, S.Jayaraman, S.Esakkirajan, J.Veerakumar, TMH-2008.

3.Digital Image Processing**,** Abhishak Yadav, Poonam Yadav, Laxmi Publications

4.Digital image Processing: An Algorithmic Approach, Madhuri A Joshi, PHI Learning Private limited

E-References

1.https://books.google.co.in/books/about/Digital_Image_Processing.html?id=a62xQ2r_f8wC&redir_esc=y
2.https://www.cengage.com/c/image-processing-analysis-and-machine-vision-4e-sonka/9781133593607/?filterBy=Higher-Education

e-Learning:

http://nptel.ac.in/courses/117105079/·
https://www.cs.nmt.edu/~ip/lectures.html

Internal choice: Unit - II & V.

Course outcomes

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

CO1: Understand pixels, enhancement, restoration, segmentation, thresholding, identify steps ,components of Image processing system, relation between pixels

CO2: Discuss algorithms used for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding.

CO3: Analyse performance of algorithms for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding

CO4: Design and implement masks, algorithms for the given image processing application

CO5: Simulate the algorithms used in image processing using modern tools.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**MODERN CONTROL THEORY**				
COURSE CODE	**19EI6PE3MC**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Control systems					

UNIT-I — 8 hours

Nonlinear Control Systems: Analysis and design Techniques, Types of Nonlinear Systems, Describing Function analysis, Stability – examples.

UNIT-II — 8 hours

State Space Representation- Physical Variables, Phase Variables, Canonical Variables, Cascade Programming, state variables of a dynamic system, block diagram and signal-flow graph state models, conversion of state equations to transfer functions and vice versa.

Solution of state equations-homogenous and non-homogenous equations, state transition matrix- Laplace transform method, Cayley Hamilton method, Similarity Transform method.

UNIT-III — 8 hours

Discrete Time Control Systems:

Basic digital control system, Pulse Transfer functions, Examples, Stability analysis in the Z-plane-Jurys stability and Bilinear Transformation Problems.

Controllability and Observability (Continuous time): Concepts, Kalmans and Gilberts Test, examples.

UNIT-IV **8 hours**

Compensator design using bode plot: Lead, Lag Networks problems.

UNIT-V **7 hours**

Compensator design using root locus technique: Lead, Lag Networks problems.

Text books:

1. Digital Control and State Variables methods – M. Gopal, 2nd edition, PHI, 1997.
2. Modelling, Simulation and Control of Non-Linear Dynamical Systems - Patricia Melin and Oscar Castillo, 2002, Taylor & Francis.

References:

1. Discrete Time Control Systems - K. Ogatta, 2nd edition, PHI, 1996.
2. Advanced control Theory - A Nagar Kani, 2nd edition, RBA .
3. Modern Control Theory – UdayBakshi and MayureshBakshi, Technical publications.
4. Modern Control Engineering - K. Ogatta, 3rdedition, PHI, 1996.

E-References

1. https://www.mheducation.co.in/digital-control-and-state-variable-methods-9780071333276-india
2. https://www.springer.com/gp/book/9781402087776

e-Learning:

1. https://nptel.ac.in/courses/108103007/

2. https://www.nptelvideos.in/2012/11/advanced-control-system-design_27.html

Internal choice: Unit – II & III.

Course outcomes

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

CO1: Understand different types of non linearities and analyze the behavior of nonlinear system using describing functions and phase plane techniques.

CO2: Represent and analyse given continuous and discrete time systems in the state space form.

CO3: Design control system using pole placement approach and understand the concept of intelligent control.

CO4: Determine observability and controllability of a given system.

CO5: Implement cascade compensators to meet the required specifications using bode plot and root locus techniques.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	INDUSTRIAL INSTRUMENTATION				
COURSE CODE	19EI6PE3ID	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Process control					

Prerequisites: Process control

UNIT-I 8 Hours

Instrumentation and Control in Power Industries

Introduction to Plant: Power plant terminologies and key terms, power plant classification: thermal, hydro, nuclear, co-generation, comparison of various power plants based on technology, usage, efficiency, and limitations.

Turbine instrumentation and control, start-up and shut-down, thermal stress control, turbine supervisory instrumentation, condition monitoring, generator, power distribution instrumentation.

UNIT-II 8 Hours

Instrumentation and Control in Food Industry

Pilot plant Size and structure, types, application and design; Materials for construction of food equipment; Hygienic design of processing system and auxiliary system ,Instrumentation in canning industry, dairy Industries.

UNIT-III 08 Hours

Process Measurement Hardware Control in Paper Industries

Wood Raw Material-The Basic Process-The Pulping Process – The Chemical Recovery Process – The Papermaking Process – Converting. Basic Weight

Measurement – Density And Specific Gravity Sensors – Basis Weight Control of a Paper Machine-Yankee Dryer Temperature Control-White Liquor Clarifier Density Control.

UNIT-IV **8 Hours**

Instrumentation and Control in Cement Industries

Processing of raw materials – Cement making equipment – Rotary kilns – Pre heaters – Pre calciners – Multi channel burners – Cooling systems– Pneumatic and Hydraulic load cells – Measurement of humidity and moisture – Coal analyzers – Particle size analyzers – Particulate emission analyzers – Pollution control instruments.

UNIT-V **7 Hours**

Instrumentation and Control in Pharmaceutical Industries

Process Description-Measurement of flow, level, pressure, temperature and smoke-Process Analyzers, Sulfur Titrator, Total Carbon Analyzer, Cyanide and Ion Analyzer- Valves-Advanced Control, Sequence control system-Fermentation control ,Distillation control, waste water neutralization control and Tablet Coating Control system.

Text books:

1 Liptak.B.G, 'Instrumentation in Process Industries', Chilton Book Company, 1994.

2 Liptak, B. G. (ed.), Instrument Engineers Handbook (Volume 1), Ch.VIII Philadelphia: Chilton, 1970.

References

1 Balchan.J.G and Mumme.K.I, 'Process Control Structures and Applications', Van Nostrand Reinhold Company, New York, 1988.

2 Providing an adequate knowledge about the unit operations, measurement of various parameters in paper industry

3 Libby, C. E., Pulp and Paper Science and Technology (Volume 1, Pulp), (Volume 2, Paper), New York McGraw Hill, 1962.

4 Ghosh.S.N, "Cement and Concrete-science and technology vol-1 part-1", 1st Edition, Abi books private limited, 1991.

5 Waddams.L, 'Chemicals from Petroleum', Butter and Janner Ltd., IV Edition, 1978.

E- References :

1 https://www.goodreads.com/book/show/4599131-instrumentation-in-the-processing-industries

2 https://www.abebooks.com/book-search/title/instrument-engineers-handbook/author/bela-liptak/

E- Learning:

1 http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html

2 https://www.classcentral.com/tag/instrumentation

Course outcomes

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

CO1: Get an adequate knowledge about the measurement of various parameters in Steel industry

CO2: Understand the unit operations, measurement of parameters in various control loops petrochemical industry

CO3: Get an adequate knowledge about the unit operations, measurement control loops in paper industry

CO4: Acquire an adequate knowledge about the measurement of various parameters in cement Industry

CO5: Get an adequate knowledge about the measurement of various parameters in Pharmaceutical industry

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	BIO MEDICAL INSTRUMENTATION				
COURSE CODE	19EI6PE3BM	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Sensors and Measurements					

UNIT-I 8 Hours

Components of Medical Instrumentation System:

Terminology of medicine and medical devices – Generalized medical Instrumentation systems – Classification of Biomedical instruments – Medical measurement constraints – The origin of Bio potentials – Electrical activity of excitable cells.

Electrodes: The electrode-Electrolyte interface, Polarization, Electrode behavior and circuit models, Electrode arrays, Surface and Microelectrodes.

UNIT-II 8 Hours

Data Acquisition, Analysis and Safety

Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes and analysis of biomedical signals – ECG, EEG, EMG, ERG – Lead systems and recording methods – Typical waveforms, Bioamplifier and filters.

Electrical safety in medical environment: Physiological Effect of Electrical Current, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT-III 8 Hours

Cardio Measurements and Therapeutic Devices

Electrical Conduction system of the heart. Cardiac cycle. Relation between

electrical and mechanical activities of the heart.

Cardiac Instrumentation: Blood pressure and Blood flow measurement. Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart. Blood flow meter, cardiac output, heart sounds and its measurement. Pacemaker, defibrillators,

UNIT-IV **8 Hours**

Neuro-Muscular Instrumentation: Specification of EEG and EMG machines. Electrode placement for EEG and EMG recording. Intrepretation of EEG and EMG.

UNIT-V **7 Hours**

Bio Telemetry: Biomedical Telemetry & Telemedicine:

Wireless telemetry, single channel telemetry, multi-patient telemetry, Multi-channel wireless telemetry Implantable telemetry systems Biotelemetry application on wix networks.

Essential parameter for telemedicine, Delivery models in telemedicine, Telemedicine system, Clinical data standards, Transmission of still images, Transmission of video images, Transmission of digital audio, Cyber medicine and application of telemedicine.

Text books:

1. Hand-book of Biomedical Instrumentation – by R.S. Khandpur, McGraw-Hill, 2003.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

3. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John Wiley and Sons.
4. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.

Reference books:

1 Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.
2 Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.
3 Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition, 2011.

E- References:

1. https://books.google.co.in/books/about/Handbook_of_Biomedical_Instrumentation.html?id=bYsiBAAAQBAJ&redir_esc=y

E Learning :

1. https://onlinecourses.nptel.ac.in/noc18_ec02

Internal choice Units: Unit – I & III.

Course outcomes

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

CO1: Understand the concept of various sensing and measurement of bio signals and its electrical origin
CO2: Understand various Biomedical Instruments and electrical parameter acquisition and analysis.
CO3: Understand various non-electrical parameter and diagnostic procedures.
CO4: Understand the concept of assisting and therapeutic devices and uses of telemedicine.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	INDUSTRIAL INTERNET OF THINGS				
COURSE CODE	19EI6CE1IN	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: General Concepts of Sensors, Computer and Internet					

UNIT-I 8 Hours

Internet of Things: Introduction, Evolution, Requirements /characteristics, challenges, SWOT analysis, Horizontal and vertical aspects of IoT, structure of IOT. Present communication models Networking and communication layer: IOT protocol stack, Wired/wireless communication, Internet layer, Application layer, comparison of IoT protocols

UNIT-II 8 Hours

IIoT in Process Automation : IT + OT, ISA95 levels, Building blocks.Big Data: Data types, Process, ultimatums, characteristics, Comparison between small and big data. Big data analytics-types, applications, implementation challenges. Cloud Computing- advantages, service models, various cloud platforms and its comparison. Edge/Fog computing- Architecture, Comparison between cloud and fog

UNIT-II 8 Hours

IIoT Reference Architecture: M2M and IIoT architecture, Industrial Internet Consortium, Industrial Internet Architecture Framework, Industrial Internet Viewpoints, Business, Usage, Functional-control domain, communication, modelling, asset management, Operational domain, Implementation. Architectural topology- Three tier, Connectivity, Key system characteristics

UNIT-IV **8 Hours**

Designing of Industrial Internet System: Concept of IIoT, proximity network, Middleware software patterns: Publish/subscribe pattern. IIOT Middleware architecture.

Industry 4.0: Definitions, Four characteristics, Benefits, Design principles, Building blocks of Industry 4.0

UNIT-V **8 Hours**

Case Study : IIoT for Smart City

Building blocks of smart city – candidate applications for SMART CITY.

Study of proposed IIoT based solutions for this application, used cases and workshop

Case Study : IIoT for Plant Operations

Introduction to plant operations (A day in the refinery / video based sessions)Today / Current Practice vs IIOT impact, IIOT in process industry,

Text books:

1. "The Era of IOT- Towards a Smart World", Khaled Salah Mohamed - 2019.
2. "Internet of Things and Big Data Analytics for Smart Generation- Springer Internet", Valentina E. Balas, Vijender Kumar Solanki, Raghvendra Kumar, Manju Khari

References:

1. "Industry 4.0- The IIoT", Alasdair Gilchrist.
2. "The Internet of Things_Industrie 4.0 Unleashed ",Ulrich Sendler - 2018, Springer.

3. "The Internet of Things 2012: New Horizons",A Smith, I.G. 2012.
4. The Internet of Things 2012: New Horizons, Smith, I.G., CASAGRAS2, 2012
5. "Internet of Things: Architectures, Protocols and Standards", Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, Wiley, 2018

E-References:

1. https://www.ebay.com/p/15038550739
2. https://www.springer.com/gp/book/9783030042028#:~:text=Internet%20of%20Things%20and%20Big,Generation%20%7C%20Valentina%20Emilia%20Balas%20%7C%20Springer

e-Learning :

1. https://swayam.gov.in/nd1_noc20_cs24/preview
2. https://nptel.ac.in/courses/106/105/106105195/

Internal choice Units: Unit –II & V.

Course outcomes

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

CO1: Understand the building blocks of an IIOT based solution and try applying it to few common problems
CO2 : Use one of the ideas of IIOT and propose a solution architecture in process Automation.
CO3 : Understand the challenges of IIOT as a technology, understand its strength, limitations.
CO4 : Solve constraints through alternatives to refine the group proposal of process Automation.
CO5: Apply concepts of IIOT in the context of plant operations.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	ALGORITHMS AND SYSTEM DESIGN				
COURSE CODE	19EI6CE1AD	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Signals and systems, Digital Signal Processing.					

UNIT-I 8 Hours

Architecture of Signal Processors: CPU, Memory Architecture, DSP Peripherals, Instruction set, JTAG emulation, Addressing modes, Memory organization , Basic Elements of Real Time DSP Systems, Input and O/P Channels, A/D Conversion, Sampling, Quantization and Encoding, D/A conversion, I/O Devices

UNIT-II 8 Hours

Fundamentals of DSP Programming: Program management, central arithmetic logic unit, multiplier, method of enhancing programming, pipelining, numerical calculations in DSP

Processor Hardware options, Fixed and Floating point processors, Real time constraints

UNIT-III 8 Hours

Algorithm Development: Selection of DSP Chips, Software development, High level software development tools, Introduction to DSP development tools, C compiler, Assembler, Linker, other development tools

UNIT-IV 8 Hours

VLIW Architecture and 6713 processor: Internal structure and core architecture 6713, CPU registers and blocks, arithmetic units, instruction

set to multiply , logical , data transfer
operations, program branching, Increased computing power, data path cross, Interrupt sources and their management

UNIT-V **7 Hours**

DSP based System Design: Design and implementation of FIR ,IIR filters, Interpolation , decimation, Noise cancellation, Adaptive filtering, Speech signal processing and echo cancellation, Harmonic detection, Fundamental frequency extraction, Signal Enhancement techniques

Text books:

1. Real Time Digital Signal Processing, Sen M. Kuo, Bob S.Lee, John Wiley & Sons, 2001
2. Digital Signal Processing and Applications with C6713 and C6416 DSK , Rulph Chassaing, John Wiley & Sons, INC. 2004

Reference books:

1. Texas Instruments Reference manual
2. Architectures for Digital Signal Processing-Peter PirschJohn, Weily and Sons 2007.

E- Reference:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/0470035528
2. https:///onlinelibrary.wiley.com/doi/book/10.1002/0471704075

Internal choice: Unit –IV & V

Course outcomes

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

CO1: Recognize and apply the fundamentals of fixed and floating point architectures of various DSPs

CO2 : Learn the architecture details , instruction set of floating point DSP and analyze their requirements in bringing out real time solutions

CO3 : Implement using DSP programming tools and apply them for real time problems and present the solutions

CO4 : Analyze and learn to implement the signal processing algorithms in DSPs to design systems

CO5: Illustrate the features of on-chip peripherals and its interfacing along with programming details.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	SUSTAINABLE SOLUTIONS FOR SMART CITIES				
COURSE CODE	19EI6OE1SM	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

UNIT-I 8 Hours

Micro sensing Networks for sustainable cities: Pollution as a key factor Introduction, urban mega cities , Smart cities, Air pollutants, air pollution sources, water pollutant, water pollutant sources, Air pollution monitoring, Water pollution monitoring, Air quality sensors, water quality sensors, the Internet of Things, Wireless sensing Energy harvesting.

Population growth in Developing countries and smart city fundamentals: Introduction, developing country growth statistics, developed country statistics.

UNIT-II 6 hours

Harvesting Energy from Ambient Sources: Wind Energy, hydropower, Radiation and Mechanical Deformation

Introduction, Ambient Sources, Wind Energy, Hydropower, Photodiodes, Radiation Sources, Piezoelectric Energy, Micro-electromechanical Structures

UNIT-III 10 hours

The Sub-systems of an Energy Harvesting Device: Focus on RFID Fundamentals Introduction, Radio-Frequency Identification, Sub-system Definitions,Antenna, Rectifier Circuits, Regulator Circuits (Low Dropout Regulator) ,Amplifier Circuits, Matching Networks ,Energy Storage

Ubiquitous Computing: Distributing Mobile Computing to Build a Global Network of Things

Introduction, Distributed Computing , Mobile Computing , Evolution of Pervasive Computing, RFID in Ubiquitous Technology , Software in Pervasive Computing Applications ,Human-Centered Pervasive Computing System Model , Pervasive Computing: Thematic Guidelines, Situated Social Context, Social Computing Challenges .

UNIT-IV **8 hours**

Designing and Planning for Sustainable Urbanism with focus on Developing Countries United Nations Millennium Development, Sustainable Resources, responsible Development, Impact Assessment, Social and Economic Metrics, Demographic Considerations, Urban Macro-Effects, Environment Impact Metrics.

UNIT-V **7 Hours**

Tools and Facilitators towards Successful Planning for Sustainable Cities

Population Growth, Smart Cities, Pollution, Ambient Sources and Energy Harvesting, GIS, Remote Sensing and Ubiquitous Computing, Environmental Impact of climate change

Case Study: Developing countries committed to an ecologically aware future:

Categories of sustainable Development, Indicators of Sustainable cities, Worldwide Smart City Initiatives- **South Africa-** Human Capital in ICT, Information Distribution and transport, **Italy-** Training Programs in theoretical Physics Aimed at Creating Environmentally Aware and therefore sustainable communities in Developing countries. **Sweden**-Best practice in

mixed use of environmental adaptation in urban areas

Text books:

1. Micro sensing Networks for sustainable cities: 2016 First Edition by Springer International publishing- Smart Sensor, Measurement and instrumentation

Reference Books:

1. Design for sustainability E-Learning Programme - https://www.gaiaeducation.org/index.php/en/online?gclid=CPCoq5Pk9dICFZaOaAodlE8OjQ
2. Sustainable Cities: https://courses.sdgacademy.org/learn/sustainable-cities-november-2016

E- Reference

1. https://www.amazon.in/Microsensing-Networks-Sustainable-Measurement-Instrumentation-ebook/dp/B01AW23N5O

Internal choice: Unit –II & V

Course Outcomes

CO-1: Understand the need for sustainable Engineering solutions for Environmental framework.

CO-2: Analyze the requirements of sustainable development for different Environmental context.

CO-3: Develop solution by applying social, economic, Environmental considerations

CO-4: Self-study on various cases and presentation of report and seminars

COURSE TITLE	MULTI DOMAIN SYSTEM MODELLING				
COURSE CODE	19EI6OE1MD	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites: Control Systems, Signals and Systems					

UNIT-I 7 Hours

Introduction to Cyber Physical Systems and multi-domain modelling: Mathematical modelling of dynamical systems. Mathematical models. First-order linear ODE models. General first-order ODE models. Higher-order ODE models. Laplace transform. Multivariable ODE models. Symbolic, graphical and numerical computation. Review of the main elements of mathematical modelling for dynamical systems with lumped parameters.

UNIT-II 8 Hours

Introduction to Differential Algebraic Equations: Installation and basic usage of the scientific computing tools, SCILAB and OpenModelica.

Numerical Simulation of dynamical systems: Introduction to numerical methods. Basic usage of Scilab. Numerical ODE solving. ODE solving with Scilab. Solving ODE systems with Scilab. Numerical simulation with Xcos

UNIT-III 8 Hours

Modelling and simulation of multi-domain systems with Modelica: Basic elements of the Modelica language. Physical modelling and simulation with OpenModelica. Simulation of mechanical oscillators with OpenModelica. Simulation of Electrical systems.

UNIT-IV **8 Hours**

Applying OM Libraries: Blocks, Basic input/output control blocks (continuous, discrete, logical, table blocks), Complex Blocks, Basic input/output control blocks with Complex signals , Electrical, Magnetic and Mechanics Libraries..

UNIT-V **8 Hours**

Application of Modelica: Modelling of Mechanical Vibrations and System, Modelling, Application of Modelica in Automotive applications, Modelica in Avionics, Modelica in Bio mechanics.

Text Books :

1. Campbell, S. L.; Chancelier, J. P.; Nikoukhah, R. Modeling and simulation in Scilab/Scicos [on line]. New York: Springer, 2006 [Consultation: 23/01/2019].
2. Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica. Peter Fritzson., 2011eboo

References:

1. Principles of Object-Oriented Modeling and Simulation with Modelica 3.3: A Cyber-Physical Approach, Peter Fritzson 2015.
2. Introduction to Modelica, Michael Tiller

E-References:

1. http://dx.doi.org/10.1007/0-387-30486-X. ISBN 9780387278025.
2. http://eu.wiley.com/WileyCDA/WileyTitle/productCd111801068X.html.

Internal choice: Unit –II & IV

Course outcomes:

The course outcomes will be attained through theory and laboratory assessments.

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

CO1: Formulate suitable mathematical models for different types of dynamical systems.

CO2: Apply the open-source computer tools Scilab to model and simulate dynamic systems of special relevance in engineering.

CO3: Use the Modelica simulation language, in particular its open-source implementation Open Modelica, to model and simulate complex and multi-domain physical systems

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	MINI PROJECT -II				
COURSE CODE	19EI6PWMP2	Credits	2	L-T-P	0:0:2
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

General Instructions:

1. A team of maximum three students shall be permitted to work on a single mini project.
2. The mini project shall comprise of hardware component. However, the software component is advisable but not mandatory.
3. Students shall be evaluated on regular and continuous basis as per the prevailing rubrics
4. The team shall ensure that the project is in working condition during final demonstration.
5. The student is required to submit a report based on the project work carried out.
6. The team needs to demonstrate their mini project developed at the end of semester (Poster presentation will be recognized)
7. Projects having scope to be taken to next higher level in next semester will be encouraged.

CO1: Apply the knowledge gained by literature review to solve Engineering problems of multidisciplinary nature.

CO2: Realize the existing solutions on selected technical domain, using modelling and simulation.

CO3: Interpret the experimental results and document while implementing the solution for the defined problem.

CO4: Explore the modern tools and evaluation platforms for project implementation towards optimization of resources.

CO5: Demonstrate with ethics, effective communication skills and relate engineering issues to broader societal context.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	APTITUDE /SKILL DEVELOPMENT				
COURSE CODE	20MLBIPCMD/ 19EI6NCASD	Credits	NC	L-T-P	

This activity provides an opportunity for students to develop Aptitude and Soft skills which will be helpful during Placements.

Students regularly attend Skill development training and placement classes conducted by Placement department.

Students has to learn sentence correction, error spotting, idioms and phrases, sentence completion and analogies, time and work, time, speed and distance, coding, decoding, number series and letter series, permutation and combination, probability and mensuration and partnership.

At the end of the course students has to take the quiz conducted by placement department and get minimum marks to clear the course.

VII Semester

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	BIOLOGY FOR ENGINEERS				
COURSE CODE	19ES7BSBFE	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 5 Hours

Introduction: Why Engineers Should Study Biology?, What Is life?, The Hierarchy of Life, Evolution, Taxonomy, Interaction of Living Things with the Environment, Brief History of Life, Basic Organic Chemical Structure

UNIT-II 5 Hours

Composition of Living Things: Carbohydrates, Lipids, Proteins, Nucleic Acids, Hybrid and Other Compounds.

The Cell: The Common Denominator of Living Things, Prokaryotes and Eukaryotes, The Biological Membrane, Eukaryotic Cell Structure and Function, Cell Reproduction

UNIT-III 5 Hours

Introduction to Radiation: Where does Radiation Come from, Types of Radiation, Types of Ionizing Radiation, X-rays for Medical Use and Generators, Types of Electromagnetic Waves, Ionization of Radiation - Property of Ionizing Radiation, Types of Radiation and Biological Effects ,Penetrating Power of Radiation, Penetrating Power of Radiation within the Body, Penetrating Power and Range of Effects on the Human Body

UNIT-IV 5 Hours

Radiation Effects on Human Body: Types of Effects, Exposure Modes and Effects, Classification of Radiation Effects, Deterministic Effects and Stochastic Effects. Mechanism of Causing Effects on Human Body:

Ionization due to Radiation, Damage and Repair of DNA, DNA Cells Human Body, Radiation Damage to DNA, Lapse of Time after Exposure and Effects, Deterministic Effects, Radiosensitivity of Organs and Tissues, Stochastic Effects

Cell phone Radiation Hazards: Introduction, Mutation

UNIT-V **6 Hours**

Organic Farming: History and Background, Requirements of Plants for Soil-Derived Nutrients: Effects of Nitrogen, Phosphorous and Potassium on Plant Growth and Quality, Symptoms of Nitrogen, Phosphorous and Potassium Deficiency in Crops

Text books:

1. Arthur T. Johnson, Biology for Engineers, Second Edition, CRC Press 2019
2. Hand Book on " Basic Knowledge and Health Effects of Radiation" by Radiation Health Management Division, Ministry of the Environment, Government of Japan and National Institutes for Quantum and Radiological Science and Technology
3. David A. Vaccari, Peter F. Strom and James E. Alleman, Environmental Biology for Engineers and Scientists Wiley Interscience, 2006
4. Allen V. Barker, Science and Technology of Organic Farming, CRC Press, 2010

Reference books:

1. Suraishkumar, Madhulika Dixit, Biology for Engineers and Non – Biologists, IIT Madras, Oxford University Press

2. Naren, Anubhav E, Vinay C, Mohsen G, 'Electromagnetic Radiation Due to Cellular, Wi-Fi and Bluetooth Technologies: How Safe are we?', IEEE Access Special section on Antenna Propagation for 5G and beyond, pp42980 - 43000, January 2020

3. Sapna E.T., India's Organic Farming Revolution, University of Iowa Press, Iowa City, 2014

E- References:

1. https://nptel.ac.in/courses/121/106/121106008/

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Understand and explain basic concepts of biology.

CO2: Apply the knowledge of Biology to convey the role of basic building blocks of life.

CO3: Analyse basics of Radiation and its effects on Human Body.

CO4: Understand role of Biology in organic farming.

COURSE TITLE	VLSI DESIGN				
COURSE CODE	19EI7PCVID	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 10 Hours

Introduction to MOS Technology: Moore's law, speed power performance, Nmos fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.

Basic Electrical Properties of MOS and BiCMOS Circuits : Drain to source current versus voltage characteristics, threshold voltage, trans conductance, nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, MOS transistor circuit model, BiCMOS inverters, latch up

UNIT-II 7 Hours

MOS and BICMOS Circuit Design Processes: MOS layers, stick diagrams, nMOS design style,CMOS design style, design rules and layout, λ - based design, scaling of MOS circuits, scaling factors for device parameters, and limitations of scaling.

UNIT-III 7 Hours

Subsystem Design and Layout -1 : Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.

UNIT-IV **7 Hours**

Subsystem Design and Layout -2 : Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.

UNIT-V **8 Hours**

Memory, Register and aspects of Timing: Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

LAB EXPERIMENTS:

PART A: DIGITAL DESIGN: Write the Verilog code for the following circuits and observe the Waveforms and synthesize the code with technological library with given constraints- An Inverter and Buffer, Transmission Gate, Basic/Universal Gates, Flip flops, Counters, Registers, Adders

PART B: ANALOG DESIGN: Design an inverter circuit by drawing the schematic and verify The following: i) Transient Analysis ii) DC Analysis, Design the following circuits with given Specification, draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis, Common Source Amplifier, Common Drain Amplifier, Differential Amplifier

Text books:

1 Basic VLSI Design -3rd Edition Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 2005.

Reference books:

1 CMOS Digital Integrated Circuits, Analysis And Design, 3rd Edition, Sung – Mo (Steve) Kang,YusufLeblbici, Tata McGraw Hill, 2002.

E-References:

1https://www.sanfoundry.com/best-reference-books-vlsi-system-design/

2https://www.freebookcentre.net/Electronics/VLSI-Books-Download.html

e learning :

1 http://nptel.ac.in/downloads/117101058/**2**http://vlsi.cs.ucf.edu/books/intro-nmos-cmos.pdf

Internal choice: Unit – I & V

Course outcomes

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

CO1: Understand the basic concept of fabrication process for MOS devices .

CO2: Apply design rules to create stick diagrams and layouts for MOS devices .

CO3: Design combinational and sequential logic structures.

CO4: Analyze and optimize the characterstics performance of sub-system design.

CO5 : Realize the sub-system design using modern tools for validation

CO6: Engage in independent study and communicate effectively.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	TECHNOLOGICAL TRENDS IN AUTOMATION				
COURSE CODE	19EI7PCTRA	Credits	1	L-T-P	1-0-0

Technologies: IIOT, Edge Technology, Cybersecurity, Artificial Intelligence(AI) in Control Automation, Advances in Controls, Augmented Reality(AR) and Virtual Reality(VR).

Application Domain:

1. Autonomous Vehicles, Industrial /Mobile Robots, Building Infrastructure Systems, Edge-AI Analytics in Instrumentation and Control, IT-OT Cyber security
2. Role of Industrial/Mobile robotics
3. Renewable & Hybrid Power
4. Edge-AI Analytics in Inst & Control

References : INTEK Magazine ISA, Manufacturing Automation etc.

E- References:

1. https://www.isa.org/

2. https://iiot-world.com/

Internal choice: Students can choose any one in Application domain, identify appropriate industry, work and come up with a case study report under the guidance of a supervisor**.**

Course outcomes

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

CO1: Conduct Investigation on a selected case study in the field of Automation

CO2: Apply ethical principles and communicate effectively through presentations and reports.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	MEMS				
COURSE CODE	19EI7CE2ME	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 7 Hours

Overview of Mems and Microsystems

Overview of MEMS & Microsystems: MEMS & Microsystems, Typical MEMS and Microsystem Products, Evolution of Microfabrication, Microsystems and Microelectronics, The Multidisciplinary nature of Microsystem Design and Manufacture, Microsystems and Miniaturization, Applications of Microsystems in the Automotive and other Industries.

UNIT-II 8 Hours

Working principles of Microsystems:

Micro sensors — Acoustic Wave, Biomedical and biosensors, Chemical, Optical, Pressure and Thermal Sensors.

Microactuation: Actuation using Thermal forces, Shape-Memory Alloys, Piezoelectric crystals & Electrostatic forces.

UNIT-III 8 Hours

Miniaturization Techniques: Introduction to scaling, scaling in rigid body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics, heat transfer.

Materials for MEMS and Microsystems: Introduction, Substrates and wafers, Active Substrate materials, Silicon as a substrate material, Silicon compounds, Silicon piezoresistors, Gallium Arsenide, Quartz.

UNIT-IV **8 Hours**

Micromachining Technologies

Thin Film Deposition: Evaporation, Sputtering, Chemical Vapor deposition, Epitaxial growth of Silicon, Thermal Oxidation for Silicon dioxide. Lithography.

Etching: Isotropic Etching, Anisotropic Etching, Etch Stops, Dry Etching. Silicon Micromachining, Advanced Process for Microfabrication.

UNIT-V **8 Hours**

Integration and Packaging: Microsystems and Microelectronics, Objectives of packaging, Special Issues in packaging, Types of microsystem Packages, Packaging Technologies, Reliability and Key failure mechanisms.

Text books:

1. Tai-Ran Hsu- MEMS and Micro systems: Design, Manufacture and Nano scale Engineering, 2nd Edition (JOHN WILEY & SONS).
2. G.K. Ananthasuresh, K.J.Vinoy, S. Gopalakrishnan, K.N.Bhat, V.K.Aatre, Micro and smart systems 1st edition (WILEY INDIA)

Reference books:

1. NadimMaluf, Kirt Williams - An Introduction to Microelectromechanical Systems Engineering, 2nd Edition (ARTECH HOUSE)

E- References:

1. https://www.comsol.co.in/video/how-set-up-run-simulation-comsol-multiphysics
2. http://1.droppdf.com/files/MC684/encyclopedia-of-materials-characterization.pdf

3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/lecture-notes/

e-Learning:

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/108/108/108108113/

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Understand the basic principles ,working and identify type of materials used for various types of micro sensors and actuators

CO2: Apply the basic engineering principles in understanding the scaling effects in different physical principles related to microsystems.

CO3: Illustrate range of fabrication techniques used in microsystem design and analytically describe different deposition techniques and identify different effects occurring during depositions on various topographies.

CO4: Comprehend the state-of-the-art of micromachining and packaging technologies.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**VISION TECHNOLOGY AND APPLICATIONS**				
COURSE CODE	**19EI7CE2VA**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

UNIT-I **8 Hours**

Digital Image processing and Feature Extraction: Fundamentals of Image Processing: Overview and State-of-the-art, Formation, Transformations: Orthogonal, Euclidean, Affine, Projective, etc; Enhancement, Restoration, Histogram Processing. Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, Image Pyramids**.**

UNIT-II **8Hours**

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation.

Motion Detection and Tracking:

Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

UNIT-III **8 Hours**

Pattern Analysis:

Introduction to AI, machine learning, TensorFlow 2.0, and Keras, Neural networks in TensorFlow, Linear regression, Classification, Logistic regression, Deep neural networks, Convolutional neural networks (CNNs), Data set creation and augmentation, off-the-shelf network architectures; transfer learning, Object detection

UNIT-IV **7 Hours**

Robot Control and Navigation: Introduction, Robotics, Control Loops of Robotic Systems, trajectory, velocity and force control, Computed Torque control. Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors, visual servo-control.

UNIT-V **8 Hours**

Applications of Vision in Robotics: Machine Vision for Robot Navigation**,** AI Vision, Defect Inspection, Robotic Guidance, OCR, Applications of robotics in active perception, medical robotics, autonomous vehicles, and other areas.

Text books:

1. Fu, Lee and Gonzalez., Robotics, control vision and intelligence-, McGraw Hill International, 2nd edition, 2007

2. John J. Craig, Introduction to Robotics- Addison Wesley Publishing, 3rd edition, 2010

Reference 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.

3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison-Wesley, 1992.

4. Klafter, Chmielewski and Negin, Robotic Engineering - An Integrated

approach,, PHI, 1st edition, 2009

E- References:

1. IEEE-T-PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence).
2. IJCV (International Journal of Computer Vision) - Springer.

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Understand and apply the principles of general practices followed in image formation.

CO2: Able to conduct experiment and investigate an appropriate feature extraction technique applicable to images to provide solutions.

CO3: Apply classification algorithms on images using parametric and non-parametric methods.

CO4: Analyze and build prototypes of the motion dynamics using the modeling techniques.

CO5: Apply the image processing techniques for computational photography and present the solution provided for an open ended problem.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	INSTRUMENTATION FOR FOOD PROCESSING AND AGRICULTURE				
COURSE CODE	19EI7OE2 IA	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 8 Hours

Introduction to food Processing

Introduction, Process control, Definition of the Elements in a control loop, Process facility consideration, Fundamentals of Food Manufacturing: Goals, Food Spoilage and Foodborne Diseases, Food Spoilage and Biological Factors, Food Spoilage and Chemical (Including Biochemical) Factors, Food Spoilage and Physical Factors, Prevention and Retardation of Food Spoilage, Sources of Information, Product Formulations and Flow Charts

UNIT-II 8 Hours

Product Developments, and Recent Advances in food processing:

Product Development, Flavor Creation and New Product Development, Generation of New Product Ideas, Isolation, Identification, and Synthesis of Flavour Compounds, Isolation and Concentration of Volatiles, Identification of Compounds, Synthesis of Flavour Compounds, Formulation and Compounding of Synthetic Flavourings, Sensory Analysis of Flavourings, Compounding of Imitation Flavouring, Trial Use of Synthetic Flavourings, Marketing of the New Product

UNIT-III 8 Hours

Sensors and Instrumentation for Food processing:

Food quality and Food safety. Flow diagram of Fruit & vegetable processing industry and instrumentation setup. Food Industry Instrumentation: Instrumentation in canning, baking, dairy

industries. Introduction to baking; Bakery ingredients and their functions; Machines and equipment for batch and continuous processing of bakery products. Objectives and techniques of food preservation Canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods

UNIT-IV **8 Hours**

Dairy Processing Instrumentation:
Building blocks of dairy processing, Heat exchangers, Centrifugal separators and milk standardisation, Homogenisers, Membrane filters, Evaporators, Deaerators, Pumps, Pipes valves and fittings, tanks, Process control and service systems

UNIT-V **7 Hours**

Agriculture Instrumentation:
An integrated view on precision smart farming from a multidisciplinary perspective, Internet of things architectures and paradigms, open source internet of things platforms, solenoid valves, relay, Moisture sensor, rainfall sensor, state of art smart object, cognitive techniques, platform, smart object interoperability, IoT applications

Text books:

1 Fundamentals of Industrial Instrumentation and Process Control by William C. Dunn, McGraw-Hill (Chapter 1)
2 Handbook of Food products and Manufacturing by YH Hui, Wiley publishers (Chapter 2 and 3)
3 Dairy Processing Handbook by Tetra Pak Processing Systems AB (Chapter 4)
4 Agricultural Internet of Things and Decision Support for Precision Smart Farming (Chapter 5)

Reference books:

1 Instrumentation and Sensors for the Food Industry by E Kress-Rogers, C J B Brimelow Woodhead Publishing, CRC, 2001

2 Introduction to Food Engineering by R Paul Singh and Dennis R. Heldman,Elsevier publication, Fourth Edition

3 Sensor in Agriculture by MDP books

Internal choice: Unit – III & V

Course outcomes

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

CO1: Understand possible technological solutions of food processing industries.

CO2: Familiarize with current literature, research in agricultural instrumentation

CO3: Analyze and design of automation system by evaluating agricultural parameter constraint.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	BUILDING AUTOMATION				
COURSE CODE	19EI7OE2BA	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 8 Hours

Automation System Structure:

Introduction, Needs and benefits of automation, Subsystems, Input Instrumentation Subsystem, Output Instrumentation Subsystem, Human Interface Subsystem- Direct Monitoring, Direct Control, Control Subsystem- Data Acquisition, Data Analysis and Decision Making, Control Execution, Communication. Basic strategies, Open and closed loop, Discrete, Continuous and Hybrid

UNIT-II 8 Hours

Building Automation

Introduction, Difference Between Building Automation and Building Control, Benefits, Structure of Building Automation and Control Networks, Typical architecture of building automation systems and control stations, Programming platform and environment.

Building Management Functions: Installation- management and control functions,, Risk- management functions, Information- processing functions, Facility- management functions, Performance monitoring and diagnosis, Maintenance management, Energy Management Functions, Comfort, Convenience, and Energy Management Functions in Room Automation, Standardized Bus Systems and Networks in Building Automation

UNIT-III 7 Hours

Sensors and Actuators:

Role of Sensors and Actuators- Importance of Estimation in Sensing, Innovative Sensor Technologies. Application Scenarios. Analog and Digital Sensors- Selection and its Applications, Digital and Innovative Sensing : Innovative Sensor Technologies, Continuous-Drive Actuators: Requirements and Applications, Overview of Temperature sensors and thermal actuators, Optical sensors and actuators, Electric and magnetic sensors and actuators, Mechanical sensors and actuators, Acoustic sensors and actuators, Chemical and biological sensors and actuators, Radiation, MEMS and smart sensors

UNIT-IV 8 Hours

Basics of Industrial Communication Technology :

Industrial Communication, Digital Data Transfer: Important Terms and Definitions, Field Bus and Network: Important Terms and Definitions

BAS communication standards and architecture: Background and problems, BACnet and its features, Konnex and its features, LonWorks and its features, Modbus and its features, PROFIBUS and its features, EIB and its features, Compatibility of different open protocol standards, Integration at management level. Examples.

Internet technologies and their applications in BASs:

An overview of applications of Internet technologies in BAS, Use of Internet technologies at automation level, Use of Internet technologies at management level, Convergence networks and total integration.

UNIT-V **8 Hours**

Control and Optimization of Air-Conditioning Systems: Typical control loops of the air- conditioning process, Control of CAV systems, Control of VAV systems

Lighting-Control Systems: Purpose of lighting- control system, Basic components of lighting and lighting- control systems, Systems based on standard lighting- control protocols

Security and Safety Control Systems: CCTV systems, Access- control systems, Burglar alarm systems, Fire alarm systems, System integration and convergence.

Case Studies : Controlling the Internet of Things – from Energy Saving to Fast vacuation in Smart Buildings

Text books:

1. Hermann Merz, Thomas Hansemann, Christof Hübner - Building Automation-Springer International Publishing (2018)
2. Shengwei Wang, Intelligent Buildings and Building Automation, Spon Press (2009)

Reference books:

1. Hermann Merz, Thomas Hansemann, Christof Hübner - Building Automation_ Communication systems with EIB_KNX, LON und BACnet-Springer-Verlag Berlin Heidelbe (2009)
2. KLS Sharma, Overview of Industrial Process Automation, Second edition, Elsevier (2017)

3. John T. Wen, Sandipan Mishra -Intelligent Building Control Systems A Survey of Modern Building Control and Sensing Strategies, Springer Publications
4. Nathan Ida- Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, The Institution of Engineering and Technology; 2nd edition (2020)
5. Clarence W. de Silva, Sensors and Actuators Engineering System Instrumentation, Second Edition, CRC Press(2016)

E- References:

1. https://digital.library.ryerson.ca/islandora/object/RULA%3A6887/datastream/OBJ/view
2. https://link.springer.com/book/10.1007/978-3-319-68462-8

e-Learning:

1. http://www.udemy.com/topic/building-management-system/
2. http://www.tpctraining.com/blogs/news/introduction-to-building-automation-systems-1

Internal choice: Unit – IV & V

Course outcomes

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

CO1: Identify and describe the major components in a BAS: ATC, Lighting, Security, Fire and Safety, Surveillance
CO2: Identify and describe the basic mechanical components and controls in an HVAC control system
CO3: Describe networking as used in BAS systems
CO4: Apply the knowledge of implementing BAS
CO5: Apply the knowledge of Energy Conservation Strategies

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PROJECT WORK- 1				
COURSE CODE	19EI7PWPW1	Credits	3	L-T-P	0:0:3
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

- The Project work is carried out in a group of 2 to 4
- The project will have problem statement identified with a thorough literature review or from an industry .
- Modelling and simulation of the proposed solution to investigate the dynamics of the physical model is suggested
- The prototype building and Result analysis is given importance.
- The project has the scope to be extended as Capstone project , with substantial experimentation and validation at the initial stage.

Course outcomes

At the end of the course, the student will have the

CO1: Collect information/knowledge from across the various field of interest, interpret, identify, analyze, formulate the problem statement

CO2: Apply suitable knowledge/concepts acquired to develop appropriate solutions.

CO3: Plan vital stages in development, Use modern tools/methods. multidisciplinary skill set, knowledge to implement the proposed work

CO4: Work as an individual and (or) in a team towards the problem statement following best practices.

CO5 : Demonstrate a thorough and systematic understanding of project work through effective communication, documentation, and report submission.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PROJECT MANAGEMENT AND FINANCE				
COURSE CODE	19ES7HSPMF	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 7 Hours

Concepts of Project Management - Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Concepts of project, Categories of project, Project life cycle phases, Project management concepts, Tools and techniques for project management, The project manager, Basic education for a project manager, Roles and responsibilities of project manager, Project manager as profession, Summary

UNIT-II 8 Hours

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, Appointing a project manager, Fixing the Zero date, Summary

UNIT-III 8 Hours

Organizing Human Resources and Contracting - Delegation, Project managers authority, Project organization , Accountability in Project Execution , Contracts , R's of contracting, Tendering and Selection of Contractors, Team building, Summary

UNIT-IV 8 Hours

Organizing Systems and Procedures for Project Implementation - Working of systems, Design of Systems, Project work system design , Work

breakdown structure, Project execution plan, Project procedure manual, Project control system, Planning, Scheduling and Monitoring, Monitoring contracts, Project diary , Summary.

UNIT-V **8 Hours**

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 ,Summary**.**

Text books:

1 Project Management – S Choudhury, Tata McGRAW Hill Publishing Company Limited

2 Projects- 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 by 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- Peason Publication

E- References:

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=5pwc2DYlKQU

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Apply the Knowledge of project management principles and to study the current market trends

CO2: Analyse project management methodologies ethically for successful project completion

CO3: Identify the investment opportunities and to formulate the projects.

CO4: Choose projects which benefit the society and organization and apply project phases and document them for future reference.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	**MOOCS COURSES**				
COURSE CODE	**19EI7NCMOC**	**Credits**		**L-T-P**	

Students need to have taken and successfully completed ONE MOOC course (of minimum four weeks duration), from any recognized online platform: NPTEL/SWAYAM/ Coursera/ Edx etc. The courses can be in the Engineering domain, Management domain, Science Domain, Sanskrit / Foreign Language, Art (music/dance/theatre any other), Journalism (media communication or any other), or any domain. Students are awarded a Pass Grade on submission of the successful completion certificate, and needs to have taken the course any time after having joined the program.

VIII Semester

COURSE TITLE	INTELLECTUAL PROPERTY RIGHTS AND CYBER LAW				
COURSE CODE	19ES8HSIPL	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 5 Hours

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 6 Hours

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.

UNIT-III **6 Hours**

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

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

Infringement of copyright: 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 copyright.

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 **5 Hours**

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

UNIT-V **4 Hours**

Indian Cyber law: Protecting Indian children online, Spam, contempt in cyberspace, Indian consumers & cyber space, E-courts of India.

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.TRamakrishna,"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.

E- References:

1. https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf

2. https://osou.ac.in/eresources/introduction-to-indian-cyber-law.pdf

e-Learning:

1. https://nptel.ac.in/courses/110/105/110105139/

2. https://nptel.ac.in/courses/109/106/109106137/

Internal choice: Unit – II & III

Course outcomes

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

CO1: Understand the prominence of professional ethics, responsibilities to obtain Intellectual property Rights.

CO2: Identify the impact of Patents, Copyright, Trademarks and Cyber Law in the societal and environmental context.

CO3: Analyse the influence of Cyber Law of a nation to assess societal, health, safety & cultural issues.

CO4: Effectively engage in teams to instil IPR & Cyber Law in one's own work.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	SMART SENSORS AND ANALYTICS				
COURSE CODE	19EI8OE3SA	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 7 Hours

Sensor Fundamental:

Introduction, sensor classification, Thermal sensor, Humidity sensor, Capacitive sensor, Planar interdigital sensor, Planar electromagnetic sensor, Light sensing Technology, Moisture sensing Technology, CO_2 sensing technology, sensor parameters, selection of sensors.

UNIT-II 8 Hours

Interfacing of Sensors and Signal Conditioning:

Change of Bias and Level of Signals, Loading Effect on Sensor's Output, Potential Divider ,Low-Pass RC Filter High-Pass RC filters ,Practical Issues of Designing Passive Filters Op-Amp Based Instrumentation Differential Amplifier Common Mode Rejection Single-Resistance Controlled Instrumentation Amplifier Current-to-Voltage Converter Comparator , A Few Guidelines to Design Signal Conditioning Circuit, Factors Affecting Performance of Sensors, Effect of Temperature ,Degradation of Sensors

UNIT-III 8Hours

Wireless Sensors, Sensors Network and Power Supplies for Sensors

Introduction ,Frequency of Wireless Communication , Development of Wireless Sensor Network Based Project, Wireless Sensor Based on

Microcontroller and Communicating Device ,Wireless Sensor Network Based on Microcontroller and ZigBee Communicating Device ,Wireless Sensor Network Based on Only ZigBee , Power Sources ,Power from Mains Supply . Selection of Batteries, ,Energy Harvesting Solar Energy, Wind Energy RF Energy Harvesting ,Energy Harvesting from Vibration, Thermal Energy Harvesting, Energy Management Techniques

UNIT-IV **8 Hours**

Sensors Signal Processing Techniques

Introduction ,A Brief Review of Signal Processing Techniques for Structural Health Monitoring ,Normalization Feature Extraction , Dimensionality Reduction ,Collaborative Damage Event Detection (CBED) Method ,Signal Processing Techniques for Information Extraction from Sensor Data ,Deriving Information from Sensor Data: Daily Activity Recognition Models, The Hidden Markov Model (HMM),Emerging Patterns (EP), Finding Patterns in Sensor Data, Classifying Sensor Data, Detecting Trends ,Characterizing Sensor Data

UNIT-V **8 Hours**

Introduction to Machine learning in wireless Sensor Networks: Algorithms, strategies and applications:

Introduction to machine learning in wireless sensor networks, Supervised Learning- K-nearest neighbour, Decision tree, Neural networks, Support vector machines ,Bayesian statistics, Unsupervised Learning- K-means clustering, Principal component analysis, Reinforcement Learning, functional challenges, non-functional challenges, miscellaneous applications, future applications of machine learning in wireless sensor networks

CASE STUDIES:

1. Measurement of Human Body Temperature
2. Intelligent Sensing System for Emotion Recognition
3. WSN Based Smart Power Monitoring System

Text books:

1. "Intelligent Sensing, Instrumentation and Measurements" Subhas Chandra Mukhopadhyay, Springer

2. "Wireless Sensor Networks'' Hossam Mahmoud Ahmad Fahmy, Springer Singapore

3. "Data Acquisition and Signal Processing for Smart Sensors'',Nikolay V. Kirianaki, Sergey Y. Yurish, Nestor O. Shpak (Author), Vadim P. Deynega, John Wiley & Sons, Ltd

Reference books:

1. "Smart Sensor Systems", Emerging Technologies and applications, Gerard Meijer, Kofi Makinwa, Michiel Pertijs,John Wiley & Sons

2. ''Handbook of Wireless Sensor Networks: Issues and Challenges in Current Scenarios'' Singh P.K., Bhargava B.K., Paprzycki M., Kaushal N.C., Hong W C, Springer

3. "Machine Learning in Wireless Sensor Networks: Algorithms, Strategies, and Applications", Mohammad Abu Alsheikh, Shaowei Lin, Dusit Niyato and Hwee-Pink Tan, IEEE Explore- IEEE Communications Surveys & Tutorials

E- References:

1. https://onlinecourses.swayam2.ac.in/arp20_ap41/preview

2. https://nptel.ac.in/courses/108/108/108108147/

Internal choice: Unit – III & IV

Course outcomes

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

CO1: Understand and explain the basic knowledge of sensors used for making wireless sensors or smart sensors

CO2: Relate the issues of interfacing sensors to a processor and signal conditioning.

CO3: Analyze interaction among different components and importance of developing of WSN , a power supply and different energy harvesting techniques

CO4: Use few signal processing techniques for analyzing the sensors data.

CO5: Choose Machine learning implementation strategies and the configuration of a sensor node and the coordinator.

CO6: Make a report on case studies and make presentation

COURSE TITLE	AUTOMOTIVE INSTRUMENTATION				
COURSE CODE	19EI8OE3AU	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

UNIT-I 8 Hours

Electric and Hybrid Electric Vehicles

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

UNIT-II 8 Hours

Energy storage for EV and HEV

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.

UNIT-III 7 Hours

Mechatronics: Mechatronic systems and components, development methods, outlook.

Control units: Operating conditions, design, data processing, digital modules in the control units, control unit software,

UNIT-IV 8 Hours

Automotive sensors: automotive applications, details of the sensor

market, sensor classification, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, , Engine Coolant Temperature (ECT) Sensor, Lambda Sensors
Actuators: Solenoid, Fuel Injector, EGR Actuator, Ignition System

UNIT-V **8 Hours**

Power Electronic Converter for Battery Charging

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging,

Text books:

1 Automotive electrics Automotive electronics, 5th edition, Robert Bosch GmbH.
2 William B.Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
3 Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.
4 Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S. Gay and Ali Emadi CRC Press 2005
5 Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press 2003

Reference books:

1. Understanding Automobile electronics, William B Ribbon, 6th Edition, 2003 Elsevier Science

E- References:

1. https://www.etf.ues.rs.ba/~slubura/Mehatronicki%20sistemi%20kod%20motora%20i%20vozila/Literatura/understanding%20automative%20electronics.pdf
2. https://instrumentationtools.com/instrumentation-books-download/

e-Learning:

1 https://swayam.gov.in/NPTEL
2 https://www.udemy.com/topic/automobile-engineering/

Internal choice: Unit – IV & V

Course outcomes

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

CO1: Understand the working OPS, ABS, ACC and TCS in gasoline and diesel engines
CO2: Analyze the architecture and role of electronic components in a vehicle
CO3: Determine the functions of control units and mechatronics in an automobile engineering
CO4: Analyze the requirement of sensors and actuators for automobile applications
CO5: Describe the working of various sensors used in automotive electronics

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	PROJECT WORK - 2				
COURSE CODE	19EI8PWPW2	Credits	9	L-T-P	0:0:9
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Course outcomes

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

CO1: Apply fundamental knowledge of measurements and Electronic instrumentation to the solution of complex engineering problem.

CO2: Analyse research based knowledge to design the system components or processes with appropriate considerations to meet the specifications

CO3: Use modern tools for modelling and simulation of complex engineering problems to arrive at suitable conclusions.

CO4: Use contextual knowledge relevant to professional engineering practice to address societal needs.

CO5 : Comprehend the need for sustainable solutions towards societal, environmental context and apply ethical engineering practise to their work.

CO6: Demonstrate the use of management principles through usage of Gantt chart and make effective presentations and documentations.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

COURSE TITLE	SEMINAR ON INTERNSHIP				
COURSE CODE	19EI8SRSMR	Credits	2	L-T-P	0:0:2
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VIII semesters. The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like:

1 Successful completion of Value Added Programs/Training Programs/ workshops organized by academic Institutions and Industries
2 Soft skill training by the Placement Cell of the college
3 Active association with incubation/ innovation /entrepreneurship cell of institute
4 Participation in Inter-Institute innovation related competitions like Hackathons
5 Working for consultancy/ research project within the institutes
6 Participation in activities of Institute“s Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests
7 Internship with industry/ NGO“s/ Government organizations/ Micro/Small/Medium enterprises
8 Development of a new product/ business plan/ registration of a start-up Long term rural internship For complete details refer: AICTE Internship Policy: Guidelines and Procedures

Course outcomes

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

CO1: Conduct a literature review, present and prepare the report.

CO2: Engage in internship in an engineering domain and comprehend the professional norms of the organization.

CO3: Interpret technological solutions, keeping the standard practices and scalability in to consideration.

CO4: Work as an individual towards critical thinking about topics of current trends in chosen technical domain.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
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COURSE TITLE	**VIRTUAL LABS**				
COURSE CODE	**19EI8NCVTL**	**Credits**		**L-T-P**	

Students need to have opted and used Virtual Labs any time after having joined the undergraduate program. Further the students are supposed to justify the usage of Virtual Lab through proper communication as per department norms.