



BMS College of Engineering, Bangalore

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು - 560 019

Department of Electronics and Instrumentation Engineering

Scheme and Syllabus: III and IV

Scheme: V to VIII

For Batch Admitted 2018 onwards

Placed for Ratification and Approval

AC Meeting held on 20 September, 2019

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.
- 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.

PEO 1	Excel in professional career in Instrumentation engineering and allied industries.
PEO 2	Adapt to modern technological advancement by upgrading knowledge.
PEO 3	Exhibit leadership, team spirit and communication skills with a commitment towards the requirements of society.

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.

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
PO8	Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: 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	Apply the concepts of data acquisition, signal conditioning, control and communication in the field of electronics and instrumentation.
PSO 2	Apply the knowledge of automatic process control and virtual instrumentation for modelling analysis, interfacing and control of physical processes & systems.
PSO 3	Apply the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

III Semester Scheme

Course Code	Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
19MA3BSEM3	Engineering Mathematics - III	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 Electronics 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
19IC3HSCIP	Constitution of India and Professional Ethics	HS	1:0:0	1	1	50	50	100
19ET3NCPYA	Physical Activity	NC	-	-	2	-	-	P/NP
Total			19:2:4	25	33	400	400	800

IV Semester Scheme

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
19MA4BSEM4	Engineering Mathematics -IV	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
19ET4PCEMF	Electro Magnetic Field Theory	PC	2:1:0	3	4	50	50	100
19IC4HSEVS	Environmental studies	HS	2:0:0	2	2	50	50	100
19ET4NCCLA	Cultural Activity	NC	-	-	2	-	-	P/NP
Total			19:4:2	25	33	350	350	700

V Semester Scheme

Code	Course Title	Type	L:T:P	Credits	Hrs	CIE	SEE	Total
19EI5PCTNI	Transducers & Instrumentation	PC	3:0:1	4	5	50	50	100
19EI5PCPCS	Process Control	PC	3:0:1	4	5	50	50	100
19ES5PCDSP	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 **							
	PP 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 -1	PW	0:0:2	2	4	50	50	100
19EI5NCDTA	Documentary & Theatre Activity	NC	-	-	2	-	-	P/NP
Total			20:0:5	25	32	400	400	800

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

VI Semester Scheme

Code		Course Title	Type	L:T:P	Credits	Hrs	CIE	SEE	Total
19EI6PCAPC		Automation in Process Control	PC	3:0:1	4	5	50	50	100
19EI6PCEST		Embedded Systems	PC	3:0:1	4	5	50	50	100
19EI6PCIDC		Industrial Data Networks	PC	3:0:1	4	5	50	50	100
19GC6HSPMT		Product Management	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*	PE						
	ID	Industrial Instrumentation**	PE						
	BM	Biomedical Instrumentation**	PE						
19EI6CE1 (Cluster Elective- I)	IN	Industrial Internet of Things SM & IOT	PE	3:0:0	3	3	50	50	100
	AD	Algorithms and System Design	PE						
19EI6OE1 (Open Elective- I)	SM	Sustainable Solutions for Smart Cities	OE	3:0:0	3	3	50	50	100
	M D	Multi-Domain System Modelling*	OE						
19EI6PWMP2		Mini Project -II	PW	0:0:2	2	4	50	50	100
19EI6NCASD		Aptitude /Skill Development	NC	0:0:0	0	2	00	00	P/NP
		Total		20:0:5	25	32	400	400	900

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

VII Semester Scheme

Code		Course Title	Type	L:T:P	Credits	Hrs	CIE	SEE	Total
19BS7ICBFE		Biology for Engineers	BS	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
	CV	Computer Vision							
19EI7OE2 (Open Elective – II)	IA	Instrumentation for Food Processing and Agriculture	OE	3:0:0	3	3	50	50	100
	IC	Industrial Automation and Control							
19EI7PWPW1		Project Work- I	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	-	-	P/NP
		Total		15:0:4	19	26	400	400	800

VIII Semester Scheme

Code		Course Title	Type	L:T:P	Credits	Hrs	CIE	SEE	Total
19ES8HSIPL		IPR & 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	OE						
19EI8PWMPJ		Major Project II	PW	0:0:9	9	18	50	50	100
19EI8PCSMR		Seminar on Internship	SM	0:0:2	2	4	50	50	100
19EI8NCVTL		Virtual labs	NC		-	2	00	00	P/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:

- Successful completion of Value Added Programs/Training Programs/ workshops organized by academic Institutions and Industries
- Soft skill training by the Placement Cell of the college
- Active association with incubation/ innovation /entrepreneurship cell of the institute;
- Participation in Inter-Institute innovation related competitions like Hackathons
- Working for consultancy/ research project within the institutes
- Participation in activities of Institute's Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests
- Internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises
- 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

Distribution of credits among various Curricular Components

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	24	19	17	175

The mapping of Department Core Courses to POs/PSOs through the COs (III and IV Semester)

SEM	CODE	CRE DITS	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	EM3	4	3	3													
	AEC	4	3	3	2	2	3				1				3		
	DEC	4	3	2	3	2	3				1				3		
	ECA	4	3	3	3		3										
	LOI	3	3	3													
	SAM	3	3	2		2	3		1			1		1	3		
	CIP	1						3		3							
	PHY	0							3			3					
IV	EM4	4	3	3													
	LIC	4	3	3	2	2	2				1	1		1	3		
	MCS	4	3	3	1	3	3				1	1		1		3	
	SAS	4	3	2		1	3	1				1		1		3	
	CST	4	3	2	2		3									3	
	MFT	3	3	3													
	EVS	2							3	3							
	CLA	0							3			3					

III Semester

Course Title	ENGINEERING MATHEMATICS - 3				
Course Code	19MA3BSEM3	Credits	4	L:T:S	3:1:0
(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.					
Course Objectives: The purpose of the course is to make the students conversant with concepts of Linear Algebraic systems, Fourier series, Fourier Transforms and develop computational skills using efficient numerical methods for problems arising in science and engineering.					

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.	
UNIT II	[09 hours]
FOURIER SERIES Introduction: Dirichlet's conditions, Fourier series of periodic functions of period $2l$, 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.	
UNIT III	[9 hours]
FOURIER TRANSFORMS Infinite Fourier transform: Fourier Sine and Cosine transforms, properties, Inverse transforms. Convolution theorem, Parseval's identities.	
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 $1/3^{\text{rd}}$ rule, Simpson's $3/8^{\text{th}}$ rule, Weddle's rule. Numerical solution of ordinary differential equations: modified Euler's method, Runge-Kutta method of fourth order.	
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.	

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question each from units 1, 2, 4 and two questions each from Unit 3 and Unit 5.

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 43rd 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.

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>

Online Courses and Video Lectures:

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)

Question Paper Pattern:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from units 1, 2, 4 and two questions each from Unit 3 and Unit 5. Questions.

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	PO1
CO2	Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.	PO1
CO3	Apply the concepts of calculus to functionals.	PO1

Course Title	ELECTRICAL CIRCUIT ANALYSIS				
Course Code	19ES3CCECA	Credits	4	L:T:S	3:1:0
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 & cut-set, 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 and Analysis of Unbalanced three-phase Load Definition of Z, Y, T, h parameters, modeling, relationship between parameters sets.					
Choice: Unit-I and Unit-IV					
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.
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 Books:

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.

MOOCs:

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

Course outcomes

At the end of the course on **Electrical Circuit Analysis**, the student will have the ability to

CO1	Ability to define, understand and explain concepts related to electrical circuits	--	PSO3(3)
CO2	Ability to apply the knowledge of network theorems to the given electrical circuit to obtain the desired parameter	PO1(3)	PSO3(3)
CO3	Ability to analyze given electrical circuit to arrive at a suitable conclusion	PO2(3)	PSO3(3)
CO4	Ability to conduct experiments to demonstrate the specified concept/ application of electrical circuit on the Multisim platform	PO1(3) PO5(3)	PSO3(3)
CO5	Ability to analyse the given electrical circuit on the Multisim platform to compute the desired parameter	PO2(2) PO5(2)	PSO3(3)

Course Title	ANALOG ELECTRONIC CIRCUITS				
Course Code	19ES3CCAEC	Credits	4	L:T:S	3:0:1

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					[07 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					[10 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					[7 hours]
MOSFETS:- Introduction ,Device structure and physical operation ---- Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small V_{DS}, Operation as V_{DS} is increased, Derivation of the $i_d - V_{DS}$ relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub-threshold region .					

Current voltage Characteristics---Circuit symbol, $i_d - V_{DS}$ characteristics, characteristics of the P- Channel MOSFET

MOSFET Circuits at DC The MOSFET as an amplifier and as a switch --- Large – signal operation , Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.

Biasing in MOS amplifier circuits---Biasing by fixing V_{GS} , Biasing by fixing V_G and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source

UNIT V

[7 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 the signal analysis, small signal equivalent circuit models, the trans conductance g_m , the T equivalent circuit model.

Single stage MOS amplifiers---The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance. Common gate (CG) Amplifier, The common Drain or source follower Amplifier.

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

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

Choice: Unit-I and Unit-V

LAB Experiments

Sl.No	Title of the 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
12	Conduct an experiment using electronic components, repeat the same experiment on the Multisim Platform and make a comparative study (voltage level, frequency, input amplitude range, input frequency range, output impedance etc)

13	Team Experiment (Hardware): connect a regulator, its output to an oscillator, its output to amplifier/clipper/clamper, and finally to the speaker (for given specifications)
14	Team Experiment (Simulation): connect a regulator, its output to an oscillator, its output to amplifier/clipper/clamper, and finally to the speaker (for given specifications)

TEXT BOOKS:

1. Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky-10th edition (PEARSON EDUCATION)
2. Microelectronic Circuits-Theory and applications by ADEL S. SEDRA and KENNETH C.SMITH FIFTH EDITION (OXFORD INTERNATIONAL STUDENT EDITION)

REFERENCE BOOKS:

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

E Books:

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

MOOCs:

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

Course outcomes:

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

CO1	Ability to define ,understand and explain concepts related to diodes and transistors (BJTs and MOSFETs)	--	PSO1(3)
CO2	Ability to apply the knowledge of network theorems to the given analog electronic circuit to obtain the desired parameter	PO1(3)	PSO1(3)
CO3	Ability to analyze given analog electronic circuit to arrive at a suitable conclusion	PO2(3)	PSO1(3)
CO4	Ability to design analog electronic circuit for given application and specifications	PO3(2)	PSO1(3)
CO5	Ability to conduct experiments to demonstrate the specified concept/ application of analog electronic circuits	PO1(3) PO5(3)	PSO1(3)
CO6	Ability to conduct experiments to verify THREE parameters of the datasheet of the given electronic component	PO4(2) PO5(3)	PSO1(3)
CO7	Ability to design and conduct experiment using analog electronic circuit for given application and specifications	PO3(2) PO5(3)	PSO1(3)
CO8	Ability to conduct experiments using discrete components, repeat the same using the Multisim tool and make a comparative study	PO4(2) PO5(2)	PSO1(3)

Course Title	DIGITAL ELECTRONIC CIRCUITS				
Course Code	19ES3CCDEC	Credits	4	L:T:S	3:0:1

UNIT I	[07 hours]
---------------	-------------------

Introduction: Review of Boolean algebra, logic gates.

Simplification of Boolean functions: Three Variable, Four Variable and Five Variable 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	[7 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	[7 hours]
----------------	------------------

Sequential systems:

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

UNIT V	[7 hours]
---------------	------------------

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

Choice: Unit-II and Unit-III

LAB Experiments

	Title of the Experiment
1	Applications of IC 7483 (Adders, Subtractors and Comparators) (Unit-II)
2	Adders: BCD, Carry Look Ahead
3	Multiplexers (using Gates and IC) and their applications (Unit-II)
4	Decoders/DeMultiplexers (using Gates and IC) and their applications (Unit-II)
5	BCD to Decimal decoder using 7-segment display (Unit-II)
6	Verification of MSJK Flip-flop (using Gates and IC 7476) (Unit-III)
7	Asynchronous counters (using ICs 7476,7490,7493) (Unit-III)

8	Synchronous Counters (using ICs 7476, 74190/74192) (Unit-III)
9	Shift registers and their applications (using ICs 7476, 7495) (Unit-III)
10	Verification of few parameters of TTL (Unit-V)
11	Verification of few parameters of CMOS (Unit-V)
12	Verify few parameters of the Digital IC from its data sheet
13	Build and verify the specified Gate/Flip-Flop using suitable analog electronic components on the Multisim platform
14	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 P Jain-TMH

E-Books:

1. <http://www.panstanford.com/pdf/9789814364591fm.pdf>
2. <https://easyengineering.net/digital-logic-and-computer-design-by-morris-mano/>
3. <https://www.sciencedirect.com/book/9780750645829/digital-logic-design>
4. <https://easyengineering.net/fundamentals-of-digital-circuits-by-anand-kumar/>

Moocs:

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

Course outcomes:

At the end of the course on **Digital Electronic Circuits**, the student will have the

CO1	Ability to understand, define and explain the fundamental concepts of Digital Electronic circuits	--	PSO1(3)
CO2	Ability to apply the concepts and simplification methods of Digital Electronic circuits for the specified application	PO1(3)	PSO1(3)
CO3	Ability to analyse digital electronic circuit and arrive at suitable conclusions	PO2(2)	PSO1(3)
CO4	Ability to design a digital circuit to meet given specifications	PO3(3)	PSO1(3)
CO5	Ability to conduct experiments to demonstrate the specific application of digital electronics using suitable digital ICs/ Multisim	PO1(3) PO5(3)	PSO1(3)
CO6	Ability to build the given Gate/Flip-Flop using suitable analog electronic components on the Multisim platform and validate its performance	PO4(2) PO5(2)	PSO1(3)
CO8	Ability to implement and demonstrate the specified mini-project using suitable digital electronic components	PO3(2) PO5(2) PO9(1)	PSO1(3)

Course Title	LASER & OPTICAL INSTRUMENTATION				
Course Code	19EI3PCLOI	Credits	3	L-T-P	3:0:0

UNIT-I**[10 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-II**[7 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**[8 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
BMSCE/E&I Page 29 Fiber losses, fiber materials.

UNIT-IV**[7 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, fluoro-optic temperature sensors, photo elastic pressure sensors, polarization fiber sensors, rotation sensors, integrated optics

UNIT-V**[7 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

CO1	To apply the basic science fundamentals in understanding the principles, characteristics and construction of various types of Lasers and Optical fibres	PO1 (2)	PSO 1(2)
CO2	To apply and analyze the basic engineering principles in understanding the basic instrumentation principle using different type of Laser and optical fibres	PO1, PO2 (2)	PSO1 (2)
CO3	To comprehend the working of optical fibre sensors and detectors for measurement of various parameters	PO1, PO2 (2)	PSO1 (2)
CO4	To apply and analyze the use of optic fiber sensor for a given optical fibre application	PO1, PO2 (2)	PSO 1(2)

Course Title	SENSORS AND MEASUREMENTS				
Course Code	19ES3GCSAM	Credits	3	L:T:S	3:0:0

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	[8 hours]
Acoustic sensor: Resistive and Fiber-optic microphones, Humidity and Moisture sensor: Concept of Humidity, Thermal conductivity and Optical, Hygrometers, Light Detectors: Photodiode, Phototransistor, Photo resistor, Radiation Detectors: Scintillating Detectors and Ionization Detectors	
UNIT IV	[7 hours]
Temperature sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, Optical Temperature sensor, Multi sensor arrays	
UNIT V	[7 hours]
Measuring Instruments: Interface Electronic Circuits, Signal conditioners, Sensor connections, excitation circuits, Data transmission, Noise in sensors and circuits, Battery for low power sensors.	
CHOICE UNITS: UNIT II and UNIT III.	
List of Experiments Application of following sensors using electronic components 1. Touch sensor 2. Light sensor 3. Linear variable position transducer 4. Temperature dependence of diodes 5. Microphone to speaker amplifier circuit 6. Water level indicator 7. IR sensor and Photodiode 8. Piezo Electric sensor 9. Heat sensor 10. Strain gauge 11. Thermistor 12. Mini project to build an instrument on Multisim platform 13. 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, Springer 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 Instrumentation and Measurements", David A Bell, PHI / Pearson Education, 2006

Course outcomes:

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

CO1	Ability to understand, define and explain the concepts of Sensors and Measurements	--	PSO1(X)
CO2	Ability to apply the concepts of Sensors and Measurements to obtain the desired parameter	PO1(3)	PSO1(3)
CO3	Ability to conduct experiments to demonstrate the specified concept/ application of Sensors	PO1(3) PO5(3)	PSO1(3)
CO4	Ability to conduct experiments to verify few parameters from the datasheet of the given sensor	PO4(2) PO5(3)	PSO1(3)
CO5	Ability to build the specified Instrument using Multisim	PO2 (2) PO5 (2) PO9 (1)	PSO1(3)
CO6	Ability to engage in independent study and make an oral presentation on the hazards of E-waste on Environment	PO7(1) PO10(1) PO12(1)	PSO3(3)

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS				
Course Code	19IC3HSCPH/ 19IC4HSCPH	Credits	1	L:T:S	1:0:0

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	[2 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 – 42 nd , 44 th , 61 st , 74 th , 76 th , 77 th , 86 th and 91 st . Emergency Provisions. Case Studies.	
UNIT IV	[3 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	[3 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; 4. edition (February 6, 2004) .

E-Book:

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.

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.	PO6(3)
CO2	Analyse the concepts and ideas of Human Rights.	PO2(3) PO6(3)
CO3	Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.	PO1(3) PO8(3)

Course Title	Physical Activity				
Course Code	19ET3NCPYA	Credits	0	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

--	--

Course Title	ENGINEERING MATHEMATICS -4				
Course Code	19MA4BSEM4	Credits	4	L:T:S	3:1:0

(Common to AS/CV/EEE/ECE/EIE/ML/TCE)

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

Course Objectives: To prepare students with adequate knowledge in Probability and Statistics, Complex Analysis and develop computational skills using efficient numerical methods for problems in science and engineering.

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	[9 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 formula and Crank-Nicolson two-level implicit formula. Solution of one-dimensional 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 $w = z + \frac{a^2}{z}$ ($z \neq 0$). Bilinear transformations. (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)

Question Paper Pattern:

1. Five full questions to be answered.
2. To set one question in Units 1, 2, 3 and two questions each in unit 4 and unit 5.

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 books and online course materials:

1. <https://www.coursera.org/learn/basic-statistics>
2. http://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

Online Courses and Video Lectures:

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)

Course outcomes:

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

CO1	Demonstrate an understanding of concepts of statistical analysis and probability distributions.	PO1(3)
CO2	Apply Numerical techniques to solve partial differential equations arising in engineering.	PO1(3)
CO3	Demonstrate an understanding of analytic functions and their application to evaluate integrals.	PO1(3)

Course Title	CONTROL SYSTEMS				
Course Code	19ES4ESCST	Credits	4	L:T:S	3:1:0
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					[8 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					[10 hours]
State Variable Analysis:					
Concept of state variables, physical variable model, phase variable model, canonical model, obtaining transfer function from state model.					
Choice: Unit-I and Unit-IV					

List of experiments:

- Determine the overall transfer function of the a control system
- Determine rise time, peak time, peak overshoot and settling time for the given transfer function.
- To obtain and plot the Unit step, Unit ramp response of a closed loop control system.
- To obtain Nyquist diagram for given transfer function.
- Determine the root locus of the given characteristic equation for the given control system.
- Determine gain margin, phase margin, gain crossover frequency and phase crossover frequency for the given control system.
- Design and analysis of lead-lad compensators using time domain specifications
- Design and analysis of lead-lad compensators using frequency domain specifications

TEXT BOOKS:

1. Control Engineering by 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 Books:

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

Moocs:

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

Course outcomes:

At the end of the course **Control Systems**, the student will have the

CO1	Ability to define, understand and explain concepts related to linear control systems	--	PSO3(3)
CO2	Ability to apply the concepts of control systems and signal processing to obtain the specified parameter/ system function	PO1(3)	PSO3(3)
CO3	Ability to analyze the given linear control system and arrive at a suitable conclusion	PO2(2)	PSO3(3)
CO4	Ability to conduct experiments to demonstrate concepts related to linear control systems using the engineering tool: Matlab/ Simulink	PO1(3) PO5(3)	PSO3(3)
CO5	Ability to design Compensators and controllers to meet given (time/frequency domain) specifications	PO3(2) PO5(2)	PSO3(3)

Course Title	LINEAR INTEGRATED CIRCUITS				
Course Code	19ES4CCLIC	Credits	4	L:T:S	3:0:1
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					[7 hours]
Voltage Regulators 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					[8 hours]
D-A and A-D converters Introduction, Analog and Digital data converter, specifications of D/A and basic DAC techniques-weighted resistor DAC, R-2R ladder DAC, A-D Converters: Specifications of A/D converter, classification of ADCs- The parallel Comparator (Flash)ADC, counter type ADC, Successive Approximation Converter, single slope type ADC and Dual slope type ADC, Sigma-delta ADC					
UNIT V					[7 hours]
Timers Phase locked loops: Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO), PLL in frequency multiplication/Division Choice: Unit-I and Unit-IV					

LAB Experiments

Sl. No.	Experiment Name
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.	Wein bridge 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
13.	Build a signal generator and drive the speaker
14.	Build the voltage regulator to drive the timer/oscillator/filter/converter
15.	Implement a mini-project, as a member of a team, to build a waveform, convert to Digital, then convert the Digital to Analog and compare the original and recovered waveform (in hardware and on the Multisim platform)
16.	Implement the experiment in Hardware and Multisim, and make the comparative study, list the differences
17.	Make a comparative study of available (i) A to D convertors, (ii) D to A convertors, (iii) timers, (iv) Operational Amplifiers, in terms of the operating frequency, specifications, cost and other relevant parameters

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Opamps 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 Books:

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

MOOCs:

1. https://swayam.gov.in/nd1_noc19_ee39/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/>

Course outcomes:

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

CO1	Ability to define ,understand and explain concepts of linear integrated circuits (LIC)	--	PSO1(3)
CO2	Ability to apply the concepts of LIC to obtain the desired parameter	PO1(3)	PSO1(3)
CO3	Ability to analyze given LIC to arrive at a suitable conclusion	PO2(3)	PSO1(3)
CO4	Ability to design LIC for given application and specifications	PO3(2)	PSO1(3)
CO5	Ability to conduct experiments to demonstrate the specified concept/ application of LIC	PO1(3) PO5(3)	PSO1(3)
CO6	Ability to conduct experiments to verify THREE parameters of the datasheet of the given LIC/Component	PO4(2) PO5(3)	PSO1(3)
CO7	Ability to design and conduct experiment using LIC for given application and specifications	PO3(2) PO5(3)	PSO1(3)
CO8	Ability to implement a mini-project to implement and demonstrate the given problem using suitable LICs and components	PO2 (2) PO5 (2) PO9 (1)	PSO1(3)

Course Title	MICROCONTROLLERS				
Course Code	19ES4CCMCS	Credits	4	L:T:S	3:0:1

UNIT I	[08 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.	
UNIT II	[08 hours]
Instruction Set and Assembly Language Programming: Introduction, Instruction syntax, Data types, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Assembly language programs, Subroutine instructions, Bit manipulation instruction.	
UNIT III	[7 hours]
Embedded C Programming: C Data Types, Timer and counter programming, Basics of Serial communication, Programming UART for serial communication, Interrupts.	
UNIT IV	[6 hours]
Memory and I/O Interfacing: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC.	
UNIT V	[7 hours]
Applications - Communication Interface: LCD, ADC, Stepper motor interfacing, DC Motor interfacing, Sensor interfacing for control applications. CHOICE: UNIT 2 and UNIT 3	
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.

Course outcomes:

At the end of the course on **Microcontrollers**, the student will have the

CO1	Ability to understand and explain various concepts of microprocessors and microcontrollers	--	PSO3(3)
CO2	Ability to apply the concepts of microprocessors and microcontrollers to obtain the desired parameter	PO1(3)	PSO3(3)
CO3	Ability to develop the code (assembly/C) to perform the specified task	PO2 (3) PO5 (3)	PSO3(3)
CO4	Ability to design and develop the logic to interface external memory and peripherals	PO3 (1)	PSO3(3)
CO5	Ability to analyse/debug the given code	PO4(3)	PSO3(3)

CO6	Ability to conduct experiments by developing the code (assembly/C) to perform the specified task	PO1 (3) PO5 (3)	PSO3(3)
CO7	Ability to conduct investigations to analyse/debug the given code	PO2 (2) PO4 (2)	PSO3(3)
CO8	Ability to implement a mini-project to develop solutions to the given problem using 8051 and suitable sensors	PO3 (2) PO5 (2) PO9 (1)	PSO3(3)
CO9	Ability to engage as a member of a team to prepare a comparative study (specifications, applications, cost) of various microcontrollers available in market	PO9 (1) PO10 (1) PO12 (1)	PSO3(3)

Course Title	SIGNALS AND SYSTEMS				
Course Code	19ES4CCSAS	Credits	4	L:T:S	3:1:0

UNIT I	[10 hours]
INTRODUCTION: Definitions of a signal, elementary signals, classification of signals and basic operations on signals.	
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.	
UNIT III	[8 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).	
UNIT IV	[10 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.	
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.	
Choice: Unit-I and Unit-III	
TEXT BOOKS: 1. Simon Haykin and Barry Van Veen “Signals and Systems”, John Wiley & Sons, 2001.Reprint 2002 2. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, “Signals and Systems” Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002	
REFERENCE BOOKS: 1. H. P Hsu, R. Ranjan, “Signals and Systems”, Scham's outlines, TMH, 2006	

2. B. P.Lathi, "Linear Systems and Signals", Oxford University Press, 2005
3. Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004

E Books:

1. NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy,
<http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html>
2. NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu,IIT
Kharagpur. <http://www.nptel.ac.in/courses/108105065/>
3. NPTEL on line Course Modules–IIT Bombay –Signals and Systems
<http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/TOC-M1.html>

Course outcomes:

At the end of the course on **Signals and Systems**, the student will have the

CO1	Ability to define, understand and explain concepts of Signals and Systems	--	PSO3(3)
CO2	Ability to apply the concepts of signals and systems processing to obtain the specified parameter/ system function	PO1(3)	PSO3(3)
CO3	Ability to analyze the given signal/ system and arrive at a suitable conclusion	PO2(2)	PSO3(3)

Course Title	Magnetic Field Theory				
Course Code	19EI4PCMFT	Credits	3	L:T:S	2:1:0
UNIT I					[08 hours]
INTRODUCTION Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate 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					[12 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					[9 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					[5 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					[6 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. Ashutosh Pramanik, '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 AND ENG
4. Clayton R Paul, ' Introduction to Electro Magnetic compatibility', 2nd edition, Wiley India Pvt,Ltd.,

E Books

1. NPTEL Video Lecture On Electromagnetic Theory By Dr. Harishankar Ramachandran, IIT Madras. <http://www.nptel.ac.in/courses/108106073/>
2. Phillips P., Engineering Dielectrics Volume IIA Electrical Properties of Solid Insulating
3. Materials: MolecularStructure and Electrical Behavior., http://www.astm.org/DIGITAL_LIBRARY/STP/SOURCE_PAGES/STP783.htm

CO1	Ability to define, understands, and explains concepts on Electrostatics and magnetostatics, Time varying fields and Maxwell's equations, EMI and EMC.
CO2	Ability to apply various properties/ laws/theorems/ Maxwell's equations of electrostatics, magnetostatics to solve/derive examples in different media of time varying fields.
CO3	Ability to analyse the given specifications of static and time varying Electric, Magnetic field.
CO4	Ability to make an effective oral presentation on Electromagnetic transmission norms, radiation hazards, effect on Environment, EMI and EMC.

Course Title	CULTURAL ACTIVITY				
Course Code	19ET4NCCLA	Credits	0	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.

Course Title	Environmental Studies				
Course Code	19IC4HSEVS	Credits	2	L:T:S	2:0:0
COURSE OBJECTIVE: 1. To acquire the knowledge of environmental studies, it's need & importance 2. To understand the concept, structure and function of different ecosystems 3. To know about pollution problems and green technology 4. To develop a sense of responsibility about the role of students in fostering the idea of learning to live in harmony with nature. 5. To aware the studies about current conditions of environment 6. To give an opportunity to the student to experience the interdisciplinary nature of the environmental studies 7. To create interest in students about the environment through a project work 8. To encourage student to prevent the environmental degradation					
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 utilisation, 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 conservation: 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.

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.

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

REFERENCES:

1. Environmental studies by – Benny Joseph
2. Environmental studies by – Dr. D.L.Manunath

LEARNING RESOURCES:

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

MOOC's:

MOOCS – <https://www.coursera.org/course/sustain>

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.	PO7(3)
CO2	Apply the environmental concepts for conservation and protection of natural resources.	PO7(3)
CO3	Identify and establish relationship between social, economical and ethical values from environmental perspectives.	PO7(3) PO8(3)

Bridge Course in Mathematics for III Semester Lateral Entry Students

(Common to all Branches)

Course Title	Additional Mathematics-I				
Course Code	19MA3IMMAT	Credits	0	L:T:S	3 – 1 – 0

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

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as differentiation, differential equations, vectors and orthogonal curvilinear coordinates for different branches of engineering.

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 functions. 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	[9 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

[8 hours]

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS [10 Hours]

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 Book:**

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 Book:

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 books and online course materials:

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)

Online Courses:

1. [https:// www.khanacademy.org/Math](https://www.khanacademy.org/Math)
2. [https:// www.class-central.com/subject/math](https://www.class-central.com/subject/math) (MOOCS)

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.	PO1(X)
CO2	Apply the concepts of polar curves and multivariate calculus.	PO1(X)
CO3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	PO1(X)

CO4	Apply techniques of vector calculus to engineering problems.	PO1(X)
CO5	Comprehend the generalization of vector calculus in curvilinear coordinate system.	PO1(X)

Bridge Course in Mathematics for IV Semester Lateral Entry Students

(Common to all Branches)

Course Title	Additional Mathematics-II				
Course Code	19MA4IMMAT	Credits	0	L:T:S	3 – 1 – 0

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

Course Objectives: To provide students with a solid foundation in mathematical fundamentals such as Laplace Transforms, Solution of ordinary differential equations using Laplace Transforms, vector integration, computation of area and volume using double and triple integrals respectively.

UNIT I	[9 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 and 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	[9 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

[9 hours]

VECTOR INTEGRATION

Line integral, Green's theorem, Stokes' theorem and Gauss divergence theorem. (7L+2T)

Text Book:

1. Higher Engineering Mathematics, B. S. Grewal, 43rd edition, 2014, Khanna Publishers.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Book:

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 books and online course materials

1. Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001
http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
2. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3. <http://ocw.mit.edu/courses/mathematics/> (online course material)

Online Courses:

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

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.	PO1(X)
CO2	Apply multiple integrals of plane figures to compute areas and volume.	PO1(X)
CO3	Use Gamma and Beta functions to evaluate integrals.	PO1(X)
CO4	Ability to understand the use of integral calculus in scalar and vector fields.	PO1(X)