BMS College of Engineering, Bangalore

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – ೫೬೦ ೦೧೯

Department of Electronics and Telecommunication Engineering

(Earlier Telecommunication Engineering)

Scheme and Syllabus: III to VIII

For Batch Admitted 2018 onwards

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

Our graduates shall be globally competent Engineering professionals

Department Mission

The department will achieve the Vision through:

Curriculum designed for holistic development
Effective implementation of the designed curriculum
Active association with Industry, Academia and Alumni
Research leading to publications/patent/start-up
Emphasis on professional ethics, contribution to society and concern for environment

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 Telecommunication 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 focused on their desire to upgrade their technical skills, the third PEO describes their communication skills and team skills, while the fourth PEO describes their attitude through their concern for environment and society.

The PEOs of the program are as under:

PEO1	Graduates will compete on a global platform to pursue their professional career in Electronics and Telecommunication Engineering and allied disciplines
PEO2	Graduates will pursue higher education and/or engage in continuous up gradation of their professional skills
PEO3	Graduates will communicate effectively and will demonstrate professional behaviour while working in diverse teams
PEO4	Graduates will demonstrate high regard for human rights, have concern for society and environment

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 Telecommunication 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. The National Board of Accreditation (www.nbaind.org), recommends having 2-4 PSOs for a program. After series of discussions with the stakeholders of the program, the Department of Telecommunication Engineering has arrived at three PSOs. Through these PSOs, we attempt to develop the ability to: (i) Build Electronic Systems, (ii) Build Communication Systems and (iii) Simulate systems using Engineering Tools.

At the time of graduation, the Telecommunication Engineers will have the ability to	
PSO1	**Build Electronic Systems** : formulate the problem, design, implement, analyze and demonstrate a feasible solution to the problem, using suitable electronic components
PSO2	**Build Telecommunication Systems** : design, implement, analyze and demonstrate the telecommunication system to receive and(or) transmit signals through the specified channel
PSO3	**Simulate Systems:** develop, test, analyze and demonstrate algorithms to simulate Electronic systems/ Telecommunication systems/ Networking protocols using the specified Engineering Tool

III Semester Scheme *(Batch admitted 2018-19)*

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
19 ES3CCAEC	Analog Electronic Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCFTH	Field Theory	PC	3:1:0	4	5	50	50	100
19ES3CCDEC	Digital Electronics Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCSAM	Sensors and Measurements	PC	3:0:1	4	5	50	50	100
19IC3HSCPH	Constitution of India, Professional Ethics	HS	1:0:0	1	1	50	50	100
19ET3NCPYA	Physical Activity	NC	-	-	2	-	-	P/NP
Total			**19:3:3**	**25**	**32**	**350**	**350**	**700**

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
19ET4PCVLD	VLSI Design	PC	3:0:0	3	3	50	50	100
19HS4ICEVS	Environmental studies	HS	2:0:0	2	2	50	50	100
19ET4NCCLA	Cultural Activity	NC	-	-	2	-	-	P/NP
Total			**20:3:2**	**25**	**32**	**350**	**350**	**700**

III Semester Scheme *(Batch admitted 2019-20)*

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
19 ES3CCAEC	Analog Electronic Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCFTH	Field Theory	PC	3:1:0	4	5	50	50	100
19ES3CCDEC	Digital Electronics Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCSAM	Sensors and Measurements	PC	3:0:1	4	5	50	50	100
20IC3HSEVS	Environmental studies	HS	1:0:0	1	2	50	50	100
19ET3NCPYA	Physical Activity	NC	-	-	2	-	-	P/NP
Total			**19:3:3**	**25**	**34**	**350**	**350**	**700**

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
19ET4PCVLD	VLSI Design	PC	3:0:0	3	3	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 / Baleke Kannada	HS	1:0:0	1	1	50	50	100
19ET4NCCLA	Cultural Activity	NC	-	-	2	-	-	P/NP
Total			**20:3:2**	**25**	**32**	**400**	**400**	**800**

III Semester Scheme *(Batch admitted 2020-21)*

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
19 ES3CCAEC	Analog Electronic Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCFTH	Field Theory	PC	3:1:0	4	5	50	50	100
19ES3CCDEC	Digital Electronics Circuits	PC	3:0:1	4	5	50	50	100
19ES3GCSAM	Sensors and Measurements	PC	3:0:1	4	5	50	50	100
21HS3ICEVS	Environmental studies	HS	1:0:0	1	2	50	50	100
20HS3ICSAK/ 20HS3ICBAK	Samskruthika Kannada / Baleke Kannada	HS	1:0:0	1	1	50	50	100
19ET3NCPYA	Physical Activity	NC	-	-	2	-	-	P/NP
Total			**20:3:3**	**26**	**35**	**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
19ET4PCVLD	VLSI Design	PC	3:0:0	3	3	50	50	100
19IC4HSCPH	Constitution of India, Professional Ethics and Human Rights	HS	1:0:0	1	1	50	50	100
19ET4NCCLA	Cultural Activity	NC	-	-	2	-	-	P/NP
Total			**19:3:2**	**24**	**31**	**350**	**350**	**600**

NOTE: *This Batch has Universal Human Values as a non-credit course in the First year*

V Semester Scheme

Course Code		Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
19ET5PCITC		Information Theory and Coding	PC	2:1:0	3	4	50	50	100
19ET5PCACM		Analog Communication	PC	3:0:1	4	5	50	50	100
19ES5CCDSP		Digital Signal Processing	PC	3:0:1	4	5	50	50	100
19ET5PCTLA		Transmission Lines and Antennas	PC	3:1:0	4	5	50	50	100
19ET5PE1	DS	C++ and Data Structures	PE	3:0:0	3	3	50	50	100
	ES	Embedded Systems Design							
	CY	Cryptography							
	SC	Satellite Communication							
	MB	Elective based on identified MOOCs							
19ET5PE2	OS	Operating Systems	PE	3:0:0	3	3	50	50	100
	VH	Verilog HDL							
	DA	DSP Architecture							
	FC	Optical Fiber Communication							
	MB	Elective based on identified MOOCs							
19ES5HSIFE		Innovation for Entrepreneurship	HS	2:0:0	2	2	50	50	100
19ET5PWREN		Hardware Project (build an electronic system)	PW	0:0:2	2	4	50	50	100
19ET5NCHVL		Human Values through Literature	NC	-	-	2	-	-	P/NP
Total				**19:2:4**	**25**	**33**	**400**	**400**	**800**

VI Semester Scheme

Course Code		Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
19ET6PCMWR		Microwaves and Radar	PC	2:1:0	3	4	50	50	100
19ET6PCDCM		Digital Communication	PC	3:0:1	4	5	50	50	100
19ET6PCCCN		Computer Communication Networks	PC	3:0:1	4	5	50	50	100
19ET6PE3	IT	IOT & Wireless Sensor Networks	PE	3:0:0	3	3	50	50	100
	NS	Network Security							
	AD	ASIC Design							
	SD	Software Defined Radio							
	MB	Elective based on identified MOOCs							
19ET6CE1	AI	Artificial Intelligence	PE	3:0:0	3	3	50	50	100
	SP	Speech Processing							
	DS	Data Science							
19ET6OE1	SP	Analog and Digital Signal Processing	OE	3:0:0	3	3	50	50	100
	MP	Microprocessors							
19GC6HSEEC		Engineering Economics	HS	2:0:0	2	2	50	50	100
19ET6PWMMS		Project Based on Multimedia Standards	PW	0:0:2	2	4	50	50	100
19ET6SRCSR		Seminar based on Internship that involves Community Service	SR	0:0:1	1	2	50	50	100
19ET6NCPDA		Personality Development, Communication and Aptitude Skill;*	NC	-	-	2	-	-	P/NP
Total				**19:1:5**	**25**	**33**	**450**	**450**	**900**

***** *This course is offered through the Placement Office*

VII Semester Scheme

Course Code		Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
19ES7BSBFE		Biology for Engineers	BS	2:0:0	2	2	50	50	100
19ET7PCWCM		Wireless Communication	PC	3:1:0	4	5	50	50	100
19ET7PCSTN		Sustainable Telecom Networks *(by industry Expert)*	PC	1:0:0	1	1	50	50	100
19ET7CE2	DR	Drones: Design and Governing Norms	CE	3:0:0	3	3	50	50	100
	IP	Image Processing							
	PM	Pattern Recognition and Machine Learning							
19ET7OE2	DM	Data Science and Machine Learning	OE	3:0:0	3	3	50	50	100
	SH	Sustainable Health with Technological Advance							
19ES7HSPMF		Project Management and Finance	HS	3:0:0	3	3	50	50	100
19ET7PWRER		Project based on identified research work	PW	0:0:3	3	6	50	50	100
19ET7NCMC1		MOOCs/ Virtual Lab with certification	NC	-	-	2	-	-	P/NP
Total				**15:1:3**	**19**	**25**	**350**	**350**	**700**

VIII Semester Scheme

Course Code		Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
19ES8HSIPL		IPR and Cyber Law	HS	2:0:0	2	2	50	50	100
19ET8OE3	SP	Satellite Principles and Applications	OE	3:0:0	3	3	50	50	100
	CN	Cellular Networks							
19ET8PWMPJ		Major Project	PW	0:0:9	9	18	50	50	100
19ET8SREDI		Seminars Based on Engineering Domain Internships	SR	0:0:2	2	4	50	50	100
19ET8NCMC2		MOOCs/ Virtual Lab with certification	NC	-	-	2	-	-	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 Internships/ 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
(Batch Admitted 2018-19)

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Course Total
Humanities and Social Sciences, Management Course (HS)			2	1	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	11	5		66
Professional Elective Course (PE)					6	6	3		15
Open Elective Course (OE)						3	3	3	9
Project/ Mini-Project (PW)					2	2	3	9	19
Seminar -Internship (SR)						1		2	
Non-Credit Mandatory Course (NC)	NC1	NC2	NC3	NC4	NC5	NC6	NC7	NC8	--
Total Credits	20	20	26	24	25	25	19	16	175

Distribution of credits among various Curricular Components
(Batch Admitted 2019-20)

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	11	5		66
Professional Elective Course (PE)					6	6	3		15
Open Elective Course (OE)						3	3	3	9
Project/ Mini-Project (PW)					2	2	3	9	19
Seminar -Internship (SR)						1		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

Distribution of credits among various Curricular Components
(Batch Admitted 2020-21)

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Course Total
Humanities and Social Sciences, Management Course (HS)			2	1	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	11	5		66
Professional Elective Course (PE)					6	6	3		15
Open Elective Course (OE)						3	3	3	9
Project/ Mini-Project (PW)					2	2	3	9	19
Seminar -Internship (SR)						1		2	
Non-Credit Mandatory Course (NC)	NC1	NC2	NC3	NC4	NC5	NC6	NC7	NC8	--
Total Credits	20	20	26	24	25	25	19	16	175

The mapping of Department Core Courses to POs/PSOs through the COs

SEM	CODE	CREDITS	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	EM3	4	3				1										
	AEC	4	3	3	2	2	3				1				3		
	DEC	4	3	2	3	2	3				1				3		
	ECA	4	3	3			3										3
	FTH	4	3	3	1		1	1				1		1			1
	SAM	3	3	2		2	3		1			1		1	3		3
	EVS	2							3	3							
	PHY	-									1			1			
IV	EM4	4	3														
	LIC	4	3	3	2	2	3				1	1		1	3		
	MCS	4	3	3	2	3	3				1	1		1			3
	SAS	4	3	2		1	3	1				1		1			3
	CST	4	3	2	2		3										3
	VLD	3	3	3	2		2										3
	CPH	1						3		3							
	SAK/BAK	-										3		3			
	CLA	-						3									
V	ITC	3	3	1	3		3						1	1			2
	ACM	4	3	2		1	3					1				1	
	DSP	4	3	3	3		3				1						3
	TLA	4	3	2	2	2	2	1	1	1	1	1		1			1
	IFE	2		3	3				3		3	3	3				
	REN	2	3	3	2	2	3	2	1	3	1	3	2	3	3	3	2
	HVL	-						3		3		3					
VI	MWR	3	3	2	1		3					1				3	
	DCM	4	3	2		2	3						2			3	
	CCN	4	3	1	2		3				1						2
	EEC	2	3						3				3				
	MMS	2	3	3	3	2		1	2	3	3	3	2	3			3
	CSR	1		1				2	2	3		3	2				
	PDA	-				3					3	3					
VII	BFE	2	3					3	3								
	WCM	4	3	3			3	1	1	3	3	3		3		3	3
	STN	1	3						3			3	3	3		3	3
	PMF	3	3	2			2	1		2			3	1			3
	RER	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
	MC1	-												3			
VIII	IPL	2						3	3	3	1	1		1			
	EDI	2	1					1	1	1	1	3	1		1		
	MPJ	9	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	MC2	-												3			

III Semester

Course Title	ENGINEERING MATHEMATICS - 3				
Course Code	19MA3BSEM3	Credits	4	L:T:P	3:1:0
(Common to AS/CV/EEE/ECE/EIE/IEM/ME/ML/ET)					

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. **(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	[9 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. **Z -TRANSFORMS** Definition, Properties, Transforms of standard functions, Inverse transforms. Solution of difference equations using Z- transforms.	**(8L + 3T)**
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.	
E books and online course materials: 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(3) PO5(1)
CO2	Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.	PO1(3)
CO3	Apply the concepts of calculus to functionals.	PO1(3)

Course Title	ELECTRICAL CIRCUIT ANALYSIS				
Course Code	19ES3CCECA	Credits	4	L:T:P	3:1:0

UNIT I **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

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

UNIT IV **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

Two Port Network Parameters and Analysis of Unbalanced three-phase Load
Definition of Z, Y, T, h parameters, modeling, relationship between parameters sets.

Unit 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)	
CO3	Ability to **analyze** given electrical circuit to arrive at a suitable conclusion	PO2(3)	
CO4	Ability to **conduct** experiments to demonstrate the specified concept/ application of electrical circuit on the Multisim platform	PO1(3) PO5(3)	
CO5	Ability to **analyse** the given electrical circuit on the Multisim platform to compute the desired parameter	PO2(2) PO5(2)	

Course Title	ANALOG ELECTRONIC CIRCUITS				
Course Code	19ES3CCAEC	Credits	4	L:T:P	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	[8 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	[8 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	[8 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 – 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, id – 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	**[8 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

Unit 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://freevideolectures.com/course/3020/circuits-for-Analog-System-Design

MOOCs:

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

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)	
CO3	Ability to **analyze** given analog electronic circuit to arrive at a suitable conclusion	PO2(3)	
CO4	Ability to **design** analog electronic circuit for given application and specifications	PO3(2)	

CO5	Ability to **design and conduct experiment** using analog electronic circuit for given application and specifications	PO3(2) PO5(3)	
CO6	Ability to **conduct** experiments to verify THREE parameters of the datasheet of the given electronic component	PO4(2) PO5(3)	
CO7	Ability to implement a **mini-project** to implement and demonstrate the **given problem** using suitable analog electronic components	PO2 (2) PO5 (2) PO9 (1)	

Course Title	**FIELD THEORY**				
Course Code	**19ES3GCFTH**	**Credits**	**4**	**L:T:P**	**3:1:0**
UNIT I					**[8Hr L + 2Hr T]**
Introduction to electrostatics: Introduction to line integral, surface integral, volume integral of vectors, Coulomb's Law (vector form), Electric Field Intensity (vector form), EFI due to different types of charge distributions. Electric Flux Density (EFD), Gauss' Law, Divergence: Electric Flux Density (EFD), Gauss' Law, Application, Divergence and Divergence Theorem					
UNIT II					**[8Hr L + 2Hr T]**
Energy and Potential: Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge and System of Charge, Energy Density Current and current density: Current and Current Density, Continuity of Current, Conductor, Properties, and Boundary Conditions					
UNIT III					**[8Hr L + 2Hr T]**
Dielectric: Dielectric materials, boundary conditions, Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, solution of Poisson's and Laplace for Single Variables, Capacitance of different configurations using Laplace's equation.					
UNIT IV					**[8Hr L + 2Hr T]**
Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials, Force on a moving charge, Force on different current element, Inductance and Mutual Inductance Magnetic Boundary Condition.					
UNIT V					**[8Hr L + 2Hr T]**
Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form, Uniform plane waves, Wave equations , solution of wave equation, wave propagation through good dielectric, good conductor, skin depth, Poynting Theorem.					
Unit Choice: Unit-II and Unit-V					

TEXT BOOKS:

1. Engineering Electromagnetics H Hayt, J A Buck, MJaleelAkhtar Tata McGraw-Hill, 8th Edition, 2014.
2. Electromagnetics, Schaum's Outline series Joseph A Ediminister Tata McGraw-Hill, revised second Edition, 2014.

REFERENCE BOOKS:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999.
2. "Field and wave electromagnetic", David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint – 2001
3. Mathew N. O. Sadiku "Elements of Electromagnetics," Oxford University Publication 2014.

Course outcomes:

At the end of the course on **Field Theory**, the student will have the

CO1	Ability to **define, understand**, and **explain** concepts of static and time varying Electric and Magnetic Fields, Maxwell's equations, wave propagation in different media	--	PSO3(1)
CO2	Ability to **apply** various properties/ laws/theorems of Electric and Magnetic Fields to obtain the specified parameter	PO1(3)	
CO3	Ability to **analyze** the given static and time varying Electric and Magnetic Fields to arrive at a suitable solution	PO2(3)	
CO4	Ability to develop the code in any programming language to demonstrate specified concept (s) of static and time varying Electric and Magnetic Fields	PO3(1) PO5(1) PO12(1)	
CO5	Ability to engage in independent study and make an oral presentation on the applications/ hazards of Electromagnetic radiation	PO6(1) PO10(1) PO12(1)	

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

UNIT I	[8 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	[8 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	[8 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	[8 hours]

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

UNIT V	[8 hours]

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

Unit Choice: Unit-II and Unit-III

LAB Experiments

	Title of the Experiment
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	Verify few parameters of the Digital IC from its data sheet
12	Build and verify the specified Gate/Flip-Flop using suitable analog electronic components on the Multisim platform
13	Implement the specified mini-project (like Adders: BCD, Carry Look Ahead, 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)	
CO3	Ability to **analyse** digital electronic circuit and arrive at suitable conclusions	PO2(2)	
CO4	Ability to **design** a digital circuit to meet given specifications	PO3(3)	
CO5	Ability to **conduct** experiments to demonstrate the specific application of digital electronics using suitable digital ICs/ Multisim	PO1(3) PO5(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)	
CO7	Ability to **conduct** experiments to verify few parameters from the datasheet of the given digital IC	PO4(2) PO5(2)	
CO8	Ability to implement and demonstrate the specified **mini-project** using suitable digital electronic components	PO3(2) PO5(2) PO9(1)	

Course Title	SENSORS AND MEASUREMENTS				
Course Code	19ES3GCSAM	Credits	3	L:T:P	3:0:1

UNIT I	[8 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	**[8 hours]**
Temperature sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, Optical Temperature sensor, Multi sensor arrays	
UNIT V	**[8 hours]**
Measuring Instruments: Interface Electronic Circuits, Signal conditioners, Sensor connections, excitation circuits, Data transmission, Noise in sensors and circuits, Battery for low power sensors.	
Unit Choice: Unit II and Unit III	

List of Experiments

Application of following sensors using electronic components/Multisim

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 1Instrumentation 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(3)
CO2	Ability to **apply** the concepts of Sensors and Measurements to obtain the desired parameter	PO1(3)	
CO3	Ability to **conduct** experiments to demonstrate the specified concept/ application of Sensors	PO1(3) PO5(3)	
CO4	Ability to **conduct** experiments to verify few parameters from the datasheet of the given sensor	PO4(2) PO5(3)	
CO5	Ability to **build** the specified Instrument using Multisim	PO2 (2) PO5 (2) PO9 (1)	
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	Environmental Studies				
Course Code For Batch 2019-20 & Batch 2020 -21	**20HS3ICEVS**	**Credits**	**1**	**L:T:P**	**1:0:0**

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 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	[04hours]
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.	
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, economic and ethical values from environmental perspectives.	PO7(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:P	3:1:0
(Common to AS/CV/EEE/ECE/EIE/ML/ET)					

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
CO2	Apply Numerical techniques to solve partial differential equations arising in engineering.	PO1
CO3	Demonstrate an understanding of analytic functions and their application to evaluate integrals.	PO1

Course Title	CONTROL SYSTEMS				
Course Code	19ES4ESCST	Credits	4	L:T:P	3:1:0

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

UNIT I **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

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 **[8Hr L + 2Hr T]**

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

UNIT V **[8Hr L + 2Hr T]**

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

Unit 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 controllers

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)	
CO3	Ability to **analyze** the given linear control system and arrive at a suitable conclusion	PO2(2)	
CO4	Ability to **conduct experiments** to demonstrate concepts related to linear control systems using the engineering tool: Matlab/ Simulink	PO1(3) PO5(3)	
CO5	Ability to **design** controllers to meet given specifications	PO3(2) PO5(2)	

Course Title	LINEAR INTEGRATED CIRCUITS				
Course Code	19ES4CCLIC	Credits	4	L:T:P	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-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	**[7 hours]**
Timers **Phase locked loops**: Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO), PLL in frequency multiplication/Division	
Unit 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)	
CO3	Ability to **analyze** given LIC to arrive at a suitable conclusion	PO2(3)	
CO4	Ability to **design** LIC for given application and specifications	PO3(2)	
CO5	Ability to **conduct** experiments to demonstrate the specified concept/ application of LIC	PO1(3) PO5(3)	
CO6	Ability to **conduct** experiments to verify THREE parameters of the datasheet of the given LIC/Component	PO4(2) PO5(3)	
CO7	Ability to **design and conduct experiment** using LIC for given application and specifications	PO3(2) PO5(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)	
CO9	Ability to implement a **mini-project** to implement and demonstrate the given problem using suitable LICs and components	PO2 (2) PO5 (2) PO9 (1)	
CO10	Ability to engage as a member of a team to prepare a comparative study (specifications, applications, cost) of various LICs available in market	PO9 (1) PO10 (1) PO12 (1)	

Course Title	MICROCONTROLLERS				
Course Code	19ES4CCMCS	Credits	4	L:T:P	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]**
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	**[7 hours]**
Applications - Communication Interface: LCD, ADC, Stepper motor interfacing, DC Motor interfacing, Sensor interfacing for control applications.	
Unit Choice: Unit II and Unit III	

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 CO_2 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, "The8051Microcontroller 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)	
CO3	Ability to **develop the code (**assembly/C) to perform the specified task	PO2 (3) PO5 (3)	
CO4	Ability to **design** and develop the logic to interface external memory and peripherals	PO3 (1)	
CO5	Ability to **analyse/debug** the given code	PO4(3)	
CO6	Ability to **conduct experiments** by developing the code **(**assembly/C) to perform the specified task	PO1 (3) PO5 (3)	
CO7	Ability to **conduct investigations** to **analyse/debug** the given code	PO2 (2) PO4 (2)	
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)	
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)	

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

UNIT I	[8Hr L + 4Hr T]
INTRODUCTION: Definitions of a signal, elementary signals, classification of signals and basic operations on signals.	
UNIT II	**[8Hr L + 4Hr T]**
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	**[8Hr L + 4Hr T]**
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	**[8Hr L + 4Hr T]**
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	**[8Hr L + 4Hr T]**
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.	
Unit 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)	
CO3	Ability to **analyze** the given signal/ system and arrive at a suitable conclusion	PO2(2)	
CO4	Ability to **conduct experiments** to demonstrate concepts related to signals and systems using the engineering tool: Matlab/ Multisim	PO1(3) PO5(3)	
CO5	Ability to conduct experiments to identify the components in the given circuit block (sealed)	PO4(1) PO5(1)	
CO6	Ability to design, implement and analyze the analog and digital signals and systems using python/ Multisim	PO2(2) PO5(2)	
CO7	Ability to **engage in independent study** and make an **oral presentation** on the applications of Signal Processing to **Society**	PO6(1) PO10(1) PO12(1)	

Course Title	VLSI Design				
Course Code	19ET4PCVLD	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]
Basic MOS technology: Enhancement and depletion mode MOS transistors. nMOS fabrication, pMOS fabrication, CMOS fabrication: p-well process, n-well process, Twin-tub process, BiCMOS fabrication in n-well process. Thermal aspects of processing. **Circuit design processes:** MOS layers. Stick diagrams: CMOS design style. Basic physical design of simple logic gates, nMOS design for inverter.	

UNIT II	[8 hours]
CMOS logic structures : Complementary Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic, Cascaded Voltage Switch Logic (CVSL), BiCMOS Logic, The Transmission Gate, Tri-state Inverter.	

UNIT III	[8 hours]
Basic circuit concepts: Sheet resistance, Area capacitance, Rise time and fall time calculations, nMOS inverter transfer characteristic. **CMOS subsystem design:** Architectural issues, General considerations, Switch logic, Gate logic, Design example of Multiplexer, Process illustration: Design of Combinational Bidirectional Shifter.	

UNIT IV	[8 hours]
CMOS subsystem design implementation: Design of: Inverting shift register and non-inverting shift register using Pass Transistor logic/Transmission gate logic, 4X4 crossbar switch and 4X4 Barrel shifter. **Adders:** Manchester Carry chain, Carry Select Adders, Carry Skip adders, Carry Look-ahead adder. **Multipliers:** Serial-Parallel multiplier, Braun Array multiplier, Baugh – Wooley multiplier, Modified Booth's multiplier, Wallace tree multiplier.	

UNIT V	[8 hours]
Memory, registers, and clock: Timing considerations of memory cells.3T dynamic RAM cell, 1T dynamic memory cell, Pseudo-static register cell, **Testability:** Performance parameters, Ground rules for design, Sensitized path testing, Practical DFT methodologies.	

Unit Choice: Unit-I and Unit-IV

Lab Experiments

1. Stick diagrams of digital circuits(Unit I)
2. Complementary Logic structures (Unit II)
3. Pseudo-nMOS Logic (Unit II)
4. Dynamic CMOS Logic (Unit II)
5. Clocked CMOS Logic (Unit II)
6. CMOS Domino Logic (Unit II)
7. Tri-state Inverter (Unit II)
8. Sub system design of digital circuits (Unit III and Unit IV)
9. Test benches (Unit V)
10. Implement the specified mini-project (like ALU, digital clock, Flip-Flop, Multiplexer, Sequence generator)

TEXT BOOKS:

1. **Douglas A. Pucknell and Kamran Eshraghian**, "Basic VLSI Design" PHI 3rd Edition, 2005.

2. **John P. Uyemura**, "Introduction to VLSI Circuits and Systems", Wiley Publications, 2002.

REFERENCE BOOKS:

1. **Neil H. E. Weste and K. Eshragian**," CMOS VLSI Design – A Circuits and Systems Perspective," 3rd edition, Pearson Education Pvt. Ltd.

2. **Sung Mo Kang and Yosuf Leblebici,** "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, Third Edition**.**

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ee25/
2. https://swayam.gov.in/nd1_noc19_cs74/preview

Course outcomes:

At the end of the course on **VLSI Design**, the student will have the

CO1	Ability to **define, understand** and **explain** concepts of nMOS and CMOS technology.	--	PSO3(2)
CO2	Ability to **apply** the knowledge of VLSI to fabricate the MOS circuits, **illustrate** different CMOS logic structures, subsystems and memory elements, **calculate** rise time and fall time estimations.	PO1(3)	
CO3	Ability to **analyze** the monochrome layout and stick diagrams of MOS technology and CMOS logic structures and subsystems, **deduce** appropriate testability vectors for the given parameters.	PO2(3)	
CO4	Ability to **conduct experiments** using VLSI tools for a given application/problem statement.	PO1(2) PO5(2)	
CO5	Ability to **analyze the given** VLSI simulation block and arrive at the application/problem statement.	PO2(2) PO5(2)	

Course Title	Environmental Studies				
Course Code For Batch 2018-19	19HS4ICEVS	Credits	2	L:T:P	2:0:0

COURSE OBJECTIVE:

The students will be able to develop a sense of responsibility about the environment, natural resources, their conservation and Understand the concept, structure and function of different ecosystems and the ill effects of pollution

COURSE OUTCOME : An ability to

CO1: Discuss 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, economic and ethical values from environmental perspectives.

Unit – I

Introduction to Environment:

- Definition, about the Earth
- Earth's Structure i.e. Atmosphere, parts of Atmosphere
- Hydrosphere, Lithosphere and Biosphere.
- Ecology & Ecosystem, Balanced ecosystem, types of Ecosystem.
- Human activities - Food, Shelter, Economic & Social Security.
- Effects of Human activities on Environment:
  - i) Agriculture
  - ii) Housing
  - iii) Industries
  - iv) Mining and
  - v) Transportation activities.
- Environmental Impact Assessment (E I A) 06 Hrs

Unit- II

Natural Resources: Definition, Renewable and Non-Renewable sources.

Major Natural Resources are -

i) Water resources, its availability, quality, water borne & water induced diseases,

ii) Mineral resources,

iii) Forest resources

Material cycles – Carbon, Nitrogen, Sulphur cycles. 04 Hrs

Unit – III

Energy Resources: Conventional and Non-conventional energy resources. Hydroelectric, Wind power, Solar, Biogas.
Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power,
Hydrogen as an alternate future sources of energy.

04 Hrs

Unit-IV

Environmental pollution: Introduction, types, effects of pollutions,

i) Water pollution, definition, types, sources, effects, control of water pollution,
ii) Land pollution, definition, types, sources, effects, Solid waste management
iii) Noise pollution, definition, sources, effects & control of noise pollution.

04 Hrs

Unit-V

Current environmental issues & importance:

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

06 Hrs

Total contact hours = 24

TEXT BOOKS:

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

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

SEE QUESTION PAPER PATTERN

PART-A

- 40 Multiple Choice Questions Covering Full Syllabus
- 1 Mark Each, Attend All Questions 40 marks

PART-B

- Consist of 4 Main Questions, It May be Subdivisions of 3 or 4.
- Each Question Consists of 20 Marks, Covering Full Syllabus
- Student Should Answer only 3 Full Questions Only.

60 marks

SEE TOTAL MARKS : 40+60=100

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS				
Course Code	19IC3HSCPH/ 19IC4HSCPH	Credits	1	L:T:P	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 – 42nd, 44th, 61st,74th, 76th, 77th, 86th and 91st. 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; 4th 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	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.

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:P	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	[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 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
2. 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**
CO2	Apply the concepts of polar curves and multivariate calculus.	**PO1**
CO3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	**PO1**
CO4	Apply techniques of vector calculus to engineering problems.	**PO1**
CO5	Comprehend the generalization of vector calculus in curvilinear coordinate system.	**PO1**

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:P	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
2. 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
CO2	Apply multiple integrals of plane figures to compute areas and volume.	PO1
CO3	Use Gamma and Beta functions to evaluate integrals.	PO1
CO4	Ability to understand the use of integral calculus in scalar and vector fields.	PO1

V Semester

Course Title	INFORMATION THEORY AND CODING				
Course Code	19ET5PCITC	Credits	3	L:T:P	2:1:0

UNIT I **[8 hours]**

Introduction, Measure of information, (Entropy) Average information content of symbols in long independent sequences, Joint Entropy and conditional entropy, Mutual information Relationship between entropy and mutual information, Mark-off statistical model for information source, Entropy and information rate of mark-off source. Problems

UNIT II **[8 hours]**

Encoding of the source output, Kraft inequality, Noiseless coding Theorem, Shannon's encoding algorithm, Shannon's Fano encoding algorithm, Huffman coding, problems.

UNIT III **[8 hours]**

Discrete communication channels: Representation of channels Channel Capacity, Shannon's Theorem on channel capacity, Channel efficiency, symmetric channel Binary symmetric channel Binary Erasure channel, Cascaded channel, problems

Continuous channels: Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem, problems

UNIT IV **[8 hours]**

Introduction, Types of errors, Types of codes : Linear Block Codes: Matrix description, Encoding and syndrome circuits, Syndrome calculation circuit, Hamming weight, Hamming distance, Design of an hamming code, Error detection and correction, Standard arrays and look up table for decoding, Decoding circuit for Linear block codes, problems

Binary Cyclic Codes: Algebraic structures of cyclic codes, properties, Galois fields, irreducible polynomials, Systematic and non-systematic Encoding using an (n-k) bit shift register, cyclic redundancy Codes, Syndrome calculation circuit, Problems

UNIT V **[8 hours]**

Introduction to Convolution Codes, Encoder for Convolution Codes using Time domain approach, Transform domain approach, State Diagram and code trees, Trellis structure, Viterbi Decoding, RS codes, Golay codes Shortened cyclic codes, Burst error correcting codes Burst and Random Error correcting codes. Introduction to Turbo Codes

Lab Experiments:

- Basics of Matrices
- Error detection and correction in Linear Block Code
- Polynomial multiplication and Division of Cyclic codes
- CRC implementation
- Generate the code vectors using Convolutional encoder
- Encoding using Shannon's Binary encoding algorithm
- Huffman Encoder

TEXT BOOKS:

1. DIGITAL AND ANALOG COMMUNICATION SYSTEMS – K. SAM SHANMUGAM, JOHN WILEY, 1996.
2. DIGITAL COMMUNICATION – SIMON HAYKIN, JOHN WILEY, 2003

REFERENCE BOOKS:

1. Concepts of Information Theory and Coding – Dr.P.S.Satyanarayana, Dynaram, 2005.
2. Elements of information theory – Thomas M. Cover, John Wiley, 2006

Unit Choice : Unit – III and Unit - IV

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

CO1	Ability to **define, understand and explain** concepts related to information theory and coding	--	**PSO3 (2)**
CO2	Ability to **apply** the knowledge of probability and source encoding algorithms to **obtain** the information of analog and discrete message sources	**PO1(3)**	
CO3	Ability to **analyze** Convolution coder	**PO2(1)**	
CO4	Ability to **design** the Block and Convolution codes for a given channel	**PO3(3)**	
CO5	Ability to **conduct experiments** to demonstrate concepts related to information theory and coding using the engineering tool: LabVIEW	**PO5(3)**	
CO6	Ability to design, implement and demonstrate the specific application of coding theory as a member of the team using LabVIEW/ Matlab/ any other	**PO5(1) PO11(1) PO12(1)**	

Course Title	ANALOG COMMUNICATION				
Course Code	19ET5PCACM	Credits	4	L:T:P	3:0:1

UNIT I	[8 hours]
RANDOM PROCESS: Random variables: Several random variables. Statistical averages: Function of Random variables, moments, Mean, Correlation and Covariance function: Central limit theorem, Properties of Gaussian process. Transmission of random signals through linear systems. NOISE: Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Noise Figure, Equivalent noise temperature.	

UNIT II	[8 hours]
AMPLITUDE MODULATION: Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves.	

UNIT III	[8 hours]
SINGLE SIDE-BAND MODULATION (SSB): Hilbert transform, band pass signals, in-phase and quadrature-phase components, canonical representation of band pass signals, natural, pre and complex envelop of band pass signals Quadrature carrier multiplexing, Canonical representation of SSB, Single side-band modulation, Frequency-Domain description of SSB wave. Phase discrimination method for generating an SSB modulated wave. Demodulation of SSB waves, **VESTIGIAL SIDE-BAND MODULATION (VSB)**: Frequency – Domain description, Generation of VSB modulated wave, Time – Domain Canonical representation of VSB, Envelop detection of VSB wave plus carrier, Frequency translation, FDM: Frequency division multiplexing.	

UNIT IV	[8 hours]
ANGLE MODULATION (FM): Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM. Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop Noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM. Figure of merit of FM .	

UNIT V	[8 hours]
RADIO RECEIVERS: Receiver types,, Tuned radio frequency receiver, Super-heterodyne receiver. AM receiver. AM Receivers RF section and Characteristics, Frequency changing and tracking, Intermediate frequencies and IF amplifiers. Broadcast standards in India. FOM of AM, DSBSC.	

LAB Experiments Part A: Using discrete components

- Analog filters;
- Generation and demodulation of AM, DSB-SC, (Unit-III)
- Generation FM, pre-emphasis and de-emphasis; (Unit-V)
- Generation of SSB (using Multisim); (Unit-IV)

Part B: Using Matlab

- Generation and demodulation of AM, DSB-SC (Unit – III)
- Generation and demodulation FM, PM;(Unit – V)
- QAM, SSB (Unit – IV)
- Correlation, Convolution, Hilbert Transform (Unit – I)
- Central Limit Theorem, Gaussian Process (Unit – II)

TEXT BOOKS:

1. Communication Systems, Simon Haykins, 3rd Edition, John Willey, 1996.
2. An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley, 2003.
3. Electronic Communication Systems. , Kennedy Davis,Fourth Edition,TMH,1999

REFERENCE BOOKS:

1. Modern digital and analog Communication systems B. P. Lathi, 3rd ed 2005 Oxford University press.
2. Communication Systems, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
3. Communication Systems: Singh and Sapre: Analog and digital TMH 2nd , Ed 2007

MOOCs:https://swayam.gov.in/nd1_noc19_ee46/preview

Unit Choice : Unit – I and Unit - III

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

CO1	Ability to define, understand and explain concepts of convolution, correlation, random variables, time and frequency domain representation of analog communication systems.		**PSO2 (1)**
CO2	Ability to **apply** the knowledge of signal processing to obtain the time and frequency domain representation, Figure of Merit of analog communication systems.	**PO1 (3)**	
CO3	Ability to **analyze** the waveforms related to analog communication.	**PO2(2)**	
CO4	Ability to **conduct experiments** to demonstrate concepts related to analog communication using suitable electronic components/Engineering Tool (Matlab).	**PO5(3)**	
CO5	Ability to make an effective **oral presentation** on broadcast standards, contribution to society, impact on health, effect on environment.	**PO10 (1)**	
CO6	Ability to perform in a team to **build an AM/FM** receiver using discrete components and demonstrate the live reception	**PO4(1) PO5 (1)**	

Course Title	DIGITAL SIGNAL PROCESSING				
Course Code	19ES5CCDSP	Credits	4	L:T:P	3:0:1

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	**[8 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.	

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 (16 December 2014)

REFERENCE BOOKS:

1. Fundamentals of Digital Signal Processing, Lonnie Ludeman, John Wiley & Sons; Wiley International 1st Edition, 1988.
2. Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald W. 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

MOOCs:

1. NPTEL Course on Digital signal processing by Prof. Dutta Roy, IIT Delhi, https://nptel.ac.in/courses/117/102/117102060/
2. NPTEL Course on Foundations of Wavelets and Multirate Digital Signal Processing, by Prof. Vikram M. Gadre ,IIT Bombay. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/

LAB EXPERIMENTS:

Generation of elementary signals
Study of sampling theorem, Effect of undersampling leading to Aliasing effect
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: Lowpass and high-pass filter,
Study of Adaptive filter using LMS Algorithm.
Interpolation and Decimation.

Unit Choice : Unit – I and Unit - III

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

CO1	Ability to **define** and **explain** concepts of digital signal processing		**PSO3 (3)**
CO2	Apply the concepts of digital signal processing to **obtain** the specified parameter	**PO1(3)**	
CO3	Ability **analyze** the given system and arrive at suitable conclusions	**PO2(2)**	
CO4	Ability to **design** the system to meet given specifications	**PO3(3)**	
CO5	To develop the Python code to design, implement and analyze LTI digital system to meet given specifications	**PO2(3) PO3(3) PO4(3) PO5(3)**	
CO6	Ability develop the tool box as a member of the team for an identified application of signal processing	**PO9(1) PO5(1)**	

Course Title	TRANSMISSION LINES AND ANTENNAS				
Course Code	19ET5PCTLA	Credits	4	L:T:P	3:1:0

UNIT I	[8 hours]

Transmission Line Theory: A line of cascaded T sections, The transmission line – general solution, Physical significance of the equations; the infinite line, Wavelength; velocity of propagation, Wave-form distortion, The distortion less line, The telephone cable, Inductance loading of telephone cables, Reflection on a line not terminated in Z_o, Reflection coefficient, Open-and short-circuited lines, Reflection factor and reflection loss, Insertion loss,T and π sections equivalent to lines

UNIT II	[8 hours]

Line at Radio Frequencies: Constants for the line of zero dissipation, Voltages and currents on the dissipation less, Standing waves; nodes; standing-wave ratio, Input impedance of the dissipation less line, Input impedance of open-and short-circuited lines, Power and impedance measurement on lines, Reflection losses on the unmatched line, The quarter-wave line; impedance matching, The half-wave line, Single stub impedance matching on a line, the Smith circle diagram, Application of the Smith Chart, Single-stub matching with the Smith char, Double-stub impedance matching on a line

UNIT III	[8 hours]

Transmission Line Parameters Line parameters, Inductance of a line of two parallel round conductors, Inductance of the coaxial line, Qualitative discussion of skin effect, Capacitance of two parallel round conductors, Capacitance of the coaxial line, Parameters of the open-wire line at high frequencies, Parameters of the coaxial line at high frequencies. Transmission media: Guided and unguided media, Signal integrity

UNIT IV	[8 hours]

Antenna Basics : Introduction, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, directivity and gain, antenna apertures, effective height, radiation efficiency, Friss transmission formula,

Point sources and arrays: point sources, power patterns, power theorem, radiation intensity, field patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, non-isotropic point sources, broad side array with non-uniform amplitude distribution, direction of maxima for arrays of n isotropic point sources of equal amplitude and spacing

UNIT V	[8 hours]

Wire antennas: Vector potential, Retarded vector potential, Radiation from a current element, Radiation resistance, The half-wave antenna in space, Radiation resistance of the $\lambda/2$ dipole, The effect of ground; the vertical antenna above earth, The grounded quarter-wave antenna, , small loop, comparison of far fields of small loop and short dipole, loop antenna general case, far field patterns of circular loop, radiation resistance, directivity

Lab Experiments

1. Study the parameters of dipole antenna using Matlab
2. Study the parameters of array of point sources
3. To create dipole antenna for the specified frequency and measure its parameters using HFSS
4. Study the parameters of transmission line
5. Making of simple wired antennas

TEXT BOOKS:

1. Network Lines And Fields - John D Ryder, 2e, PHI

2. Antennas, John D. Krauss, III (SEI) Edition, Mcgraw-Hill International Edition

REFERENCE BOOKS:

1. Antenna theory analysis and design- C.A.Balanis, 2nd edition john Wiley,1997
2. Engineering Electromagnetics – W.H.Hayt, J A Buck, seventh edition, TATA Mcgraw Hill
3. Data Communication And Networking – Behrouz A Forouzan
4. Signal and power integrity - by Eric Bogatin, Prentice Hall

MOOCs:

Transmission lines - https://onlinecourses.nptel.ac.in/noc20_ee04/
Antennas https://onlinecourses.nptel.ac.in/noc17_ee03/course

Unit Choice : Unit – I and Unit - IV

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

CO1	Ability to define, understand, and explain concepts of transmission lines, signal integrity, time varying fields to obtain the radiation pattern and related parameters of antennas		**PSO3 (1)**
CO2	Ability **to apply** various properties/laws/theorems/ to **solve/derive** transmission line problems and **obtain** parameters of wired antennas	**PO1(3)**	
CO3	Ability to **analyze** the given specifications of different types of transmission lines and antennas in various configurations/ distributions	**PO2(2)**	
CO4	Ability to **design** solutions to meet the given specifications of transmission lines and antennas.	**PO3(2)**	
CO5	Ability to **conduct experiments** to design and analyze concepts related to transmission lines and antennas using Matlab/HFSS	**PO4(2)** **PO5(2)**	
CO6	Ability to perform in **a team** to prepare a report and make an **effective oral presentation** of the study on topics related to transmission lines/ antenna applications/ radiation hazards/ broadcast standards/ EMC-EMI/ any other	**PO6(1)** **PO7(1)** **PO8(1)** **PO9(1)** **PO10(1)** **PO12(1)**	

Course Title	C++ AND DATA STRUCTURES				
Course Code	19ET5PE1DS	Credits	3	L:T:P	3:0:0

UNIT I **[8 hours]**

Introduction to C++ & its Features

Principles of object oriented programming, Beginning with C++, Tokens, Expressions and Control structures, Functions in c++, Classes and Objects.

UNIT II **[8 hours]**

Constructors, Destructors, Operator Overloading, Console I/O operations

Parameterized constructors, Multiple constructors in a class, Constructors with default arguments, Dynamic initialization of objects, Copy constructor, Dynamic constructors, Destructors, Overloading unary and binary operators, Stream classes, Formatted and Unformatted I/O operations, Manipulators

UNIT III **[8 hours]**

Inheritance, Polymorphism, Templates, Exception handling

Derived classes, Single/Multilevel/Multiple/Hierarchical/Hybrid Inheritance, Virtual base class, Pointer to Object, This pointer, Virtual/Pure virtual function, Virtual constructor and destructor, Class templates, Function templates , Exception handling

UNIT IV **[8 hours]**

Linked List, Stacks and Queues

Singly linked list, various operations on singly linked list, Implementation of stack using arrays and linked list, Applications of stack, Implementation of queue using arrays and linked list, Applications of queue.

UNIT V **[8 hours]**

Skip list, Hashing, Binary tree

Skip list and hash table representation, Binary tree implementation using linked list, Binary tree traversal mechanisms, Heap sort algorithm.

TEXT BOOKS:

1. OBJECT ORIENTED PROGRAMMING WITH C++, E. BALAGURUSWAMY, TMH, 6TH EDITION, 2013.
2. D.S. MALIK, DATA STRUCTURES USING C++, INDIA EDITION, CENGAGE LEARNING, 2003.

REFERENCE BOOKS:

1. Object Oriented Programming using C++, Robert Lafore, Galgotia publication 2010.
2. Data structures, Algorithms, and applications in C++, SartajSahni, Universities Press, 2nd Edition, 2005.

MOOCs: Programming in C++ by Prof. Partha Pratim Das, Indian Institute of Technology, Kharagpur, https://nptel.ac.in/courses/106/105/106105151/ (NPTEL)

LAB Experiments:

1. Program to implement classes and objects (unit 1)
2. Program to implement inline functions (unit1)
3. Program to implement friend and virtual functions(unit 1)
4. Program to implement Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors, and destructors. (unit 2)
5. Program to implement Operator overloading and type conversions: Overloading unary and binary operators, overloading using friends, rules for overloading. (unit 2)
6. Program to implement public, private and protected inheritance. Types of inheritance: Single, Multilevel, multiple, hierarchical, hybrid. (unit 3)
7. Program to implement Pointers, virtual functions and polymorphism.(unit 3)
8. Program to implement Class templates, function templates, overloading template functions(unit 3)
9. Program to implement stacks and queues using data structures (unit 4)
10. Program to implement hashing and trees using data structures (unit 5)

Unit Choice : Unit – IV and Unit - V

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

CO1	Ability to understand the programming concepts for data structures		**PSO3 (3)**
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient codes in C++	**PO1(3)**	
CO3	Ability to analyze abstract object and real object using class	**PO2(2)**	
CO4	Ability to design programming solutions with operator overloading and memory management	**PO3(1)**	
CO5	Ability to work as an individual and thereby conduct experiments using any C compiler for a given application/problem statement.	**PO5(3)** **PO9(3)**	
CO6	Develop, test, analyze and demonstrate applications using C++ and Data structures through implementing the specified mini-project	**PO11(1)** **PO12(1)**	

Course Title	EMBEDDED SYSTEM DESIGN				
Course Code	19ET5PE1ES	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]
A System Engineering Approach to Embedded Systems Design: Introduction to Embedded Systems , Definition , Architecture, The Embedded Systems Models, Embedded Hardware building blocks, Reading a Schematic	
UNIT II	**[8 hours]**
Embedded Processors & Memory: ISA Architecture Models: Application specific, Internal Processor Design, Processor Performance, Reading Processor's Datasheet, ROM, RAM, Cache Memory, Cache mapping techniques, Memory Management of External Memory, Board Memory and Performance	
UNIT III	**[8 hours]**
Board I/O & Buses: Managing Data: Serial vs. Parallel I/O, Interfacing the I/O Components, I/O and Performance, Bus Arbitration and Timing, I2C, SPI, USB, CAN & PCI protocols, integrating the Bus with Other Board Components, Bus Performance	
UNIT IV	**[8 hours]**
Embedded Software: Device Drivers: Device Drivers for Interrupt-Handling, Memory Device Drivers, On-board Bus Device Drivers, Board I/O Driver. Embedded Operating Systems: Multitasking and Process Management, Memory Management, I/O and File System Management, OS Standards Example: POSIX, OS Performance Guidelines, OSs and Board Support Packages (BSPs).	
UNIT V	**[8 hours]**
Middleware and Application Software: Introduction to Middleware, Applications with Examples, Application Layer Software Examples. Implementing the Design: Main Software Utility Tool: Writing Code in an Editor or IDE, Interpreters, Compilers, and Linkers, Debugging Tools, System Boot-Up.	

TEXT BOOKS:

Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard

REFERENCE BOOKS:

1. Computer Organization and Embedded Systems. 6th Edition. By Carl Hamacher and Zvonko Vranesic and Safwat Zaky and Naraig Manjikian
2. Embedded system Design –Steve Heath , second edition, Newness Publication
3. James K Peckol, "Embedded Systems – A contemporary Design Tool", John Weily, 2008.

MOOCs:

1. Embedded System design: https://nptel.ac.in/courses/106/105/106105159/
2. Introduction to Embedded System Design: https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee98/

Unit Choice : Unit – III and Unit - IV

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

CO1	Ability to define and understand embedded system, architecture, memory mapping, IDE tools		**PSO3 (3)**
CO2	Ability to apply the embedded system models, features of processors, memory and I/O systems in developing embedded System.	**PO1(3)**	
CO3	Ability to analyze the embedded OS functionality, protocols and device drivers used in embedded applications.	**PO2 (3)**	
CO4	Ability to design embedded applications using given specifications and concepts of development process.	**PO3 (2)**	

Course Title	**CRYPTOGRAPHY**				
Course Code	**19ET5PE1CY**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Computer and Network Security concepts: Computer security concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack surface and attack trees, A model for network security

Symmetric Cipher: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography

UNIT II **[8 hours]**

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, S-DES, the Data Encryption Standard, A DES Example, the Strength of DES

Introduction to Number Theory: Divisibility and the Division Algorithm, the Euclidean Algorithm, Modular Arithmetic, Fermat's and Euler's Theorems, The Chinese Remainder Theorem

UNIT III **[8 hours]**

Advanced Encryption Standard: AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example,

Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode

UNIT IV **[8 hours]**

Asymmetric Ciphers:Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Pseudorandom Number Generation Based on an Asymmetric Cipher

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes

UNIT V **[8 hours]**

Pseudo-Random-Sequence Generators and Stream Ciphers: Principles of Pseudorandom number generation , Pseudorandom number generator, Linear Congruential Generators , blum blum shub generator, , Design and analysis of stream ciphers, Stream ciphers, Pseudorandom number generation using block cipher, RC4

TEXT BOOKS:

Cryptography and Network security: Principles and Practice, William Stallings, 6th edition, Pearson Education

REFERENCE BOOKS:

1. **Cryptography, Network Security and Cyber Laws** – Bernard Menezes, Cengage Learning, 2010 edition
2. **Introduction to Cryptography and Network Security**- Behrouz A Forouzan, Mc-Graw Hill Higher Education, 1st Edition, 2008

MOOCs:

1. https://swayam.gov.in/nd1_noc20_cs02
2. https://swayam.gov.in/nd1_noc20_cs21

Unit Choice : Unit – I and Unit - IV

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

CO1	Ability to **define, understand and explain** concepts related to network security		**PSO3 (2)**
CO2	Ability to **apply** the knowledge of mathematics to cryptography	**PO1(2)**	
CO3	Ability to **analyze** the given security systems parameters	**PO2(2)**	
CO4	Ability to implement and demonstrate the specified **mini-project** using suitable cryptography techniques	PO3(2) PO5(2) PO9(2)	

Course Title	SATELLITE COMMUNICATION				
Course Code	19ET5PE1SC	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]

Orbital Mechanics and Launchers: Introduction, Orbital Mechanics, Look Angle Determination, Orbital perturbations, Orbit determination, Launches and Launch vehicles, Orbital effects in communication systems performance.

UNIT II	[8 hours]

Satellites: Satellite subsystems, Attitude and orbit control systems, Telemetry, Tracking, Command and Monitoring, Power systems, Communication subsystems, Satellite Antennas, Equipment reliability and space qualification

UNIT III	[8 hours]

Satellite Link design: Basic Transmission Theory, System Noise Temperature and G/T ratio, Design of Downlinks, Uplink Design, Design for specified C/N, System design examples, Propagation effects

UNIT IV	[8 hours]

Modulation and Multiplexing Techniques for satellite links: Frequency Modulation, Analog FM transmission by satellite, Digital Transmission, Digital modulation and demodulation, Digital transmission of Analog signals, Time division multiplexing, Multiple access, Satellite networks

UNIT III	[8 hours]

Satellite Applications: Communication Satellites, Remote sensing satellites, weather satellites, Navigation satellites, Scientific satellites, Indian Satellites

TEXT BOOKS:

Satellite Communications: Dennis Roddy, III edition, Tata McGraw Hill

REFERENCE BOOKS:

1. Satellite Technology Principles and Applications: 3rd Edition, by Anil Maini, Varsha Agrawal, Publisher: John Wiley & Sons

2. Satellite Communications: Design Principles — M. Richcharia, 2nd Ed., BSP, 2003.
3. Satellite Communications Engineering — Wilbur, L. Pritchand, Robert A. Nelson and Heuri G. Suyderhoud, 2nd Ed., Pearson Publications.
4. Digital Satellite Communications — Tn. T. Ha, 2nd Ed., MGH, 1990.
5. Satellite Communications: – 2nd Edition, by Timothy Pratt, Charles W.Bostian, Jeremy.E.Allnutt, Publisher: Wiley India

MOOCs:

1. Introduction to Satellite Communications- Institut Mines-Télécom
   https://www.classcentral.com/course/satellitecommunications-6313

2. A system view of communications: From signals to packets(part 3)-The Hong Kong University of Science and Technology

   https://www.classcentral.com/course/edx-a-system-view-of-communications-from-signals-to-packets-part-3-3438

Unit Choice : Unit – and Unit -

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

CO1	Ability to **define, understand and explain** the concepts of satellite communication system	--	**PSO2 (1)**
CO2	Ability to **apply** the knowledge of physics and communication theory for satellite orbits, subsystems, communication links and networks	PO1(3)	
CO3	Ability to **analyse** uplink and downlink system design for a specified C/N for a satellite communication link	PO2(2)	
CO4	Ability to **interpret** sample satellite data and arrive at suitable conclusion	PO3(1)	
CO5	Ability to function effectively as an individual or as a team member to **make an oral presentation on the Indian Satellites, and applications**	PO10(1)	

Course Title	MOOCs Based Elective				
Course Code	19ET5PE1MB	Credits	3	L:T:P	3:0:0

At the beginning of the semester, the department identifies a list of relevant MOOCs being floated by NPTEL/SWAYAM/Coursera/EDx etc
The faculty and the interested students take up the identified online MOOC
The faculty conducts the internal assessments and the SEE based on the identified MOOCs

Course Title	Operating System				
Course Code	19TE5PE2OS	Credits	3	L:T:P	3:0:0

UNIT I **[8 hours]**

Introduction to Operating Systems: OS, Goals of an OS, Operation of an OS, Computational Structures, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes operating System, Batch processing, Multiprogramming, Time Sharing Systems, Real Time and distributed Operating Systems

UNIT II **[8 hours]**

Process Management: Process and programs, program view of processes,OS View of Processes, , Threads, Preliminaries of scheduling, Non-preemptive scheduling, Preemptive Scheduling, Real Time Scheduling, Scheduling in Unix and Scheduling in Linux

UNIT III **[8 hours]**

Memory Management: Memory allocation process, Reuse of memory, Contiguous Memory allocation, Noncontiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, page replacement policies, Memory allocation process

UNIT IV **[8 hours]**

Message Passing: Overview of message passing, Implementing message passing, Mailboxes, message passing in Unix

Deadlocks: Definition of deadlock, Deadlock in resource allocation, Handling deadlocks, Deadlock detection and resolution, Deadlock prevention, Deadlock avoidance

UNIT V **[8 hours]**

File systems: File system and IOCS, File and file operations , fundamental of file organization, directory structure, , allocation of disk space, implementation of file access, Unix file system

TEXT BOOKS:

1. "Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH, 2nd Ed

REFERENCE BOOKS:

Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education, 4th Ed, 2006

MOOCs: https://onlinecourses.nptel.ac.in/noc19_cs50/

Unit Choice : Unit – II and Unit - III

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

CO1	Ability to **understand, define and explain** the fundamental concepts of operating systems	--	**PSO3 (1)**
CO2	Ability to **apply** the knowledge of mathematics and coding towards operating systems	PO1(2)	
CO3	Ability to **analyse** the system parameters and arrive at suitable conclusions	PO2(1)	
CO4	Ability to implement and demonstrate the specified **mini-project** using suitable operating system algorithms	PO3(2) PO5(2) PO9(2)	

Course Title	**VERILOG HDL**				
Course Code	**19ET5PE2VH**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Overview of Digital Design with Verilog HDL:

Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL? Trends in HDLs.

Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.

UNIT II **[8 hours]**

Basic Concepts:

Lexical conventions, data types, system tasks, compiler directives.

Modules and Ports:

Module definition, port declaration, connecting ports, hierarchical name referencing

UNIT III **[8 hours]**

Gate-Level Modeling:

Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays.

Dataflow Modeling:

Continuous assignments, delay specification, expressions, operators, operands, operator types.

UNIT IV	[8 hours]

Behavioral Modeling:

Structured procedures, initial and always, blocking and non-blocking, statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks

Switch level modeling:

Switch modeling elements, MOS Switches, CMOS Switches, Bidirectional Switches, Power and Ground, Resistive switches

UNIT V	[8 hours]

Logic Synthesis with Verilog HDL:

What is logic synthesis? Impact of Logic synthesis, Verilog HDL synthesis, Synthesis design Flow, Verification of Gate level netlist

TEXT BOOKS:

Samir Palnitkar, "**Verilog HDL: A Guide to Digital Design and Synthesis**", Pearson Education

REFERENCE BOOKS:

1. Michael D. Ciletti, **"Advanced Digital Design with the Verilog HDL" ,** Pearson Education
2. Padmanabhan, Tripura Sundari, **"Design through Verilog HDL",** Wiley Publication
3. J.Bhaskar, **"A Verlog HDL Primer" -** BSPublications
4. Nazeih M.Botros **, "HDL Programming",** Dreamtech Press
5. Stephen Brown and Zvonko Vranesic ,"**Fundamentals of Digital logic with Verilog Design**", McGraw Hill

MOOCs:
https://nptel.ac.in/courses/106/105/106105165/

Unit Choice : Unit – III and Unit - IV

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

CO1	Ability to **understand, define and explain** the fundamental concepts of VERILOG HDL for modeling Digital circuits		**PSO3 (2)**
CO2	Ability to **apply** the knowledge of Digital Electronics fundamentals to describe the VERILOG behaviour of a digital circuit using data flow, Behavioral , structural modelling and switch level modeling	**PO1 (3)**	
CO3	Ability to **analyse and design** a digital circuit through VERILOG for given specifications	**PO2 (2)**	
CO4	Ability to **synthesize** a digital circuit for given VERILOG behaviour	**PO3 (2)**	
CO5	Ability to **conduct experiments** using modern engineering CAD tool to: (i) perform simulation (ii) perform synthesis	**PO5 (2)** **PO9 (2)**	

Course Title	**DSP ARCHITECTURE**				
Course Code	**19ET5PE2DA**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I	**[8 hours]**
UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs - Introduction to Programmable DSPs, Architectural Features of PDSPs – Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Applications of Programmable DSPs.	
UNIT II	**[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 III	**[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 IV	**[8 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	
UNIT V	**[8 hours]**
Advanced Processors: Study of TI‘s advanced processors – TMS320C674x and TMS320C55x DSPs, ADSP‘s Blackfin and SigmaDSP Processors, NXP‘s DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors.	

Lab Experiments
Experiments using TMS 6713 board and Code Composer Studio

1. Implement FIR and IIR filters
2. Decimation and interpolation
3. Adaptive filtering
4. Audio processing
5. Noise cancellation
6. Signal Enhancement
7. Harmonic Detection

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
3. B. Venkataramani and M. Bhaskar, ―Digital Signal Processors – Architecture, Programming and Applications‖ – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.

REFERENCE BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
2. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
3. User guides Texas Instruments, Analog Devices and NXP.

Unit Choice : Unit – III and Unit - IV

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

CO1	Ability to define and understand the architectural features of programmable DSPs, development tools and various blocks of DSP Processors		**PSO2(3)**
CO2	Ability to identify the addressing modes, write and execute assembly and C codes for DSP applications.	**PO1(3)**	
CO3	Ability to debug and analyze the assembly and embedded C code for TMS320C67xx processor	**PO2(2)**	
CO4	Ability to conduct experiments using assembly and embedded C in CCS environment for implementing signal processing algorithms on the TMS32067XX DSP Processor	**PO5(3)** **PO9(3)**	

Course Title	OPTICAL FIBER COMMUNICATION				
Course Code	19ET5PE2FC	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]

Optical Fiber Waveguides: Introduction, General system, Advantages of Optical fiber Communication, Ray Theory Transmission, Electromagnetic mode theory for optical propagation, Cylindrical Fiber, Cut-off wavelength, mode field diameter, phase velocity, group velocity, group delay, Single mode fibers, Fabrication of Optical Fibers

UNIT II	[8 hours]

Transmission characteristics of optical fibers: Introduction, Attenuation, Material Absorption, Linear scattering losses, Non-linear scattering losses, Fiber bend loss, Intramodal and Intermodal dispersion, Polarization.

Optical Sources and Detectors: Introduction, LASER diodes, LEDs, Photodetectors: Device Types, Principles, Absorption co-efficient, Efficiency, Responsivity, Photodiodes without internal gain, Avalanche Photodiodes.

UNIT III	[8 hours]

Fiber couplers and connectors: Introduction, Fiber Alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers. OPTICAL RECEIVER: Introduction, Optical Receiver operation, Noise, Analog Receiver sensitivity.

UNIT IV	[8 hours]

Analog and Digital Links: Analog Links-Introduction, Overview of analog links, CNR, multichannel transmission techniques, Digital links-Introduction, point-point links, System Considerations, link and rise time power budget analysis.

UNIT V	[8 hours]

Introduction to optical networks: WDM concepts, Multiplexers, Optical Amplifiers, Couplers & Connectors, SONET/SDH, Optical Interfaces.

TEXT BOOKS:

1. Optical Fiber Communications: Gerd Keiser, III edition,Tata McGraw Hill
2. Optical Fiber Communications: Principles and Practice – 3rd Edition, by John.M.Senior, Publisher: PHI

REFERENCE BOOKS:

1. **Fiber optic Communication Systems:** G.P. Agrawal, John Wiley and sons, Fourth Edition, 2011
2. **Optical Fiber Communication Systems with MATLAB and Simulink Models,** 2e, Le Nguyen Binh, Huawei Technologies Co., Ltd, CRC Press, Inc., 2015
3. **Harold Kolimbris-** Fiber Optics Communication, 2nd Ed., 2004, PEI

MOOCs:

1. Fiber Optic Communication Systems and Techniques By Prof.Pradeep Kumar k-IIT Kanpur
   https://swayam.gov.in/nd1_noc19_ee67/preview
2. Fiber Optic Communications-Purdue University
   https://www.edx.org/course/fiber-optic-communications

Unit Choice : Unit – II and Unit - V

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

CO1	Ability to **define, understand and explain** the concepts of Optical Fiber communication system	--	**PSO3 (1)**
CO2	Ability to **apply** the knowledge of physics, electronics and communication theory to study the components of Optical Fiber communication system, ray theory and EM theory of wave propagation and optical networks	PO1(3)	
CO3	Ability to **analyse** analog and digital links using link design and rise time budget analysis for a given Optical Fiber communication link	PO2(2)	
CO4	Ability to **interpret** sample data through optical fiber link and arrive at suitable conclusion	PO3(1)	
CO5	Ability to function effectively as an individual or as a team member to **conduct** experiments using hardware and/simulation.	PO1(1) PO5(1)	

Course Title	**MOOCS BASED ELECTIVE**				
Course Code	**19ET5PE2MB**	**Credits**	**3**	**L:T:S**	**3:0:0**

At the beginning of the semester, the department identifies a list of relevant MOOCs being floated by NPTEL/SWAYAM/Coursera/EDx etc
The faculty and the interested students take up the identified online MOOC
The faculty conducts the internal assessments and the SEE based on the identified MOOCs

Course Title	INNOVATION FOR ENTREPRENEURSHIP				
Course Code	19ES5HSIFE	Credits	2	L:T:P	2:0:0

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 abroad.

TEXT BOOKS:

Disciplined Entrepreneurship: 24 Steps to a Successful Startup (Wiley, 1st Edition) Bill Aulet, ISBN: 1118692284, 2013

REFERENCE 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

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

MOOCs:
https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring-2013/assignments/assignment-12/
https://www.edx.org/course/entrepreneurship-101-who-customer-mitx-15-390x

Ebook
https://segera-wisuda.blogspot.in/2016/05/46-ebooks-entrepreneurship-download-free.html

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	**PO3(3)**	
CO2	Able to formulate goals as entrepreneur for a startup defining your goals as an entrepreneur	**PO2(3)**	
CO3	Able to identify business opportunities by performing market research and choosing target customer	**PO11(3)**	
CO4	Engage with a range of stakeholders to deliver creative and sustainable solutions to specific problems communicate effectively both orally and in writing	**PO7(3)** **PO10(3)**	
CO5	Work effectively with peers with diverse skills, experiences and be able to critically reflect on own practice	**PO9(3)**	

Course Title	HARDWARE PROJECT				
Course Code	19ET5PWREN	Credits	2	L:T:P	0:0:2

This is a project based on re-engineering (or innovative engineering). Students, in groups of 4 -6 shall identify an existing electronic equipment, study its functioning and re-build the same, a complete working product (not a prototype or a simulation study). Some examples are: Signal generator, IQ generator, Audio system, Audio-video mixer, AM radio, FM radio, vacuum cleaner, speech to signal generator, etc. While re-engineering is the emphasis, student groups can come out with innovative products as well (this is not mandatory).

The identified products shall be an application of Electronic components.

At the end of this course, the students shall have the ability to:

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

CO1	engage in relevant survey and identify the product to be re-engineered, together with desired specifications	**PO2 (3)** **PO12 (3)**	**PSO1 (3)** **PSO2 (3)** **PSO3 (2)**
CO2	identify the essential concepts, and identify the design for the product implementation	**PO1 (3)** **PO2 (3)** **PO3 (2)**	
CO3	implement and analyse the designed product, to match the specifications	**PO4 (2)** **PO5 (3)**	
CO4	perform cost and performance analysis of the product with that of the initial identified product	**PO11 (2)**	
CO5	prepare the project report, three minute video and the poster of the work	**PO10 (3)**	
CO6	engage in the team to document the business plan for a commercial venture of the designed product, together with complying to relevant norms	**PO7 (1)** **PO8 (3)** **PO9 (1)** **PO11 (1)**	
CO7	identify the community that shall benefit from the product	**PO6 (2)**	

Course Title	HUMAN VALUES THROUGH LITERATURE				
Course Code	19ET5NCHVL	Credits	NC	L:T:P	0:0:0

Objective: The aim of the course is to conserve values like truthfulness, kindness, honesty, law, justice, patriotism, humanism, etc. in society and eliminate negative attitudes. The course explores how Literature can be effective to inculcate human values.

Method of evaluation: Students will study Indian literary works and present it as a play in groups of four to six students.

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

CO1	Ability to understand the significance of human values and responsibility in a society	**PO8(3)**	
CO2	Ability to apply the knowledge of human values acquired through Indian literature in the form of a play	**PO6(3)**	
CO3	Ability to analyze and write reports from different literary works	**PO10(3)**	

VI semester

Course Title	Microwaves and Radar				
Course Code	19ET6PCMWR	Credits	3	L:T:P	2:1:0

UNIT I **[8 hours]**

Transmission Line, waveguides and Antenna: Quarter wave transformer, Generator and Load mismatch, coaxial line, waveguides, microstrip transmission lines, Horn antenna, parabolic reflector antenna and Patch Antenna

UNIT II **[8 hours]**

Microwave Network Analysis: Impedance and admittance matrix, Scattering matrix, Transmission matrix, signal flow graphs, matching with lumped elements, theory of small reflections, binomial multi section matching transformer, Chebyshev Multisection Matching Transformers, Tapered Lines

UNIT III **[8 hours]**

Power Dividers, Directional Couplers and Microwave filters: The T-Junction Power Divider, The Wilkinson Power Divider, The Quadrature Hybrid, Filter Design by the Insertion Loss Method, Filter Transformation and Implementation, RF Diode and transistor Characteristics, Two-Port Power Gains for amplifiers, RF oscillator and super-heterodyne mixer

UNIT IV **[8 hours]**

RADAR Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, Pulsed Radar Principles, Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, Tracking Radar, Angular resolution, Monopulse Technique

UNIT V **[8 hours]**

Measurements with RADAR: Match Filtering, Radar Ambiguity Function, Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging, Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models, Ground Penetrating Radar for close sensing, EM hazards

TEXT BOOKS:

1. Antennas, John D. Krauss, III edition, McGraw-Hill International edition
2. Microwave Engineering, by David Pozar, Third edition, 2005, Wiley Publication
3. Microwave Engineering, by Annapurna Das and Sisir K Das, second edition, McGraw Hill
4. Introduction to RADAR systems: Merril I Skolnik, Second edition, McGraw Hill
5. Antenna Theory Analysis and Design -C A Balanis, second edition,John Wiley

REFERENCE BOOKS:

1. Microwave Devices and Circuits, Samuel Y Liao, Third Edition, PHI

MOOCs:

1. Microwave Engineering, By Prof. Ratnajit Bhattacharjee, IIT Guwahati https://swayam.gov.in/nd1_noc19_ee68/
2. Principles and Techniques of Modern Radar Systems, By Prof. Amitabha Bhattacharya, IIT Kharagpur, https://swayam.gov.in/nd1_noc19_ee58/

Unit Choice : Unit – II and Unit - III

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

CO1	Ability to define and understand the operation and working of the various tubes or sources for the transmission of the microwave frequencies and the concepts associated with RADAR		**PSO2 (3)**
CO2	Ability to apply the knowledge of electromagnetic theory for propagation/transmission of microwaves and RADAR communication.	**PO1(3)**	
CO3	Ability to analyze various parameters and characteristics of the various microwave components used for the transmission of the EM waves and in RADAR systems.	**PO2(2)**	
CO4	Ability to design waveguide components for various applications.	**PO3(1)**	
CO5	Ability to conduct experiments to measure the losses, power, VSWR, coupling factor, isolation, directivity, S-parameters (using microwave bench/simulation tool)	**PO5(3)**	
CO6	Ability to engage in independent learning, submit a report and use ICT for effective presentation on the study on topics related to microwave link / standards / radiation hazards / specifications / applications / impact on society/environment	**PO10(1)**	

Course Title	DIGITAL COMMUNICATION				
Course Code	19ET6PCDCM	Credits	4	L:T:P	3:0:1

UNIT I	[8 hours]
Block Diagram of Digital Communication System Pulse Analog Modulation: Sampling theorem, sampling of band-pass signals, Practical aspects of sampling, Reconstruction of message from its samples, PAM, PWM, PPM, TDM. Pulse-Digital Modulation: Elements of PCM, Noise in PCM systems, Quantization, Companding, Differential PCM, Delta modulation. T1 digital Hierarchy.	

UNIT II	[8 hours]
Base-band Data transmission: Elements of binary PAM, Baseband shaping, Optimum transmitting and receiving filters, Correlative coding, Baseband M-ary PAM, Adaptive equalization, Eye pattern, Examples: Line coding	

UNIT III	[8 hours]
Gram-Schmidt orthogonalization procedure, Matched filters, Properties of matched filters.Band-pass data transmission: Time and frequency domain representation of ASK, FSK,PSK;generation and detection; Performance analysis: power and bandwidth, bit error rate.	

UNIT IV	[8 hours]
Band-pass data transmission:,Time and frequency domain representation of DPSK,QPSK; generation and detection; Performance analysis: power and bandwidth, bit error rate. Introduction to OFDM, MSK, GMSK, MQAM	

UNIT V	[8 hours]
Need for Spread Spectrum Modulation. PN sequence and its properties, Direct sequence SS system-DS/BPSK Transmitter & Receiver, Frequency hopping, Processing gain, Jamming margin, CDMA	

TEXT BOOKS:

Digital Communications By Simon Haykins –John Wiley 2003

REFERENCE BOOKS:

1. Digital and Analog Communication by K Sam Shanmugham, John Wiley

2. Analog and Digital communications by Simon Haykins –John Wiley

Lab Experiment

Part A: Using suitable components

- Sampling Theorem verification (Unit-I)
- Generation of PAM, PWM, PPM, PAM-TDM (Unit-I)
- Generation of Line-Codes (Unit-III)
- Generation of ASK, PSK, FSK (Unit-IV)
- Demodulation of ASK, FSK, PSK (Unit-IV)

Part B: Using LabVIEW

- Sampling Theorem verification (Unit-I)
- Generation of DM, ADM (Unit-II)
- Generation of Line-Codes (Unit-III)
- Obtaining the eye-pattern (Unit-III)
- Generation ASK, PSK, FSK, QPSK, (Unit-IV)
- Obtain the BER, Bandwidth, Signal Constellation diagram for the modulation scheme (Unit-IV)
- PRBS sequence generation (Unit-V)
- Properties of Matched Filters (Unit-IV)
- Generation and demodulation of OFDM symbol (Unit-V)
- Generation and demodulation of SS, DS-BPSK symbol (Unit-V)

Unit Choice : Unit – I and Unit - III

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

CO1	Ability to **define, understand and explain** concepts related to digital communication		**PSO2 (3)**
CO2	Ability to **apply** the knowledge of mathematics and signal processing to various blocks of the digital communication system	**PO1(3)**	
CO3	Ability to **analyze** the given block/waveform of the digital communication system	**PO2(2)**	
CO4	Ability to **conduct experiments** to demonstrate concepts related to digital communication using discrete electronic components	**PO5(3)**	
CO5	Ability to **conduct experiments** to demonstrate concepts related to digital communication using the engineering tool: LabVIEW	**PO5(3)**	
CO6	Ability to perform in a team to build **the complete digital communication system** for transmitting and receiving the audio/data/image, and study the performance in added noise (using discrete components or an engineering tool)	**PO4(2)** **PO5(2)** **PO11(2)**	

Course Title	COMPUTER COMMUNICATION NETWORKS				
Course Code	19ET6PCCCN	Credits	4	L:T:P	3:0:1

UNIT I	[8 hours]

Introduction : Data communication , Networks, **Network models:** layered tasks, The OSI model, layers in the OSI model, TCP/IP protocol suite, Addressing , **Transmission media:** Telephone network, Dial up modems, DSL

Data link Control: Framing, Flow and error control, Protocols,

UNIT II	[8 hours]

Data link Control: Noiseless channels, Noisy channels, HDLC, Point to point protocol.

Multiple access: Random access, controlled access

Connecting LANs, Backbone networks and Virtual LANs: Connecting Devices, Backbone Networks

UNIT III	[8 hours]

Network layer: Logical Addressing: IPv4 addresses,IPv6 Addresses,

Network layer: Logical Addressing Internet Protocol:IPv4, IPv6,Transition from IPv4 to IPv6, **Network Layer: Delivery, Forwarding, and Routing:** Delivery, Forwarding, Unicast Routing Protocols, Multicast and Broadcast (without applications)

UNIT **IV**	[8 hours]

Transport layer: Process to process delivery,User Datagram Protocol(UDP),TCP, SCTP,

Congestion **control & QOS:** Data traffic, Congestion, Congestion control, Quality of Service, Techniques to improve QoS

UNIT V	[8 hours]

Application layer: Domain Name system: Name space, Domain Name space, Distribution of name space, DNS in the internet, Resolution

Remote logging, Electronics mail and File transfer: Remote logging, Electronic mail, File transfer **WWW and HTTP:** Architecture, web documents , HTTP

TEXT BOOKS:

1. **Data Communication and Networking, Behrouz Forouzan, 4th Edition, Tata Mcgraw Hill**

REFERENCE BOOKS:

Computer Networks, Andrew S Tanenbaum, 3rd Edition, PHI

Sl.No	**Experiment List**
1	Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool
2	Study of Network Devices in Detail
3	Study of network IP
4	Connect the computers in Local Area Network
5	Study of basic network command and Network configuration commands.
6	Configure a Network topology using packet tracer software
7	Performing an Initial Switch Configuration
8	Performing an Initial Router Configuration
9	Configuring and Troubleshooting a Switched Network, Connecting a Switch
10	Configure a Network using Distance Vector Routing protocol and Link State Vector Routing protocol

Unit Choice: Unit – II and Unit - III

Course outcomes:

*At the end of the course on **Computer Communication Networks**, the student will have the*

CO1	Ability to **understand, define and explain** the fundamental concepts of computer network	--	PSO3(2)
CO2	Ability to **apply** the knowledge of communication and networks to computer communication	PO1(2)	
CO3	Ability to **analyse** the given network systems parameters and arrive at suitable conclusions	PO2(1)	
CO4	Ability to **conduct experiments** to demonstrate networking concepts using the hardware and software engineering tool: Qualnet / Matlab/packet tracer	PO1(3) PO5(3)	
CO5	Ability to implement and demonstrate the specified **mini-project** using suitable computer communication network parameters	PO3(2) PO5(2) PO9(1)	

Course Title	IoT AND WIRELESS SENSOR NETWORKS				
Course Code	19ET6PE3IT	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]
Introduction to IoT, Introduction, physical design of IoT, Logical Design of IoT, IoT enabling technology, IoT levels and deployment templates	

UNIT II	[8 hours]
Overview of Internet of Things: IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT,Sources of IoT,M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices	

UNIT III	[8 hours]
Architecture and Design Principles for IoT: Internet connectivity, Internet-based communication,IPv4,IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS,FTP,TELNET and ports.Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits	

UNIT IV	[8 hours]
Prototyping and Designing Software for IoT Applications: Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server. Introduction to IoT privacy and security. Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model	

UNIT V	[8 hours]
Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts	

TEXT BOOKS:

1. RAJ KAMAL, "INTERNET OF THINGS-ARCHITECTURE AND DESIGN PRINCIPLES", MCGRAW HILL EDUCATION.
2. HOLGER KARL & ANDREAS WILLIG, "PROTOCOLS AND ARCHITECTURES FOR WIRELESS SENSOR NETWORKS", JOHN WILEY,2005.
3. VIJAY MADISETTI & ARSHDEEP BAHGA, INTERNET OF THINGS , A HANDS ON APPROACH, UNIVERSITIES PRESS

REFERENCE BOOKS:

1. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach",Elsevier, 2007.

2. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.

3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

MOOCs: https://onlinecourses.nptel.ac.in/noc19_cs65

Unit Choice : Unit – II and Unit - III

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

CO1	Ability to **understand, define and explain** the fundamental concepts of Internet of things and wireless sensor networks	--	**PSO3 (1)**
CO2	Ability to **apply** the knowledge of communication, networks and coding to networks	PO1(2)	
CO3	Ability to **analyse** the given network parameters and arrive at suitable conclusions	PO2(1)	
CO4	Ability to implement and demonstrate the specified **mini-project** using suitable communication and sensor network parameters	PO3(2) PO5(2) PO9(1)	

Course Title	**NETWORK SECURITY**				
Course Code	19ET6PE3NS	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Digital Signatures: Digital signatures, Elgamal Digital signature scheme, Schnorr digital signature scheme, NIST digital signature algorithm

Message authentication Codes: Message authentication requirement, Message authentication functions, requirements for MAC, Security of MACs, MACs based on hash functions (HMAC)

UNIT II **[8 hours]**

Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, distribution of public keys

Transport level security : web security considerations, secure socket layer, Transport layer security, HTTPS, SSH

Electronic mail security : PGP, S/MIME

UNIT III	[8 hours]
Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computing Security Concerns	
UNIT IV	**[8 hours]**
Introduction : overview of block chain, public ledgers, Bitcoin, smart contract, block in the blockchain, transactions, Distributed consensus, public versus private block chain, understanding crypto currency to block chain, permission model of the block chain, overview of security aspects of blockchain	
UNIT V	**[8 hours]**
Basic Crypto primitives: verifiable random functions, Zero-knowledge systems Basic Blockchain (Blockchain 1.0) – concepts germane to Bitcoin and contemporary proof-of-work based consensus mechanisms, operations of Bitcoin blockchain, crypto-currency as application of blockchain technology	

TEXT BOOKS:

1. William Stallings , “Cryptography and Network Security Principles andPractice”, Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3

2. Bruce Schneier, “Applied Cryptography Protocols, Algorithms, andSource code in C”, Wiley

Publications, 2nd Edition, ISBN: 9971-51-348-X

3.Josh thompsons, block chain : the block chain for beginners- guide to block chain technology and leveraging block chain programming

REFERENCE BOOKS:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007.

2. Cryptography and Network Security, AtulKahate, TMH, 2003.

Unit Choice : Unit – II and Unit - III

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

CO1	Ability to **define, understand and explain** concepts related to network security	-	**PSO 3(1)**
CO2	Ability to **apply** the knowledge of mathematics to cryptography	PO1(2)	
CO3	Ability to **analyze** the given security systems parameters	PO2(2)	
CO4	Ability to perform as an individual, prepare a report and make an **effective oral presentation** on applications of network security protocols of communication system, satellite systems , any other.,	PO6(2) PO7(2) PO8(2) PO9(3) PO10(2) PO12(2)	

Course Title	ASIC DESIGN				
Course Code	19ET6PE3AD	Credits	3	L:T:P	3:0:0

UNIT I **[8 hours]**

Introduction to ASICs

Types of ASICs:-- Full Custom with ASIC, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channel less gate array, structured gate array, Programmable logic device, Field programmable gate array, Design flow, ASIC cell libraries

UNIT II **[8 hours]**

CMOS LOGIC

Data path Logic Cells: - Data Path Elements, Adders, Multiplier. I/O cell, Cell Compilers

ASIC LIBRARY DESIGN

Logical effort: - practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

UNIT III **[8 hours]**

PROGRAMMABLE ASICS
The Antifuse, Static RAM, EPROM and EEPROM Technology.Programmable ASIC logic cells

UNIT IV **[8 hours]**

Programmable ASIC I/O cells, Programmable ASIC interconnect

UNIT V **[8 hours]**

Low-level Design Entry: Schematic Entry: -Hierarchical design. The cell library, Names, Schematic Icons & Symbols, Nets, schematic entry for ASICs, connections, vectored instances and buses, Edit in place, attributes, Netlist screener, Back annotation

TEXT BOOKS:

1. M.J.S .Smith, - "Application - Specific Integrated Circuits" – Pearson Education

REFERENCE BOOKS:

1. Jose E. France, Yannis Tsividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
2. Malcolm R. Haskard, Lan. C. May, "Analog VLSI Design - NMOS and CMOS" Prentice Hall, 1998.
3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill.

MOOCs:
https://nptel.ac.in/courses/106/105/106105161/

Unit Choice : Unit – II and Unit - III			
At the end of the course, the student will have the ability to,			
CO1	Ability to **understand, define and explain** the fundamental concepts of ASIC Design		**PSO3 (3)**
CO2	Ability to **apply** the knowledge of Digital Electronics, VLSI and Verilog HDL to describe systems using different VLSI design methodologies such as Full- custom and Semi-custom approaches	**PO1 (3)**	
CO3	Ability to **analyse and design** a VLSI system for given specifications	**PO2 (2)**	
CO4	Ability to investigate the performance of VLSI systems	**PO3 (2)**	
CO5	Ability to apply industry standard CAD tools for designing VLSI systems	**PO5 (2)** **PO9 (2)**	

Course Title	**SOFTWARE DEFINED RADIO**				
Course Code	**19ET6PE3SD**	**Credits**	**3**	**L:T:P**	**3:0:0**
UNIT I					**[8 hours]**
Introduction to Software Defined Radio: History, Definition of Software defined Radio and evolution, interoperability, dynamic spectrum access, Radio frequency spectrum availability and its characteristics, Regulations, allocation and reallocation of spectrum and spectrum optimization, applications of SDR					
UNIT II					**[8 hours]**
Digital Communication Fundamentals for SDR: Spectrum occupancy studies, channel efficiency, Spectrum sensor arrays, Wireless Systems and Device Design Opportunities, AWGN and band-limited channel, Digital modulation techniques, Probability of Bit error, Multicarrier Modulation, OFDM, Multicarrier Equalization, ISI and pulse shaping					
UNIT III					**[8 hours]**
Spectrum Sharing: Unlicensed spectrum and licensed spectrum sharing, secondary spectrum access, real-time and non-real time spectrum access, peak-to-average power ratio problem and its properties					

UNIT IV	[8 hours]

Adaptation and optimization: Adaptation engine, operating parameters, parameter relationships, expert systems, genetic algorithms, case-based reasoning systems, mobility and energy efficiency in wireless networks

UNIT V	[8 hours]

Introduction to Cognitive Radio: Cognitive Radio network architecture, architecture for spectrum sensing, network optimization, topology aware architecture, relay systems, user cooperation in wireless networks

TEXT BOOKS:

Cognitive Radio Communications and Networks: Principles and Practice, Alexander Wyglinski and Maziar Nekovee, Academic Press, 2010

REFERENCE BOOKS:

Unit Choice : Unit – II and Unit - V

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

CO1	Ability to define and understand the fundamentals of the communication link, the characteristics of network protocols, and be able to discuss the allocation of radio resources and technologies		**PSO2(3)**
CO2	Ability to apply the concepts of analog and digital technologies to the systems required by a software-defined radio to function and the trade-offs and limitations encountered in the design of a software-defined radio system	**PO1(3)**	
CO3	Ability to analyze accurate link budget for a software-defined radio system or other wireless communications link	**PO2(2)**	
CO4	Ability to design and test a complete software defined radio system	**PO3(3)** **PO5(3)**	
CO5	Ability to conduct experiments using simulation tools to demonstrate the application of software in radio	**PO5(3)** **PO9(3)**	

Course Title	MOOCs Based Elective				
Course Code	19ET6PE3MB	Credits	3	L:T:P	3:0:0

At the beginning of the semester, the department identifies a list of relevant MOOCs being floated by NPTEL/SWAYAM/Coursera/EDx etc
The faculty and the interested students take up the identified online MOOC
The faculty conducts the internal assessments and the SEE based on the identified MOOCs

Course Title	Artificial Intelligence				
Course Code	19ES6CE1AI	Credits	3	L:T:P	3:0:0

UNIT I **[8 hours]**

Introduction to AI: History, Foundations of AI, state of the Art systems, risks and benefits of AI, Intelligent Agents, Concept of Rationality, Nature of environments, Structure of agents, problem solving agents

UNIT II **[8 hours]**

Problem Solving: Search Algorithms, Uninformed search strategies, informed search strategies, Heuristic functions, local search and optimization problems, optimal decision in games, heuristic alpha-beta tree search, Monte carlo tree search, stochastic games

UNIT III **[8 hours]**

Constraint satisfaction and Knowledge: constraint satisfaction problems, constraint propagation, backtracking search, local search for constraints, structure of problems, propositional logic, propositional theorem proof, propositional model

UNIT IV **[8 hours]**

Uncertainty in AI: Motivation, Basics of probability, Bayes Rule, Bayesian Network, conditional independence, maximum likelihood, Bayesian learning

UNIT V **[8 hours]**

Decision Theory: Introduction to decision theory, non-deterministic uncertainty, expected utility and value, Markov decision process, policy evaluation using linear equations, introduction to reinforcement learning

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed., Prentice Hall, 2009. Can also use 2nd Ed., Pearson Education International, 2003.
2. Nils Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann, 1998

REFERENCE BOOKS:
David Poole, Alan Mackworth, Artificial Intelligence: Foundations for Computational Agents, Cambridge Univ. Press, 2010

MOOCs:
An introduction to Artificial Intelligence, Prof. Mausam, Department of Computer Science, IIT Delhi, https://nptel.ac.in/courses/106/102/106102220/

Unit Choice : Unit – II and Unit – III

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

CO1	Ability to define and understand the fundamentals of Artificial Intelligence and its applications		**PSO3(3)**
CO2	Ability to apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	**PO1(3)**	
CO3	Ability to analyze models of machine learning	**PO2(2)**	
CO4	Ability to design and test intelligent and expert AI systems, artificial neural networks and other machine learning models	**PO3(3)** **PO5(3)**	
CO5	Ability to conduct experiments using python to demonstrate the application of s	**PO5(3)** **PO9(3)**	

Course Title	**SPEECH PROCESSING**				
Course Code	**19ES6CE1SP**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Speech Production & Auditory Perception
Introduction, The speech chain, Phonetic representation of speech, Models for speech production, Hearing and auditory perception, Perception of loudness, critical bands, Pitch perception, Auditory masking, Applications of digital speech processing

UNIT II **[8 hours]**

Short Time Analysis of Speech
Voiced/Unvoiced system model for speech, Short-Time Energy and Zero-Crossing Rate, Short-Time Autocorrelation Function (STACF), Short-Time Fourier Transform (STFT), sampling the STFT in Time and Frequency, The Speech Spectrogram, Relation of STFT to STACF, Short-Time Fourier Synthesis.

UNIT III **[8 hours]**

Cepstrum & Homomorphic Speech Analysis
Cepstrum and Complex Cepstrum, Short time Cepstrum, computation of Cepstrum, Short time homomorphic filtering of speech, Application to pitch detection, Applications to Pattern Recognition:

Compensation for Linear Filtering, Liftered Cepstrum Distance Measures, Mel-Frequency Cepstrum Coefficients

UNIT IV	[8 hours]

Linear Predictive Analysis

Linear Prediction and the Speech Model, Computing the Prediction Coefficients: The Covariance Method, The Autocorrelation Method, The Levinson–Durbin Recursion, LPC Spectrum, PARCOR Coefficients, Log Area Coefficients

UNIT V	[8 hours]

Digital Speech Coding

Sampling and Quantization of Speech (PCM), Digital Speech Coding, **Closed-Loop Coders:** Predictive Coding, Delta Modulation, Adaptive Differential PCM Systems, Vector quantization, **Analysis-by-Synthesis Coding:** Basic Analysis-by-Synthesis Coding System, Perceptual Weighting of the Difference Signal, Generating the Excitation Signal, Multi-Pulse Excitation Linear Prediction (MPLP), Code-Excited Linear Prediction (CELP), **Open-Loop Coders:** The Two-State Excitation Model, Residual-Excited Linear Predictive Coding, Mixed Excitation Systems, **Frequency-Domain Coders:** Subband coder and decoder for speech

TEXT BOOKS:

1. INTRODUCTION TO DIGITAL SPEECH PROCESSING (FOUNDATIONS AND TRENDS IN SIGNAL PROCESSING 1:1-2, 2007), LAWRENCE R. RABINER AND RONALD W. SCHAFER , NOW PUBLISHERS INC.,2007

REFERENCE BOOKS:

1. Digital processing of speech signals – L. R. Rabiner and R. W. Schafer, Pearson Education Asia, 2004.

2. Discrete time speech signal processing– T. F. Quatieri, Pearson Education Asia, 2004.

LAB EXPERIMENTS:

1. Stationary and non-stationary nature of speech signal.
2. Identification of voiced/unvoiced and silence regions
3. Different sounds in language
4. Short time processing of speech
5. Linear prediction analysis
6. Cepstral analysis of speech
7. Estimation of pitch and formants
8. Voice activity detection

MOOCs: Introduction to digital speech processing by Dr. Shyamal Kumar Das Mandal, Indian Institute of Technology, Kharagpur, https://nptel.ac.in/courses/117/105/117105145/ (NPTEL)

Unit Choice : Unit – II and Unit - V

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

CO1	Ability to define, understand, and explain discrete time model of the speech production and short time processing of the speech		
CO2	Ability to solve LPC equations for speech communication and obtain complex Cepstrum of speech for pitch estimation	**PO1 (3)**	
CO3	Ability to analyze and synthesize the speech in frequency domain through short time Fourier transform	**PO2 (2)**	**PSO3 (3)**
CO4	Ability to function effectively as an individual or as a team member to conduct experiments using modern engineering tools for a given Speech processing problem.	**PO5 (3)** **PO9 (3)**	
CO5	Ability to perform in a team to implement the specified mini-project	**PO5 (3)** **PO9 (3)** **PO12 (3)**	

Course Title	**DATA SCIENCE**				
Course Code	**19ES6CE1DS**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Introduction to Data Science and Python Programming

What is data science, data sciencester, the basics of python: whitespace formatting, modules, arithmetic, functions, strings, exceptions, lists, tuples, dictionaries, sets, control flow, truthiness, sorting, list comprehensions, generators and iterators, randomness, regular expressions, object oriented programming, functional tools, enumerate, visualizing data: matplotlib, linear algebra: vectors and matrices

UNIT II **[8 hours]**

Statistics, Probability, Hypothesis and Inference

Describing single set of data, central tendencies, dispersion, correlation, Simpsons paradox, correlation and causation, dependence and independence, conditional probability, Bayes theorem, random variables, continuous distribution, the normal distribution, the central limit theorem, Statistical hypothesis testing, confidence intervals, P-hacking, Bayesian inference

UNIT III **[8 hours]**

Gradient Descent, Working with Data

Idea behind Gradient descent, estimating the gradient, using the gradient, choosing the right step size, stochastic gradient descent, Exploring one dimensional data, two dimensions, many dimensions, cleaning and munging, manipulating data, rescaling, dimensionality reduction.

UNIT IV	[8 hours]
Introduction to Machine Learning-I Modeling, what is machine learning, overfitting and underfitting, correctness, the bias variance trade offs, feature extraction and selection, k nearest neighbors, naive Bayes, spam filters, simple linear regression, maximum likelihood estimation, Multiple regression.	
UNIT V	**[8 hours]**
Introduction to Machine Learning-II Logistic regression, logistic function, support vector machines, decision trees, entropy, entropy of a partition, creating a decision tree, random forests, Neural networks: perceptron, feed forward neural networks, back propagation, clustering, bottom up hierarchical clustering.	
TEXT BOOKS: 1. Data science from scratch (first principles with python) by Joel Grus, Oreilly, April 2015, 1st edition.	
REFERENCE BOOKS: 1. Doing data science (straight talk from the front line) by Rachel Schutt and Cathy O Neil, Oreily, October 2013, 1st edition.	
LAB PROGRAMS: 1. Basics of python programming (unit 1) 2. Statistics, Bayes theorem and inference using python programming (unit 2) 3. Gradient descending using python (unit 3) 4. Working with multi-dimensional data using python (unit 3) 5. Feature extraction using python (unit 4) 6. KNN, Naïve Bayes and Regression using python (unit 4) 7. Logistic regression, Decision trees, SVM using python (unit 5)	
MOOCs: Python for Data Science by Prof. Ragunathan Rengasamy, Indian Institute of Technology, Madras, https://nptel.ac.in/courses/106/106/106106212/ (NPTEL)	
Unit Choice : Unit – IV and Unit - V	

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

CO1	Ability to understand the data science concepts		**PSO3(3)**
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient machine algorithms in data science	**PO1(3)**	
CO3	Ability to analyze the regression and classification models	**PO2(2)**	
CO4	Ability to design a solution for data science application	**PO3(3)**	
CO5	Ability to work as an individual and thereby conduct experiments using matlab/python for a given application/problem statement.	**PO5(3)** **PO9 (3)**	
CO6	Develop, test, analyze and demonstrate applications using python through a mini-project	**PO4(3)** **PO5(3)** **PO11(3)**	

Course Title	**ANALOG AND DIGITAL SIGNAL PROCESSING**				
Course Code	**19ET6OE1SP**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I	**[8 hours]**
Introduction to Signals and Systems Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems	
UNIT II	**[8 hours]**
Frequency-Domain representation of Continuous Time Signals Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems,	
UNIT III	**[8 hours]**
Analog Filters Frequency response of ideal analog filters, Salient features of Butterworth filters, Design and implementation of Analog Butterworth filters to meet given specifications	
UNIT IV	**[8 hours]**
Analog to Digital conversion Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems. (FFT not included)	

UNIT V	[8 hours]
Digital Filter Design Definition of FIR and IIR filters. Frequency response of ideal digital filters Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response	
TEXT BOOKS: 1. 'Signals and Systems', by Simon Haykin and Barry Van Veen, Wiley	
REFERENCE BOOKS: 1. 'Theory and Application of Digital Signal Processing', Rabiner and Gold 2. 'Signals and Systems', Schaum's Outline series 3. 'Digital Signal Processing', Schaum's Outline series	
MOOCs: NPTEL Course on Introduction to time frequency analysis and wavelet transforms by Prof. Arun, IIT Madras. https://nptel.ac.in/courses/103/106/103106114/	
LAB Experiments: 1. Design and implementation of analog Butterworth filters (using Circuit simulation tool-Multisim) 2. Design and implementation of Digital filters (using engineering tool - Matlab) 3. Perform analog to digital conversion and comprehend the sampling theorem **4.** Appreciate digital filters through the use of audio files	
Unit Choice : Unit – IV and Unit -V	

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

CO1	Understand and explain continuous time and discrete time signals and systems, in time and frequency domain		**PSO3 (2)**
CO2	Apply the concepts of signals and systems to obtain the desired parameter/ representation	**PO1(3)**	
CO3	Analyse the given system and classify the system/arrive at a suitable conclusion	**PO2(1)**	
CO4	Design analog/digital filters to meet given specifications	**PO3(3)**	
CO5	Design and implement the analog filter using components/ stable simulation tools	**PO3(3)** **PO5(3)**	
CO6	Design and implement the digital filter (FIR/IIR) using suitable simulation tools, and record the input and output of the filter for the given audio signal	**PO3(2)** **PO4(2)** **PO5(2)**	

Course Title	**MICROPROCESSORS**				
Course Code	**19ET6OE1MP**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I	**[8 hours]**

8086 Processor

Historical background, 8086 CPU Architecture. Addressing modes, Machine language instruction formats.

Instruction Set of 8086:

Data transfer and arithmetic instructions., Illustration of these instructions with example programs

UNIT II	**[8 hours]**

Logical Instructions and Control/Branch Instructions

Logical Instructions, String manipulation instructions, Flag manipulation and Processor control instructions, Illustration of these instructions with example programs, control and branch instructions. Assembler Directives and Operators, Assembly Language Programming and example programs

UNIT III	**[8 hours]**

Stack and Interrupts

Introduction to stack, Stack structure of 8086, Programming for Stack. Interrupts and Interrupt Service routines, Interrupt cycle of 8086, NMI, INTR, Interrupt programming, Timing and Delays.

UNIT IV	**[8 hours]**

8086 Bus Configuration and Timings

Physical memory Organization, General Bus operation cycle, I/O addressing capability, Special processor activities, Minimum mode 8086 system and Timing diagrams, Maximum Mode 8086 system and Timing diagrams.

Basic Peripherals and their Interfacing with 8086 : Static RAM Interfacing with 8086 , Interfacing I/O ports, PIO 8255, Modes of operation – Mode-0 and BSR Mode, Interfacing simple switches and simple LEDs using 8255.

UNIT V	**[8 hours]**

Applications Interfacing ADC-0808/0809, DAC-0800, Stepper Motor using 8255 . Timer 8254 – Mode 0 & 3 and Interfacing programmes for these modes.

TEXT BOOK:

Advanced Microprocessors and Peripherals - A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition, 2012, ISBN 978-1-25-900613-5.

REFERENCE BOOKS:

1. Microprocessor and Interfacing- Douglas V Hall, SSSP Rao, 3rd edition TMH, 2012.
2. Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu and A. Gibson, 2nd edition, PHI - 2003.
3. The 8086 Microprocessor: Programming & Interfacing the PC – Kenneth J Ayala, CENGAGE Learning, 2011.
4. The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e, Pearson Education / PHI, 2003.

Unit Choice : Unit – II and Unit -III

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

CO1	Ability to understand and explain the evolution of Microprocessors, Architecture and instruction set of 8086, CISC & RISC, Von-Neumann & Harvard CPU Architecture, Configuration & Timing diagrams of 8086 and interrupt function calls.	--	**PSO3 (1)**
CO2	Ability to **develop the assembly code** to perform a specified task	**PO1 (3)**	
CO3	Ability to **design** and develop the logic to interface external memory and peripherals	**PO2 (3)**	
CO4	Ability to **conduct experiments** by developing the assembly code to perform a specified task	**PO5 (1)**	

Course Title	ENGINEERING ECONOMICS				
Course Code	19GC6HSEEC	Credits	2	L:T:P	2:0:0

UNIT I **[8 hours]**

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – P/V ratio.

UNIT II **[8 hours]**

Elementary Economic Analysis: Introduction- Material selection for product, Design selection for a product, Material design – Process planning.

UNIT III **[8 hours]**

Value Engineering : Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT IV **[8 hours]**

Cash Flow: Revenue dominated cash flow diagram, cost dominated cash flow diagram, Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT V **[8 hours]**

Replacement and Maintenance Analysis

Maintenance -Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return.

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation.

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCE BOOKS:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley.

MOOCs:

1. https://easyengineering.net/engineering-economics-by-panneerselvam-book/ (E-book)
2. https://www.coursera.org/lecture/faecalsludge/4-7-engineering-economics-KoVa9

Unit Choice : Unit – 3 and Unit - 4

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

CO1	Acquire the skills to apply the basics of economics in engineering field	**PO1(3)** **PO11(3)**	
CO2	Perform cost analysis for optimization to engineering products	**PO11(3)**	
CO3	To take economically sound decisions in maintenance of products.	**PO7(3)** **PO11(3)**	

Course Title	PROJECT BASED ON MULTIMEDIA STANDARDS				
Course Code	19ET6PWMMS	Credits	2	L:T:P	0:0:2

There will be 6-8 hours of lectures in the beginning of the semester to introduce the Multimedia concepts and standards.
The project would be based on the basics of multimedia processing and the same would be implemented using tools such as MATLAB / LABVIEW.

A batch of 3 - 4 students is required to undertake the project to showcase the knowledge acquired during the classes held initially for the same. The project may be pursued with respect to the following sub – domains (but not limited to):

1. Image processing techniques such as enhancement, restoration, segmentation etc.
2. Image compression techniques such as JPEG, JPEG 2000, TIFF etc.
3. Text processing techniques like Huffman coding etc.
4. Text Compression techniques such as LZW coding, ZIP, RAR etc.
5. Audio / Speech processing techniques.
6. Audio / Speech compression techniques.
7. Video processing / compression techniques such as MPEG etc.

Project Report has to be submitted with the following chapters followed by demonstration:

- Abstract
- Contents
- Introduction
- Literature survey
- Implementation
- Results
- Conclusion and Future Enhancements
- Bibliography
- Appendix: Source Code of the Project

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

CO1	Engage in relevant survey and **identify** the standard to be implemented, together with listing the **desired specifications**	**PO2 (3)** **PO12 (3)**	**PSO3 (3)**
CO2	**Identify** the essential concepts, and identify the algorithm for the implementation	**PO1 (3)** **PO3 (3)**	
CO3	**Implement** and **analyse** the designed program, to match the specifications	**PO4 (2)**	
CO4	Calculate the **performance analysis** of the project	**PO11 (2)**	
CO5	Prepare the **project report**, three minute **video** and the **poster** of the work	**PO10 (3)**	
CO6	Engage in the **team** to document the business plan of the designed project, together with **complying** to **relevant norms**	**PO7 (2)** **PO8 (3)** **PO9 (3)**	
CO7	Identify the **community** that shall benefit from the project	**PO6 (1)**	

Course Title	SEMINAR BASED ON INTERNSHIP				
Course Code	19ET6SRCSR	Credits	1	L:T:P	0:0:1

During semester breaks, students are encouraged to engage in community service, through an NGO or as an individual. The duration of the activity shall be of 4 to 6 week duration. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable, through suitable projects in later semesters.

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

CO1	Engage in community service	**PO6 (2)**	
CO2	Prepare the project report, three minute video and the poster of the work	**PO10 (3)**	
CO3	Identify and specify an engineering product that can make their life comfortable	**PO2 (1)**	
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms	**PO7 (2) PO8 (3) PO11 (2)**	
CO5	Identify the community that shall benefit from the product	**PO6 (2)**	

Course Title	PERSONALITY DEVELOPMENT, COMMUNICATION AND APTITUDE SKILLS				
Course Code	19ET6NCPDA	Credits	NC	L:T:P	0:0:0

This course introduces to the following components:

Personality development:

Communication Skills:

Soft skills: Emotional Intelligence, Adaptability, Team player attitude, openness to feedback, growth mindset, work ethics, active listening

Aptitude skills:

The contents of this is to be developed.

It is planned to offer this course with support from alumni, or faculty/students from other departments.

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

CO1	Demonstrate professional communication skills	**PO10 (3)**	
CO2	Demonstrate aptitude and reasoning skills	**PO4 (3)**	
CO3	Demonstrate balanced emotional quotient and interpersonal skills	**PO9 (3)**	

VII SEMESTER

Course Title	BIOLOGY FOR ENGINEERS				
Course Code	19ES7BSBFE	Credits	2	L:T:P	2:0:0

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	**[6 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	**[5 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	
Unit Choice : Unit II and V	

Course Outcomes:

CO1	Ability to understand and explain basic concepts of Biology		
CO2	Ability to apply the knowledge of Biology to convey the role of basic building blocks of life	**PO1(3)**	
CO3	Ability to understand and analyse basics of Radiation and its effects on Human Body	**PO6(3)**	
CO4	Understand role of Biology in organic farming	**PO7(3)**	

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 Resourse:

https://letstalkscience.ca/educational-resources/backgrounders/radiation-effects-on-body

MOOCs

https://nptel.ac.in/courses/121/106/121106008/

Course Title	WIRELESS COMMUNICATION				
Course Code	19ET7PCWCM	Credits	4	L:T:P	3:1:0

UNIT I	[8 hours]

Introduction to Wireless Communication System: Overview of Cellular Systems and evolution 2G/3G/4G/5G. **The Cellular Concept-System Design fundamentals:** Introduction, Frequency reuse, Channel assignment strategies, Handoff Strategies, interference and system capacity, trunking and Grade of Service, Improving coverage and capacity in cellular systems

UNIT II	[8 hours]

Mobile Radio Propagation: Large scale Path loss-Introduction to radio wave propagation, free space propagation model, the three basic propagation mechanisms, Reflection, ground reflection model, Diffraction, Scattering, practical link budget design using path loss models Outdoor propagation models: Okumura model and Hata model. Indoor propagations models: ITU indoor path loss model, Long Distance Path Loss model

UNIT III	[8 hours]

Small Scale fading and multipath: Small scale multipath propagation, parameters of mobile multipath channels, types of small scale fading,. **Equalization and Diversity techniques**: Introduction, Fundamentals of Equalization, Equalizers in a Communications Receiver, Survey of Equalization technique, Diversity technique, practical space diversity considerations, RAKE receiver

UNIT IV	[8 hours]

GSM: system overview, the Air interface, Logical and physical channels, Synchronization, Voice encoding, channel encoding, block encoding, convolution encoding, interleaving. Establishing a connection and handover, Examples of Different Kinds of Handovers- Handover between BTSs Belonging to the same BSC, Handover between Two BTSs that are controlled by Different BSCs & the Same MSC. Services and Billing

UNIT V	[8 hours]

Introduction to Multi Access, Frequency Division Multi Access, Time Division Multi Access, Spread Spectrum Multi Access, Space Division Multi Access, introduction to Long Term Evolution (4G)- LTE Architecture, Radio Spectrum, Frame Structure, OFDMA Principle, Physical channels, Signal flow during Cell Search, UL Transmission, DL transmission

Unit Choice: Unit I and Unit III

Course Outcomes

Course Outcomes		
CO1: Ability to **define, understand** and **explain** concepts related to wireless communication	--	PSO2(3) PSO3(3)
CO2: Ability to **apply** the knowledge of communication and coding to wireless communication	PO1 (3)	
CO3: Ability to a**nalyse** the given parameters for different propagation models of wireless networks	PO2 (3)	
CO4: Ability to **conduct experiments** to demonstrate wireless concepts using suitable the engineering tool (for example: QUALNET)	PO5 (3) PO9(3)	
CO5: Ability to perform in a team to prepare a report and make an effective **oral presentation** of the study on topics related to Wireless Networks, radiation hazards and use of ICT in healthcare.	PO6 (1) PO7 (1) PO8 (3) PO10 (3) PO12 (3)	

Laboratory experiments

1. Simulate simple BSS with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
2. Simulate simple Wi-fi and Wimax with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
   a) WIFI b)WIMAX
3. MANET (Mobile Adhoc Networks) simulation using Omni-directional Antenna model and Analysis
4. To find S-parameters of the given passive device.
5. To find impedance of a given load using slotted line method.
6. To find insertion loss, VSWR, output power and frequency of Operation of the given passive device. 7
7. To verify the characteristics of the given micro strip antenna
8. Setting up of optical analog link
9. Setting up of optical digital link
10. To find various Fibre losses of the given optical fibre
11. To find the Numerical Aperture of the given optical fibre

TEXT BOOKS:

1. Wireless Communications- Principles And Practice, Theodore S Rappaport, Pearson, 2nd Edition
2. Wireless Communications, Andreas F Molisch, Wiley, 2012
3. Introduction to LTE, Christopher Cox, Wiley
4. LTE- The UMTS long term Evolution: From Theory to Practice Stefania, ISSan Toufik and Mathew Baker 2009 , John Wiley and Sons Ltd

REFERENCE BOOKS:

1. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005
2. LTE- The UMTS long term Evolution: From Theory to Practice Stefania, ISSan Toufik and Mathew Baker 2009 , John Wiley and Sons Ltd

MOOCs:

1. Wireless Communication https://nptel.ac.in/courses/117/102/117102062/
2. Introduction to wireless and cellular communication : https://nptel.ac.in/courses/106/106/106106167/

Course Title	**SUSTAINABLE TELECOM NETWORKS**				
Course Code	**19ET7PCSTN**	**Credits**	**1**	**L:T:P**	**1:0:0**

UNIT I	**[2 hours]**
Sustainability: Definition, theory of sustainability, Human, Social, Economic and Environmental sustainability, drivers and challenges of sustainability	
UNIT II	**[2 hours]**
Green Communication: Origins of Green Communications, Energy Efficiency in Telecommunication Systems: Then and Now, Telecommunication System Model and Energy Efficiency, Techniques and Challenges, Applications, Energy Saving Concepts	
UNIT III	**[2 hours]**
Regulatory Framework: Radio regulation, The Telecommunication Interconnection Usage Charges Regulations, Mobile number regulations, portability, interconnection issues	
UNIT IV	**[3 hours]**
Radiation standards: Introduction, RF and Microwave Radiation, Safety standards for personnel- CENELEC, IEEE and FCC standards, SAR for cell phones, radiation hazards, Myths and Realities	
UNIT V	**[3 hours]**
Revenue models through Telecommunication Networks: Constant Revenue Model for Telecommunication Networks, different Pricing Approaches in the Telecom Sector, Marketing and Pricing Strategies of Telecom service providers	
Unit Choice: Unit III and V	

Course Outcomes

CO1	Ability to **understand** and **explain** concepts and techniques of telecommunications networks, the business models of telecommunication companies, the role of regulatory bodies and telecommunication companies in bringing sustainability in networks	-	PSO2 (3) PSO3 (3)
CO2	Ability to **apply** the knowledge of electromagnetics, alternate renewable energy sources, to minimize the effect of radiation hazards on human health and environment	PO1 (3) PO7 (3)	
CO3	Ability to **apply** the knowledge of finance management to arrive at effective business models and revenue models for telecommunication networks	PO7 (3) PO11 (3)	
CO4	Ability to **analyse** the carbon footprint data to develop green networks	PO7 (1)	
CO5	Ability to engage in independent learning to make **effective presentation** on research papers published in the area of sustainability, green networks, alternate energy sources, hazards and effective ways to reduce their effects	PO7 (3) PO10 (3) PO12 (3)	

TEXT BOOKS:

1. The Telecommunications Handbook, Kornel Terplan, Patricia A. Morreale, CRC Press
2. The Telecom Regulatory Authority of India Act, 1997, Georg Thieme Verlag
3. Telecommunication: New Signposts to Old Roads, Paul Slaa
4. Telecom Management in Emerging Economies: Evolutionary and Contemporary Perspectives, Murali Krishna Medudula, Mahim Sagar, Ravi Parkash Gandhi

.

REFERENCE BOOKS:

Green Networking and Communications: ICT for Sustainability, Shafiullah Khan, Jaime Lloret Mauri

Course Title	**DRONES: DESIGN AND GOVERNING NORMS**				
Course Code	**19ET7CE2DR**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Introduction to Aerial Robotics: Unmanned Aerial Vehicles, Quadrotors, Key components of Autonomous flight, Frame Rotations and Representations, Dynamics of a Multirotor Micro Aerial Vehicle, Dynamics and 1-D control, Design considerations, Kalman Filter, Component Selection, Applications

UNIT II **[8 hours]**

Mechanics: State estimation, Basic mechanics, Agility and Maneuverability, Eigenvalues and Eigenvectors of Matrices, Skew-Symmetric Matrices, Newton-Euler Equations, Principal Axes and Principal Moments of Inertia, Quadrotor Equations of Motion, Rotations and transformations, Euler Angles, Axis/Angle Representations for Rotations, Angular velocity

UNIT III **[8 hours]**

Planning and Control: PID Control, Linear Quadratic Regulator Control, 2-D and 3-D Quadrotor Control, Time, Motion, and Trajectories, Motion Planning for Quadrotors, Minimum Velocity Trajectories from the Euler-Lagrange Equations, Solving for Coefficients of Minimum Jerk Trajectories, Linearization of Quadrotor Equations of Motion

UNIT IV	**[8 hours]**

Sensing and motion: Sensing and Estimation, Nonlinear Control, Control of Multiple Robots, Introduction to the Motion Capture System, Propellers, speed controllers, motors, flight controller, landing gear, Collision free navigation

UNIT V	**[8 hours]**

Drone Laws: Civil aviation requirements, Permission to fly drones, take off policies, compliance to policies and penalties for violations, distinction between public and private drones, drones for leisure and commercial purposes, weight-based classification of drones, rules for design and manufacture of drones, certification and licensing for drones' usage, registration of drones, insurance requirements and safety measures

Unit Choice: II and III

Course Outcomes

CO1	Ability to **understand** and **explain** basic concepts of drone, flight and the policies	-	PSO1(3)
CO2	Ability to **apply** the knowledge of programming, mathematics, control systems and sensors to build drones	PO1 (3)	
CO3	Ability to **analyse** the model and flight of drone abiding by the flight policies and safety	PO2 (3) PO6(3) PO8(3)	
CO4	Ability to **conduct experiments** as an individual using modern engineering tool Python to develop drones for different applications	PO5(2) PO9 (2)	

TEXT BOOKS:

1. Introduction to Aerial Robotics, Dr. Kostas Alexis, University of Nevada, Online book

REFERENCE BOOKS:

MOOCs: Robotics: Aerial Robotics, by Vijay Kumar, University of Pennsylvania, https://www.coursera.org/learn/robotics-flight

Course Title	IMAGE PROCESSING				
Course Code	19ET7CE2IP	Credits	3	L:T:P	3:0:0

COURSE OUTCOMES

CO1	Ability to **understand** and **explain** concepts of digital image processing.	--	PSO3 (3)
CO2	Ability to **apply** the knowledge of image processing techniques to enhance the quality of gray scale and colour image, restore the degraded image, illustrate different segmentation principles, and solve problems based on different image processing transforms.	PO1 (3)	
CO3	Ability to **analyse** the distance relationship between pixels, evaluate Histogram equalization on gray scale and colour image, deduce filter operations on the image, 116nalyse image segmentation and image transforms.	PO2 (3)	
CO4	Ability to **conduct experiments** as an individual using modern engineering tool Python/Matlab for a given image processing problem statement.	PO5(1) PO9(1)	

UNIT I	[8 hours]

Introduction to Image Processing: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Arithmetic and Logical operations on images, Image file formats.

UNIT II	[8 hours]

Image Enhancement: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization. Spatial Domain Smoothening filters.

Enhancement in Frequency Domain: Properties of Gaussian filters, Gaussian LPF and HPF, Homomorphic filter.

UNIT III	[8 hours]

Image Restoration and De-noising: Image degradation/restoration model, Inverse filter, Pseudo Inverse filter, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Wiener filter, Constrained Least squares filter.

UNIT IV	[8 hours]

Color Image Processing: Fundamentals of color image processing, Color models, Conversion of color models from one form to other form, Pseudo color image processing, Chromaticity diagram, Color Image Quantization, Histogram of color Image, Color Image Filtering, Gamma correction of color image.

UNIT V	[8 hours]

Image Segmentation: Classification, Region approaches to segmentation, Edge Detection basics: Roberts Kernel, Prewitt Kernel and Sobel Kernel, Canny edge detector.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing

Unit Choice: Unit II and Unit IV

Laboratory Experiments:

1. Arithmetic and Logical Operations on an image (Unit I)
2. Average of an image, Zooming and Pixel replication of an image (Unit I)
3. Transformations of an image (Unit II)
4. Gaussian Low Pass and High Pass filters (Unit II)
5. Inverse Filter and Pseudo Inverse filter (Unit III)
6. Wiener filter (Unit III)
7. Color histogram equalization and Color Median filter (Unit IV)
8. Pseudo – color image processing (Unit IV)
9. Image Segmentation (Unit V)
10. Image Morphological operations (Unit V)

TEXT BOOKS:

1. **Digital Image Processing** by Rafael C. Gonzalez & Richard E. Woods, Fourth Edition, Pearson education, 2018.

2. **Digital Image Processing** by S.Jayaraman, S.Esakkirajan, T.Veerakumar, McGraw Hill, 2009.

REFERENCE BOOKS:

1. **Digital Signal and Image Processing Using Matlab** by Gérard Blanchet, Maurice Charbit, ISTE Ltd., 2006.

2. **Image Processing and Acquisition using Python** by Ravishankar Chityala, Sridevi Pudipeddi, CRC Press, 2014.

3. **Machine Learning for OpenCV 4** by Aditya Sharma, Vishwesh Ravi Shrimali and Michael Beyeler, Packt Publishing Limited, 2019.

MOOCs:

https://swayam.gov.in/nd1_noc19_ee55/

Course Title	PATTERN RECOGNITION AND MACHINE LEARNING				
Course Code	19ET7CE2PM	Credits	3	L:T:P	3:0:0

Course Outcomes

CO1	Ability to understand the machine learning concepts	--	PSO3 (3)
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient machine learning algorithms	PO1 (3)	
CO3	Ability to 118nalyse the regression and classification models	PO2 (3)	
CO4	Ability to design a solution for machine learning application	PO3 (2)	
CO5	Ability to work as an individual and thereby conduct experiments using Pyhton/python for a given application/problem statement.	PO5 (3) PO9 (3)	
CO6	Develop, test, 118nalyse and demonstrate applications using Pyhton/python through an Open-Ended Experiment	PSO3 (3)	

UNIT I **[8 hours]**

Introduction

Polynomial curve fitting, probability theory: Probability densities, Expectations and covariances, Bayesian probabilities, The Gaussian distribution, Bayesian curve fitting, model selection, the curse of dimensionality decision theory: Minimizing the misclassification rate, Minimizing the expected loss, The reject option, Inference and decision, Loss functions for regression, information theory: Relative entropy and mutual information

UNIT II **[8 hours]**

Linear Models for Regression

Linear Basis Function Models: Maximum likelihood and least squares, Geometry of least squares, Sequential learning, Regularized least squares, Multiple outputs, The Bias-Variance Decomposition, Bayesian Linear Regression: Parameter distribution, Predictive distribution, Equivalent kernel, Bayesian Model Comparison, The Evidence Approximation, Limitations of Fixed Basis Functions

UNIT III **[8 hours]**

Linear Models for Classification

Discriminant Functions: Two classes, Multiple classes, Least squares for classification, Fisher's linear discriminant, Relation to least squares, Fisher's discriminant for multiple classes, The perceptron algorithm, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression, Support vector machines

UNIT IV	[8 hours]

Unsupervised Learning and Clustering

Introduction, Mixture Densities and Identifiability, Maximum-Likelihood Estimates, Application to Normal Mixtures, K means clustering, Fuzzy k-means clustering, Unsupervised Bayesian Learning, Data Description and Clustering, Criterion Functions for Clustering, Iterative Optimization, Hierarchical Clustering, Agglomerative Hierarchical Clustering

UNIT V	[8 hours]

Neural Networks

Introduction, Feed-forward Network Functions, Network Training, Error Back propagation, The Hessian Matrix, Regularization in Neural Networks, Mixture Density Networks, Bayesian Neural Networks.

Unit Choice: Unit III and IV

TEXT BOOKS:

1. Pattern Recognition and Machine Learning by Christopher Bishop, Springer, first edition, 2006
2. Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley, First Edition, 2019

REFERENCE BOOKS:

2. Introduction to Machine Learning, Ethem Alpaydin, PHI Learning, 3rd edition 2015

Introduction to Machine Learning with Python, Andreas C. Müller & Sarah Guido, O Reilly, First Edition, 2016

LAB Experiments using Python:

1. To implement Polynomial curve fitting(unit 1)
2. Program to implement linear models for regression (unit 2)
3. Program to implement linear models for classification (unit 3)
4. Program to implement SVM (unit 3)
5. Program to implement k means clustering technique (unit 4)
6. Program to implement Fuzzy C means clustering technique (unit 4)
7. Program to implement Agglomerative clustering technique (unit 4)
8. Program to implement a Neural Network (unit 5)

MOOCs: Machine Learning by Andrew NG, Coursera, https://www.coursera.org/learn/machine-learning

Course Title	DATA SCIENCE FOR MACHINE LEARNING				
Course Code	19ET7OEDM	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]
Introduction to Data Science. Functions (polynomial functions, exponential, sinusoidal); integration and differentiation of functions. To plot the functions, and perform integration/differentiation using Python	
UNIT II	**[8 hours]**
Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Poisson Distribution, Binomial Distribution Random Variables, Continuous Distributions, The Normal Distribution, The Exponential distribution, The Uniform Distribution, The Central Limit Theorem To plot the given distribution, and compute the Mean, variance, standard deviation using Python	
UNIT III	**[8 hours]**
Introduction to Machine learning concepts – Bias/variance, over-fitting and train/test splits. Types of Machine learning – Supervised, Unsupervised, Semi-supervised, Classification and Regression algorithms, Linear Regression, Logistic Regression algorithms, the concept, and implementation using Python.	
UNIT IV	**[8 hours]**
The Naïve Bayes Classifier for Discrete and Continuous Input; Decision Trees (for Discrete and Continuous Input and Output); the concept, and implementation using Python.	
UNIT V	**[8 hours]**
Kmeans Clustering, Regularization (lasso, ridge). Support vector machines (SVM), Analysis of Time Series; Bagging and Boosting (to balance bias and variance) and random forest. Introduction to Neural Networks. Data Science Applications: To implement two or more relevant Machine Learning models on a given data set, and make a comparative study.	
Unit Choice: Unit III and Unit V	

Course Outcomes

CO1	Ability to understand the data science concepts		
CO2	Ability to apply the knowledge of Engineering mathematics and programming skills to develop efficient machine algorithms in data science	**PO1 (3)**	**PSO3 (3)**
CO3	Ability to 120nalyse the regression and classification models	**PO2 (2)**	
CO4	Ability to design a solution for data science application	**PO3 (3)**	
CO5	Ability to work as an individual and thereby conduct experiments using matlab/python for a given application/problem statement.	**PO5 (3)** **PO9 (3)**	
CO6	Develop, test, 120nalyse and demonstrate applications using python through a mini-project	**PO4(3)** **PO5(3)** **PO11(3)**	

TEXT BOOKS:

Data science from scratch (first principles with python) by Joel Grus, Oreilly, April 2015, 1st edition.

REFERENCE BOOKS:

Doing data science (straight talk from the front line) by Rachel Schutt and Cathy O Neil, Oreily, October 2013, 1st edition.

MOOCs: Machine Learning by Andrew NG, Coursera,
https://www.coursera.org/learn/machine-learning

Course Title	**SUSTAINABLE HEALTH WITH TECHNOLOGICAL ADVANCE**				
Course Code	**19ET7OE2SH**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I **[8 hours]**

Information Technology and Healthcare
Healthcare Informatics Developments, Different Definitions of Telemedicine, The Growth of E-health to M-health, Evolving from the Internet, Digital Health on the Move, Data as a Sequence of "Packets", Connected World Between Human and Devices

UNIT II **[8hours]**

Communication Networks and Services
The Basics of Wireless Communications, Wired vs. Wireless, Types of Wireless Networks – Bluetooth, Infrared (IR) Wireless Local Area Network (WLAN) and Wi-Fi , ZigBee, Li-Fi, Cellular Networks, Broadband Wireless Access (BWA) ,M-health and Telemedicine Applications, RFID in Telemedicine, The Outdoor Operating Environment

UNIT III **[8 hours]**

Information and Communications Technology in Health Monitoring

Body Area Networks, Emergency Rescue, Smart Ambulance, Network Backbone, Smart Hospital, Radiology Detects Cancer and Abnormality, Robot Assisted Telesurgery, Ward Management Using RFID , Electromagnetic Interference on Medical Instrument, Smart Wearable Integration, General Health Assessments, Case Studies

UNIT IV **[8 hours]**

Data Analytics and Medical Information Processing- Introduction, Non-invasive Health Data Collection, Body Temperature, Heart Rate, Blood Pressure, Respiration Rate, Blood Oxygen Saturation, Blood Glucose Concentration, Biosignal Transmission and Processing, Medical Imaging, Magnetic Resonance Imaging, X-ray, Ultrasound, Medical Image Transmission and Analysis, Image Compression, Biopotential Electrode Sensing, Patient Records and Data Mining Applications, Artificial Intelligence (AI) in Digital Health, Deep Learning, AI in Mobile Health, Virtual Reality (VR) and Augmented Reality (AR)

UNIT V	[8 hours]
Digital Health for Community Care: Radiation Hazards from Cell phones, Safety standards for personnel, Telecare, Telecare for Senior Citizens, Telemedicine in Physiotherapy, Faster Wireless Communications for Supporting Virtual Reality (VR) in Telemedicine, The Future of Telemedicine and Information Technology for Everyone	

Unit Choice: II and III

Course Outcomes		
CO1: Ability to **explain** different heath parameters and concepts of ICT in Healthcare	--	PSO1 (1)
CO2: Ability to **apply** the knowledge of ICT in Telecare, Telemedicine and health monitoring	PO1 (3) PO6 (3)	
CO3: Ability to a**nalyse** the role of data analytics, AR, VR, AI and digital health for community care	PO2 (3) PO6 (3)	

Text book:

Telemedicine Technologies: Information Technologies in Medicine and Digital Health, Bernard Fong, A.C.M. Fong,C.K. Li, Wiley 2nd edition, 2020

Reference Textbook

Wearable Technology in Medicine and Health Care, Raymond K Y Tong, Elsevier Inc, 2018

3

Course Title	PROJECT MANAGEMENT AND FINANCE				
Course Code	19ES7HSPMF	Credits	3	L:T:P	3:0:0

UNIT I	[8 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.	
Unit Choice: Unit II and Unit IV	

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

Course Outcomes		
CO1: : Apply the Knowledge of project management principles and to study the current market trends	PO1(3) PO11(3)	PSO3 (3)
CO2: Choose projects and to implement project management methodologies ethically for successful project completion	PO5(2) PO8(2) PO11(2)	
CO3: To identify the investment opportunities and to formulate the projects	PO2(2) PO11(2)	
CO4: Ability to choose projects which benefit the society and organization and apply project phases and document them for future reference	PO6(1) PO11(1) PO12(1)	

Text Books:

Project Management – S Choudhury, Tata McGRAW Hill Publishing Company Limited

Projects- Planning , Analysis , Selection, Financing ,Implementation and Review –Dr. Prasanna Chandra McGRAW Hill Publishing Company Limited

Project Management Institute A Guide to the Project Management Body of Knowledge PMBOK Guide (Sixth Edition), Sept 2017

Reference Books:

Fundamentals of Project Management by Dr.Vijay Kanabar

Project Management – David I Cleland – Mcgraw Hill International edition

Project Management – Gopalakrishnan – Mcmillan India Ltd

Project Management – harry – Maylor- Peason Publication

E Books:

https://www.youtube.com/watch?v=5d16JwWwjKo

Nptel lecture on Introduction to project management by prof. Arun Kanda
https://www.youtube.com/watch?v=5pwc2DYlKQU

Course Title	PROJECT BASED ON IDENTIFIED RESEARCH WORK				
Course Code	19ET7PWRER	Credits	3	L:T:P	0:0:3

Course Outcomes		
CO1: Ability to engage in independent study to research literature, and identify the research work to be reproduced	**PO 12 (3)**	**PSO1 (2)** **PSO2 (2)** **PSO3 (3)**
CO2: Ability to prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team	**PO 11(3)**	
CO3: Ability to identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	**PO 6(3)** **PO 7(3)**	
CO4: Ability to identify and apply the mathematical concepts, science concepts, and engineering concepts necessary to reproduce the identified research work	**PO 1(3)** **PO 2(3)**	
CO5: Ability to identify and select the engineering tools /components required to reproduce the identified research work	**PO 5(3)**	
CO6: Ability to design, implement, analyse and interpret results of the study aimed at partial reproduction of the identified research work	**PO 3 (3)** **PO 4 (3)**	
CO7: Ability to engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and and the four page IEEE format of the work	**PO 10 (3)**	
CO8: Ability to engage in effective oral communication through presentation of the project work, demonstration of the project	**PO 10 (3)**	
CO9: Ability to demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics	**PO 8 (3)**	
CO10: Ability to perform in the team, contribute to the team and mentor/lead the team	**PO 9(3)**	

Project Rubrics:

Parameter	**≥75%**	**≥25% to <75%**	**< 25%**
Literature Survey	Referred to more than TEN recent articles; appropriately summarized; includes recent references	Referred to more than SIX recent articles; appropriately summarized; NO recent references	NO references included
Project Scheduling and work delegation	Proposed and implemented Gantt chart included; with clear distribution of workload among the team members	Proposed Gantt chart included; without clear distribution of workload	Gantt chart NOT provided; NO distribution of workload
Contribution to society, concern for environment	The community that shall benefit clearly specified; ensures safety to environment	Community clearly specified; however safety measures not specified	Hazard to society and to environment

Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without necessary details/ justification	There is NO mention of any of the essential Concepts
The Modern Tool	Clear justification in selecting the TOOL/Components being used is provided	There is no justification for the tool/components being used	--
Design and Analyze the results	More than ONE design solution implemented, with comparison Included clear analysis, along with advantages and disadvantages	Only ONE design solution implemented Included analysis, without the advantages and disadvantages	NO design included NO analysis
Written Communication	The Project report is well organized, clear objectives and outcomes for every chapter The Poster is well designed and includes the aim, the outcome, the results and conclusion All necessary details are included and the IEEE paper is well organized	The Project report is NOT well organized The Poster is NOT well organized, and includes few details Only few details are included for IEEE paper and is NOT well organized	The Project report is NOT submitted by the deadline The Poster is NOT included The IEEE paper format NOT included
Oral Presentation	well organized, clear presentation, have equal participation	Slides are not well organized, presentation not clear	Poor organization, No equal role
Compliance to Standards	Clear statement of existing Standards/ Norms, with compliance	Clear statement, but does not include compliance	Standards/Norms NOT stated
Performance in the Team	Contributes and cooperates in the team, and mentors/leads the team	cooperates but does NOT contribute to the team	Does NOT cooperate

Synopsis Submission:
First Evaluation- within two weeks of semester commencement
(CO1, CO2; Evaluation of the Team 10 % weightage)
Second Evaluation: after 10 weeks of semester commencement
(CO3, CO4, CO5; Evaluation of the Team 20 % weightage)
Third Evaluation: during the last week of the semester
(CO6, CO9 – Evaluation of the Team 25 % weightage)
(CO7- Evaluation of the Team, 20 % weightage)
(CO8, CO10: Individual Evaluation of every member 25% marks)
The department constitutes a Project Evaluation Committee (PEC), that schedules, allocates the guides and evaluates certain components of the project

Course Title	**MOOCS/ VIRTUAL LAB WITH CERTIFICATION**				
Course Code	**19ET7NCMC1**	**Credits**	**NC**	**L:T:P**	**0:0:0**

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/ VirtualLabs or any other

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.

Course Outcomes:

Ability to engage in independent study, take up an online course in a domain of personal choice and successfully complete the course (PO12 (3))

VIII SEMESTER

Course Title	IPR AND CYBER LAW				
Course Code	19ES8HSIPL	Credits	2	L:T:P	2:0:0

UNIT I **[4 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, patent drafting, database searching, and Case studies.

UNIT III **[6 hours]**

Copyright: Meaning and characteristics of copyright, Indian copyright law, requirement of copyright, 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, Case studies

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

UNIT IV	**[4 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.

Unit Choice: Unit II and Unit III

Course Outcomes

CO1: Ability technical concepts of IPR and Cyber Law to access societal, health, safety issues and continue responsibilities relevant to the professional engineering practices.	PO6 (3)
CO2: Understand the impact of Patents, Copyrights and Trademarks and demonstrate the knowledge of Cyber Law..	PO7 (3)
CO3: Ability to apply ethical principles to obtain Intellectual property rights like Patents, Copyrights and Trademarks and action taken due to unethical Telecom practices in Cyber laws.	PO8 (3)
CO4: Ability to work as an individual/ in a team to effectively communicate Intellectual Property rights and Cyber Law leading to improvement in team work and leadership qualities.	PO10 (1) PO9 (1) PO12 (1)

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Dr. T Ramakrishna, "Ownership and Enforcement of Intellectual Property Rights", CIPRA, NSLIU -2005.
2. "Intellectual Property Law (Bare Act with short comments)",Universal Law Publishing Co. Ltd. 2007.
3. "The Trade marks Act 1999 (Bare Act with short comments)", Universal Law Publishing Co. Ltd., 2005.

Course Title	Satellite Principles and Applications				
Course Code	19ET8OE3SP	Credits	3	L:T:P	3:0:0

UNIT I	[8 hours]

Introduction to Satellites and Applications: History of evolution of satellites, Basic principles, Satellite orbits, orbital parameters, Launch vehicles, orbital perturbations, look angles

UNIT II	[8 hours]

Satellites Hardware: Satellite subsystems, Mechanical structure, Propulsion subsystem, Thermal control subsystem, Attitude and orbit control, Telemetry tracking and command subsystem, Payload, Antenna subsystem

UNIT III	[8 hours]

Communication Techniques: Types of information signals, AM, FM, Pulse communication, Digital modulation techniques, Multiplexing Techniques, Multiple Access Techniques-FDMA,TDMA,CDMA, Satellite link design fundamentals, Earth station, Networking protocols.

UNIT IV	[8 hours]

Satellite Applications: Communication satellites, Remote sensing satellites, Weather satellites, Navigation satellites

UNIT V	[8 hours]

Scientific satellites: satellite based versus ground based scientific Techniques, Applications of scientific satellites-study of earth, Astronomical observations, Military satellites, Emerging trends-Millimeter wave satellite communication, space stations

Unit Choice: Unit I and Unit III

TEXT BOOKS:

Satellite Technology Principles and Applications: 3rd Edition, by Anil K Maini, Varsha Agrawal, Publisher: John Wiley & Sons

REFERENCE BOOKS:

1. **Satellite Communications:** Dennis Roddy, Tata McGraw Hill
2. **Satellite Communication:** Timothy Pratt, Second Edition, John Wiley and sons.
3. **Satellite Communications Systems : systems, techniques and technology**, 5th edition, by G. Maral, M. Bousquet, Z. Sun, Publisher: John Willy and sons
4. **The Satellite Communication Applications Handbook,** Bruce R. Elbert Artech House, 2004 – Technology & Engineering

Course Outcomes

CO1	Ability to define, understand and explain concepts of satellite communication system	-	PSO2(1)
CO2	Ability to apply the knowledge of communication theory to study the technologies of satellite communication	PO1 (3)	
CO3	Ability to analyse whole/parts of a given satellite communication link	PO2 (2)	
CO4	Ability to function effectively as an individual or as a team member to conduct experiments using hardware and/simulation.	PO5 (1) PO9 (1)	

Course Title	**CELLULAR NETWORKS**				
Course Code	**19ET8OE3CN**	**Credits**	**3**	**L:T:P**	**3:0:0**

UNIT I	**[8 hours]**
Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum –IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security – IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX	
UNIT II	**[8 hours]**
Introduction – Mobile IP: IP packet delivery, Agent discovery, 130nalyse130ng and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol – mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing	
UNIT III	**[8 hours]**
TCP enhancements for wireless protocols – Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility – Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP – TCP over 3G wireless networks.	
UNIT IV	**[8 hours]**
Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.	
UNIT V	**[8 hours]**
Introduction – 4G vision – 4G features and challenges – Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services	
Unit Choice: Unit II and Unit IV	

Course Outcomes

CO1	Ability to **understand** and **explain** concepts of cellular networks	--	**PSO 3(1)**
CO2	Ability to **apply** the knowledge of communication techniques to understand the different cellular technology and solve problems	PO1(2)	
CO3	Ability to a**nalyse** the given parameters for different propagation models of wireless networks	PO2 (1)	
CO4	Ability to perform in a team to prepare a report and make an effective **oral presentation** of the study on topics related to Networks protocols, contribution of cellular systems to the society and its effect on environment	PO6(1) PO7(2) PO8(1) PO9(1) PO10(1) PO12(1)	

TEXT BOOKS:

1. Vijay Garg , "Wireless Communications and networking", First Edition, Elsevier 2007
2. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.

REFERENCE BOOKS:

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition
2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006

Course Title	MAJOR PROJECT					
Course Code	19ET8PWMPJ	Credits	9	L:T:P	0:0:9	

CO1: Ability to engage in independent study to research literature in the identified area	PO12 (3)	
CO2: Ability to consolidate the literature search to identify and formulate the engineering problem	PO2 (3)	
CO3: Ability to prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team	PO11 (3)	
CO4: Ability to identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	PO6 (3) PO7 (3)	
CO5: Ability to identify and apply the mathematical concepts, science concepts, and engineering concepts necessary to implement the identified engineering problem	PO1 (3) PO2 (3)	
CO6: Ability to identify and select the engineering tools /components required to reproduce the identified project	PO5 (3)	PSO1(3) PSO2(3)
CO7: Ability to design, implement, analyse and interpret results of the implemented project	PO3 (3) PO4 (3)	PSO3(3)
CO8: Ability to engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE format of the work	PO10 (3) PO10 (3)	
CO9: Ability to engage in effective oral communication through presentation of the project work, demonstration of the project	PO10 (3)	
CO10: Ability to demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics	PO8 (3)	
CO11: Ability to perform in the team, contribute to the team and mentor/lead the team	PO9 (3)	
CO12: Ability to clearly specify the outcome of the project work (leading to start-up/ product/ research paper/ patent)	PO11 (3)	

Parameter	**≥75%**	**≥25% to <75%**	**< 25%**
Literature Survey	Referred to more than TEN recent articles; appropriately summarized; includes recent references	Referred to more than SIX recent articles; appropriately summarized; NO recent references	NO references included
Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without	There is NO mention of any of the essential Concepts

		necessary details/ justification	
Project Scheduling and work delegation	Proposed and implemented Gantt chart included; with clear distribution of workload among the team members	Proposed Gantt chart included; without clear distribution of workload	Gantt chart NOT provided; NO distribution of workload
Contribution to society, concern for environment	The community that shall benefit clearly specified; ensures safety to environment	Community clearly specified; however safety measures not specified	Hazard to society and to environment
Identification of essential concepts	Clear list, description and justification of MOST essential Mathematical, Science, Engineering and Management Concepts included	SOME essential Mathematical, Science, Engineering and Management Concepts included, without necessary details/ justification	There is NO mention of any of the essential Concepts
The Modern Tool	Clear justification in selecting the TOOL/Components being used is provided	There is no justification for the tool/components being used	--
Design and Analyze the results	More than ONE design solution implemented, with comparison Included clear analysis, along with advantages and disadvantages	Only ONE design solution implemented Included analysis, without the advantages and disadvantages	NO design included NO analysis
Written Communication	The Project report is well organized, clear objectives and outcomes for every chapter The Poster is well designed and includes the aim, the outcome, the results and conclusion All necessary details are included and the IEEE paper is well organized	The Project report is NOT well organized The Poster is NOT well organized, and includes few details Only few details are included for IEEE paper and is NOT well organized	The Project report is NOT submitted by the deadline The Poster is NOT included The IEEE paper format NOT included
Oral Presentation	well organized, clear presentation, have equal participation	Slides are not well organized, presentation not clear	Poor organization, No equal role

Compliance to Standards	Clear statement of existing Standards/ Norms, with compliance	Clear statement, but does not include compliance	Standards/Norms NOT stated
Performance in the Team	Contributes and cooperates in the team, and mentors/leads the team	cooperates but does NOT contribute to the team	Does NOT cooperate
Outcome of the Project	Clearly specified the outcome of the project and also successfully implemented the same.	Clearly specified the outcome of the project however was NOT successful in its implementation.	NOT specified the outcome of the project.

Synopsis Submission:
First Evaluation- within two weeks of semester commencement
(CO1, CO2, CO3; Evaluation of the Team 10 % weightage)

Second Evaluation: after 10 weeks of semester commencement
(CO4, CO5, CO6; Evaluation of the Team 20 % weightage)

Third Evaluation: during the last week of the semester
(CO7, CO10, CO12 – Evaluation of the Team 25 % weightage)
(CO8- Evaluation of the Team, 20 % weightage)
(CO9, CO11: Individual Evaluation of every member 25% marks)

The department constitutes a Project Evaluation Committee (PEC), that schedules, allocates the guides and evaluates certain components of the project

Course Title	SEMINARS BASED ON ENGINEERING DOMAIN / INTERNSHIPS				
Course Code	19ET8SREDI	Credits	2	L:T:P	0:0:2

During semester breaks, students are encouraged to take up Internships, each of duration 4 to 6 weeks. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report and a video submission. It is expected that this association will help the student in choosing his/her professional career.

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

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

CO1	Engage in internship in an engineering domain, and comprehend the professional norms of the organization	**PO8 (1)**	**PSO3(1)**
CO2	Identify the key engineering, management, science, mathematics concepts, being transformed to a successful organization	**PO1(1)** **PO11(1)**	
CO3	Identify the community that benefit from the product	**PO6 (1)**	
CO4	Identify and comprehend the professional norms and the model for sustainable development of the organization	**PO7(1)**	
CO5	Identify the skills/concepts from various disciplines, and able to perform as a member of the multidisciplinary team	**PO9(1)**	
CO6	Prepare the seminar report of the work	**PO10 (3)**	

Course Title	MOOCs/ VIRTUAL LAB WITH CERTIFICATION				
Course Code	19ET8NCMC2	Credits	NC	L:T:P	0:0:0

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/ VirtualLabs or any other

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.

Ability to engage in independent study, take up an online course in a domain of personal choice and successfully complete the course (PO12 (3))