

Curriculum and Syllabi

B.E. Electronics and Communication Engineering

Semesters I to VIII

Regulations 2019

(2021 Batch Onwards)

Dr. Mahalingam College of Engineering and Technology
Department of Electronics and Communication
Engineering

Vision

To strive for excellence in Electronics and Communication Engineering education, research and technological services imparting quality training to students, to make them competent and motivated engineers.

Mission

- Impart high quality technical education in Electronics and Communication Engineering through effective teaching- learning process and updated curriculum.
- Equip the students with professionalism and technical expertise to provide appropriate solutions to societal and industrial needs.
- Provide stimulating environment for continuously updated facilities to pursue research through creative thinking and team work.

Programme: B.E. Electronics and Communication Engineering

Programme Educational Objectives (PEOs) - Regulations 2019

B.E. Electronics and Communication Engineering graduates will:

PEO1. Actively apply knowledge and technical skills in engineering practices towards the progress of the organization in competitive and dynamic environment.

PEO2. Own their professional and personal development by continuous learning and apply the learning at work to create new knowledge.

PEO3. Conduct themselves in a responsible and ethical manner supporting sustainable economic development which enhances the quality of life.

Programme Outcomes (POs) - Regulations 2019

On successful completion of B.E. Electronics and Communication Engineering programme, graduating students/graduates will be able to:

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/Development Of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary 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 multi disciplinary environments

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs) - Regulations 2019

On successful completion of B.E. Electronics and Communication Engineering programme, graduating students/graduates will be able to:

PSO1. Technology deployment: Apply technologies of electronics, embedded systems, signal processing, communication and networking in the field of Industrial Automotive, Consumer, Medical and Defense Electronics industries

PSO2. IC design: Apply the design flow of Very Large Scale Integrated circuits to design and test Integrated Circuits in semiconductor industries

Programme: B.E Electronics and Communication Engineering
2019 Regulations (2021 batch onwards)
Curriculum for Semesters I to VIII

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU,ME,CE,EC,EE&EI
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19CHBC2001	Chemistry for Electrical Sciences	3	0	2	4	100	EC, EE&EI
19ECSN2101	Fundamentals of Electrical and Electronics Engineering	3	0	2	4	100	---
19MESC2001	Introduction to Engineering	2	0	2	3	100	AU,ME,EC,EE&EI
19PSHG6001	Wellness for Students*	0	0	2	-	-	All
Total		13	1	10	18	500	

Semester II

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1201	Ordinary Differential Equations and Complex Variables	3	1	0	4	100	AU,ME,CE,EC,EE&EI
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19PHBC2001	Physics for Electrical Sciences	3	0	2	4	100	EC,EE & EI
19ECSN2201	Electric Circuits and Electron devices	3	0	2	4	100	---
19CSSC2001	C Programming	3	0	2	4	100	AU,ME,CE,EC,EE&EI
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU,ME,EC,EI,CS,IT,AD&SC
19CHMG6201	Environmental Sciences	1	0	0	0	100	All
19PSHG6001	Wellness for Students*	0	0	2	1	100	All
19PSHG6003	தமிழர் மரபு /Heritage of Tamils**	1	0	0	1	100	All
Total		17	1	13	23.5	900	

* Annual Pattern

** Applicable only for 2022 Batch

Semester III

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1302	Numerical Methods and Linear Algebra	3	1	0	4	100	EC,EE,EI&MC
19ECCN1301	Analog Circuits - I	3	0	0	3	100	-
19ITSN2302	Data Structures and Algorithms - I	3	0	2	4	100	-
19ECCN2301	Transmission Lines and Waveguides	3	0	2	4	100	-
19ECCN1302	Digital Principles and System Design	3	1	0	4	100	-
19ECCN3301	Analog Circuits - I Laboratory	0	0	3	1.5	100	-
19ECCN3302	Digital Principles and System Design Laboratory	0	0	3	1.5	100	-
XXXXXXXXXX	One Credit Course (OCC).	0	0	2	1	100	-
19PSHG6004	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology**	1	0	0	1	100	All
Total		16	2	12	24	900	

Semester IV

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	All
19ECCN1401	Analog Circuits - II	3	1	0	4	100	-
19ITSN2401	Data Structures and Algorithms - II	3	0	2	4	100	-
19ECCN1402	Signals and Systems	3	1	0	4	100	-
19ECCN3401	Analog Circuits - II Laboratory	0	0	3	1.5	100	-
19ECPN6401	Mini- Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course (OCC)	0	0	2	1	100	-
19PSHG6002	Universal Human Values 2 :Understanding Harmony	2	1	0	3	100	All
Total		14	4	11	23.5	800	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXXXXXX	Internship or Skill Development*	2 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

** Applicable only for 2022 Batch

Semester V

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECCN1501	Analog and Digital Communication	3	1	0	4	100	-
19ECCN1502	Control Systems	3	1	0	4	100	-
19ECCN2501	Digital Signal Processing	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective - I	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective-II	3	0	0	3	100	-
XXXXXXXXXX	Open Elective - I	3	0	0	3	100	-
19ECCN3501	Analog and Digital Communication Laboratory	0	0	3	1.5	100	-
19ECCN3502	Data Science Laboratory	0	0	3	1.5	100	-
19PSHG6501	Employability Skills 1: Teamness and Interpersonal Skills	0	0	2	1	100	All
Total		18	2	10	25	900	

Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECCN1601	VLSI System Design	4	0	0	4	100	-
19ECCN1602	Internet of Things	3	0	0	3	100	-
19ECCN2601	Microcontroller and Its Interfacing Techniques	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective - III	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective - IV	3	0	0	3	100	-
XXXXXXXXXX	Open Elective - II	3	0	0	3	100	-
19ECPN6601	Innovative and Creative Project	0	0	4	2	100	-
19PSHG6601	Employability Skills 2: Campus to Corporate	0	0	2	1	100	All
Total		18	0	8	23	800	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	2 or 4 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

Semester VII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECCN1701	RF and Microwave Engineering	3	0	0	3	100	-
19ECCN1702	Machine Learning	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective - V	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective - VI	3	0	0	3	100	-
XXXXXXXXXX	Open Elective - III	3	0	0	3	100	-
19ECCN3701	RF and Microwave Laboratory	0	0	3	1.5	100	-
19ECCN3702	VLSI Laboratory	0	0	3	1.5	100	-
Total		15	0	6	18	700	

Semester VIII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECPN6801	Project	0	0	16	8	200	-
Total					8	200	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXX	Internship or Skill Development*	8 or 16 weeks	4	100

*Refer to clause: 4.8 in UG academic regulations 2019

Total Credits (2021 batch): 167

Total Credits (2022 batch): 169

Vertical wise Electives

Networking Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1001	Computer Communication Networks	3	0	0	3	100	-
19ECEN1010	Cryptography and Network Security	3	0	0	3	100	-
19ECEN1009	Wireless Sensor Networks	3	0	0	3	100	-
19ECEN1030	Cognitive Networks	3	0	0	3	100	-
19ECEN1028	Advanced Networking Technologies	3	0	0	3	100	-
19ECEN1004	High Speed Networks	3	0	0	3	100	-

RF technologies Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1005	Electromagnetic Interference and Compatibility	3	0	0	3	100	-
19ECEN1029	Mobile Communication and Networks	3	0	0	3	100	-
19ECEN1027	OFDM and MIMO Concepts	3	0	0	3	100	-
19ECEN1006	Bluetooth Technology	3	0	0	3	100	-
19ECEN1036	RF Circuit Design	2	0	2	3	100	-
19ECEN1037	Millimeter Wave communication	3	0	0	3	100	-

Communication Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1003	Antenna and Wave Propagation	3	0	0	3	100	-
19ECEN1002	Wireless Communication	3	0	0	3	100	-
19ECEN1026	Fiber Optic Communication	3	0	0	3	100	-
19ECEN1007	Multimedia Communication	3	0	0	3	100	-
19ECEN1025	Satellite Communication	3	0	0	3	100	-
19ECEN1024	Advanced Wireless Communication	3	0	0	3	100	-

VLSI Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1023	Digital System Design and Verification	3	0	0	3	100	-
19ECEN1022	Low Power VLSI Design	3	0	0	3	100	-
19ECEN1035	ASIC Design	3	0	0	3	100	-
19ECEN1020	CMOS Analog IC Design	3	0	0	3	100	-
19ECEN1038	FPGA Based System Design	3	0	0	3	100	-
19ECEN1034	Testing of VLSI Circuits	3	0	0	3	100	-

Signal Processing Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1018	Information Theory and Coding	3	0	0	3	100	-
19ECEN1016	Digital Image and Video Processing	3	0	0	3	100	-
19ECEN1017	Speech and Audio Processing	3	0	0	3	100	-
19ECEN1039	Multirate signal processing	3	0	0	3	100	-
19ECEN1033	Adaptive Signal Processing	3	0	0	3	100	-
19ECEN1015	Wavelets and Its Applications	3	0	0	3	100	-

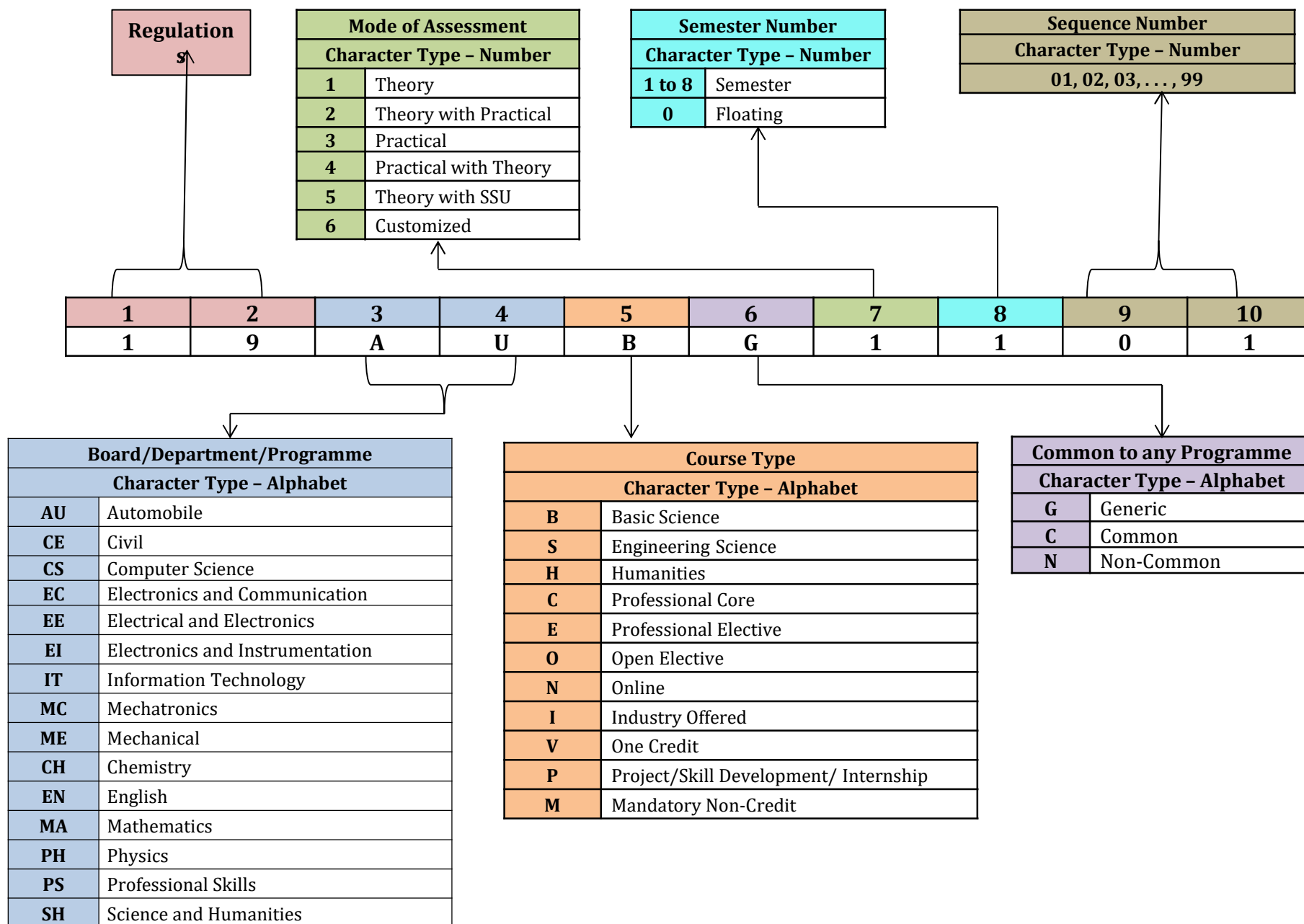
Diversified Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ECEN1008	Telecommunication and Digital Switching Techniques	3	0	0	3	100	-
19ECEN1011	Television and Video Systems	3	0	0	3	100	-
19ECEN1013	Error Control Coding	3	0	0	3	100	-
19ECEN1019	Computer Architecture	3	0	0	3	100	-
19ECEN1014	Biomedical Electronics	3	0	0	3	100	-
19ECEN1012	High Speed Electronics	3	0	0	3	100	-
19ECEN1021	Advanced Microcontrollers	3	0	0	3	100	-
19ECEN1031	Introduction to MEMS	3	0	0	3	100	-

19ECEN1032	Nano electronics	3	0	0	3	100	-
19CSEC1001	Programming Using JAVA	3	0	0	3	100	EC,EE & EI
19CSEC1002	Data Mining and Analytics	3	0	0	3	100	EC,EE & EI
19CSEC1003	Software Testing	3	0	0	3	100	EC,EE & EI
19CSEC1004	Database Management System Concepts	3	0	0	3	100	EC,EE & EI
19ECCN1036	Industrial Electronics	3	0	0	3	100	-
19EEEC1001	Industrial Automation	3	0	0	3	100	EC & EE
19EEEC1002	Automotive Electronics	3	0	0	3	100	EC & EE
19EEEC1003	Virtual Instrumentation	3	0	0	3	100	EC & EE
19EEEC1005	Industrial Safety	3	0	0	3	100	EC & EE
19MEEC1014	Engineering Economics and Cost Analysis	3	0	0	3	100	AU,ME,EC EE &EI
19MEEC1015	Principles of Management	3	0	0	3	100	ME,EC,EE & EI
19EEEC1045	Disaster Management	3	0	0	3	100	EC,EE & EI
19CSEC6701	Professional Readiness for Innovation, Employability and Entrepreneurship	0	0	6	3	100	EC,CS&IT
19ITEC1001	Intellectual Property Rights	3	0	0	3	100	All
19MEEC1026	Design Thinking and Innovation	3	0	0	3	100	All
19MEEC1025	Fundamentals of Entrepreneurship	3	0	0	3	100	All
19SCEC2001	Cyber Security	2	0	2	3	100	All

Open Electives

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
19ECOC1001	In Vehicle Networking	3	0	0	3	100
19ECOC1002	Consumer Electronics	3	0	0	3	100
19ECOC1003	Internet Of Everything	3	0	0	3	100
19ECOC1004	Data Science Using Hadoop with R	3	0	0	3	100
19ECOC1005	Artificial Intelligence	3	0	0	3	100
19ECOC1006	Machine Vision System	3	0	0	3	100
19ECOC1007	Soft Computing	3	0	0	3	100

Dr. Mahalingam College of Technology, Pollachi
2019 Regulations - Course Code Generation Procedure for UG Courses(v1)



Regulations 2019

(2021 Batch Onwards)

Detailed Syllabi for Semesters I & VIII

Course Code: 19SHMG6101	Course Title: Induction Program (common to all B.E/B.Tech programmes)
Course Category: Mandatory Non-Credit Course	Course Level: Introductory
Duration: 3 Weeks	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and society

List of Activities:

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2, Module 3 and Module 4
5. Orientation on Professional Skill Courses
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-

High-3; Medium-2;Low-1

Semester I

Course Code:19MABC1101		Course Title:Matrices and Calculus (Common to AU,ME,CE,EC,EE & EI)	
CourseCategory:Basic Science		CourseLevel: Introductory	
L:T:P(Hours/Week)3: 1: 0	Credits:4	Total Contact Hours:60	Max Marks:100

Pre-requisites

➤ NIL

Course Objectives

The course is intended to:

1. Determine the canonical form of a Quadratic form using Orthogonal transformation
2. Use different testing methods to check the convergence of infinite series
3. Apply differential and integral calculus to determine the evolute of a curve and improper integrals
4. Apply partial derivatives to find extreme values of functions of two variables
5. Apply multiple integrals to find area of plane curves and volume of solids

Unit I	Matrices	9+3 Hours
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Rank of a matrix - System of linear equations – Symmetric - Skew symmetric and orthogonal matrices-(Definitions and examples only) – Eigenvalues and Eigenvectors - Diagonalization of symmetric matrices through orthogonal transformation – Cayley-Hamilton Theorem - Transformation of quadratic forms to canonical forms through orthogonal transformation.

Unit II	Sequences and Series	9+3Hours
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Sequences - Definition and Examples - Series- Tests for convergence- Power series - series for exponential, trigonometric and logarithm functions - Comparison Test – Integral Test - Cauchy's root test - D'Alembert's ratio test - Alternating series- Leibnitz's test.

Unit III Differential and Integral Calculus 9+3Hours

Curvature – Radius of curvature - Evolutes and Involutives - Evaluation of definite and improper integrals - Beta and Gamma functions and their properties.

Unit IV Multivariable Differentiation**9+3 Hours**

Limit – continuity - Mean value theorems and partial derivatives-Taylor's series and Maclaurin's series – Jacobian – Maxima, Minima and saddle points - Method of Lagrange's multipliers.

Unit V Multivariable Integration**9+3 Hours**

Multiple Integration: Double integrals - Change of order of integration in double integrals - Change of variables (Cartesian to polar, Cartesian to spherical and Cartesian to cylindrical) - Triple integrals - Applications: areas and volumes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Determine the canonical form of a Quadratic form using Orthogonal transformation	Apply
CO2: Use different testing methods to check the convergence of infinite series	Apply
CO3: Determine the evolute of a curve and evaluate improper integrals using beta gamma functions	Apply
CO4: Apply partial derivatives to find extreme values of functions of two variables	Apply
CO5: Apply multiple integrals to find area of plane curves and volume of solids	Apply

Text Book(s):

T1.Erwinkreyzig, Advanced Engineering Mathematics, 9thEdition, John Wiley& Sons, 2006.

T2.Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

T3.Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

Reference Book(s):

R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9thEdition, Pearson, Reprint, 2002.

R2. N.P.Bali and Manish Goyel, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2008.

R3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Web References:

- 1.https://onlinecourses.nptel.ac.in/noc16_ma05
- 2.<https://nptel.ac.in/courses/122101003/2>
- 3.<https://nptel.ac.in/syllabus/111104092/>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	2	1	1	-	1	-	1	1	1	1	2	3	-
C02	3	2	1	1	-	1	-	1	1	1	1	2	3	-
C03	3	2	1	1	-	1	-	1	1	1	1	2	3	-
C04	3	2	1	1	-	1	-	1	1	1	1	2	3	-
C05	3	2	1	1	-	1	-	1	1	1	1	2	3	-

High-3; Medium-2;Low-1

Course Code:19ENHG2101		Course Title: Communication Skills – I (Common to all B.E/B.Tech Programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week)2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Pre-requisites

- The student should have undergone English as his/her first or second language in school.

Course Objectives

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level
2. Speak in simple sentences to convey their opinions and ideas on par with B1 of CEFR level
3. Read and infer a given text on par with B1 of CEFR level
4. Draft basic formal written communication on par with B1 of CEFR level

Unit I Listening

15 Hours

Importance of active listening –Physical condition needed for active listening-Identifying relevant points while taking notes.- Framing questions at different linguistic contexts - Listening for specific details of concrete monologues and dialogues –Listening to organize ideas - Developing ideas –Listening to compose paragraphs – Paraphrasing the aural input.

Unit II Speaking

15 Hours

Importance of note making to practice speaking - Traditional note making, developing Mind map - Collecting points from various sources - Identifying relevant ideas needed for the speech -Using mind-map to organize thought processing - Prioritizing the ideas - Types of sentences - Frequently used words (Institution, home and leisure) - Mother Tongue Influence - Expressing the thoughts in simple sentences - Tenses & Voices (Active & Passive) - Postures, gestures and eye contact - Intonation and Sentence stress - Express one's thoughts coherently.

Unit III Reading**15 Hours**

Reading strategies - Skimming -Scanning - Interpretation of visual data - Factual texts on subjects of relevance - Inferring texts –Reading to write a review –Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend.

Unit IV Writing**15 Hours**

Writing Simple and short sentences - Writing E-mail, Memo, Note and Message - Letter Writing - Importance of punctuations -- Identifying the main points - Organising the main ideas - Writing a draft.

List of Tasks

1. BEC Preliminary Listening Test – I & Speaking Test – 1
2. BEC Preliminary Listening Test – 2 & Speaking Test – 2
3. BEC Preliminary Listening Test – 3 & Speaking Test – 3
4. BEC Preliminary Listening Test – 4 & Speaking Test – 4
5. BEC Preliminary Listening Test – 5 & Speaking Test – 5
6. BEC Preliminary Listening Test – 6 & Speaking Test – 6

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues	Apply
CO2: Express one's views coherently in a simple manner	Apply
CO3: Read and comprehend factual texts on subjects of relevance	Understand
CO4: Write texts bearing direct meanings for different contexts maintaining an appropriate style	Apply

Text Book(s):

- T1. Whitby Norman, Business Benchmark Pre-intermediate to Intermediate Students' Book
CUP Publications, 2nd Edition, 2014.
- T2. Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning, 2nd Edition, 2015.
- T3. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. BEC-Preliminary - Cambridge Handbook for Language Teachers, 2nd Edition, CUP 2000.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

Web References:

1. <http://www.grammarinenglish.com> -Jan 23,2018
2. https://www.northshore.edu/support_centre/pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html- Jan 23, 2018

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	1	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	1	-	3	-	2	-	-

High-3; Medium-2;Low-1

Unit IV Biofuels and Fuel Cells**9 Hours**

Biomass – Biogas – Constituents, manufacture and uses. General outline of fermentation process – manufacture of ethyl alcohol by fermentation process. Combustion – Calorific values – Gross and net calorific value – problems based on calorific value. Fuel cells – Construction working and applications of Hydrogen Oxygen fuel cells, methanol oxygen fuel cells, solid oxide fuel cells

Unit V Synthesis and Applications of Nano Materials**9 Hours**

Introduction – Difference between bulk and Nano materials – size dependent properties. Nano scale materials – particles, clusters, rods and tubes. Synthesis of Nanomaterials: Sol-gel process, Electro deposition, Hydrothermal methods. Applications of Nano materials in Electronics, Energy science and medicines. Risk and future perspectives of nano materials.

List of Experiments**30 Hours**

1. Estimation of iron in water by spectrophotometry
2. Estimation of Fe^{2+} by potentiometric titration
3. Determination of corrosion rate by weight loss method
4. Measurement of emf of electrochemical cell – Poggendorff's method
5. Determination strength of acid by pHmetry
6. Conduct metric titration of strong acid against strong base

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain batteries based on their characteristics, construction, working principle and applications	Understand
CO2: Explain the mechanism of corrosion and its control techniques	Understand
CO3: Use Beer- Lambert's law and other spectroscopic methods for chemical analysis	Apply
CO4: Calculate energy potential of fuel cells and calorific value of biofuels	Apply
CO5: Describe synthesis, properties and applications of nano-materials	Understand

Text Book(s)

- T1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition., Dhanpat Rai Pub, Co., New Delhi (2018).
- T2. Wiley Engineering Chemistry, 2nd Edition, Wiley India Pvt. Ltd. New Delhi (2011).

Reference Book(s):

- R1. Larry Brown and Tom Holme, Chemistry for Engineering Students, 3rd Edition, Cengage Learning, 2010.
- R2. S. S. Dara, S. S. Umare "A text book of Engineering Chemistry" 12th Edition S. Chand & Co. Ltd., New Delhi (2014).
- R3. Charles P. Poole, Jr., Frank J. Owens "Introduction to Nanotechnology" Wiley India Pvt. Ltd. New Delhi (2003).

Web References:

1. <http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf>
2. <https://nptel.ac.in/courses/104106075/Week1/MODULE%201.pdf>
3. <https://nptel.ac.in/courses/103102015/>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	3	3	2	3	2	-	-	-	-
CO2	2	1	-	-	-	3	3	2	3	2	-	-	-	-
CO3	3	2	1	1	-	3	3	1	-	-	-	-	-	-
CO4	3	2	1	1	-	3	3	1	-	1	-	-	-	-
CO5	2	1	-	-	-	3	3	1	-	1	-	-	-	-

High-3; Medium-2; Low-1

Unit V Special Semiconductor Devices**9 Hours**

Construction, operation and application of Varactor Diode, Tunnel Diode, PIN Diode, UJT, SCR, Photodiode and Phototransistor.

List of Experiments:**30 Hours**

1. Verification of Kirchhoff's Voltage and Current laws
2. Voltage and Frequency measurement using CRO
3. Half wave and full wave rectifiers
4. Clippers and Clampers
5. Voltage regulator using Zener diode
6. Characteristics of UJT

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO4: Analyze the electric circuits using circuit laws	Apply
CO2: Explain the Construction and operation of DC and AC Electrical machines	Understand
CO3: Explain the operation of basic measuring instruments and transducers for Electrical and Electronic circuits	Understand
CO4: Design simple Electronic circuits using semiconductor devices	Apply
CO5: Explain the construction, operation and applications of special semiconductor devices	Understand

Text Book(s)

T1.M.Arumugham and N.Premkumar," Electric Circuit theory", Khanna publishers, 2010

T2.Kalsi .H.S," Electronics Instrumentation" 3rd Edition (copyright 2010,Second Reprint 2011)
Tata McGraw Hill, New Delhi, 2010.

T3.Millman.J, Halkias.C and Satyabratajit, "Electronic Devices and Circuits",2nd Edition,Tata

McGraw Hill, New Delhi, 2007.

Reference Book(s):

- R1. Theraja .B.L, “ Electrical Technology Volume II AC/DC machines”, S. Chand and Company Ltd., New Delhi (India), 2008.
- R2. Anil K Maini, Varsha Agarwal, “ Electronic Devices and Circuits”, Wiley India Private Ltd., New Delhi 1st Edition 2015
- R3. A. Sudhakar, S. Shyam mohan and Pillai, “Circuits and Network (Analysis and synthesis)”, Tata McGraw Hill, New Delhi, 2004.
- R4. Sawhney. A.K, “A course in Electrical and Electronic measurement and Instrumentation”, Dhanpat Rai & Sons New Delhi, 18th Edition 2001.

Web References:

1. <http://nptel.cG.in/video.php?subjectId=117103063>
2. <http://nptel.ac.in/video.php?subjectId=122106025>
3. <http://nptel.ac.in/courses/108108076>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	2	1
CO2	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	2	2	-	-	-	2	3	2	-	1	2	2
CO5	2	2	2	2	-	-	-	2	3	2	-	1	2	-

High-3; Medium-2; Low-1

Course Code:19MESC2001		Course Title: Introduction to Engineering (Common to AU,EC,EE,EI and ME)	
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week)2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Explain the career opportunities in engineering
2. Explain how to acquire engineering competencies
3. Explain how to remain, relevant and versatile as an engineer
4. Observe engineering products and processes
5. Take ownership for learning and development
6. Identify and rectify unsafe conditions and acts

Unit I Career Opportunities in Engineering

5 Hours

Technicians, engineers and scientists, history of engineering. 17 sustainable development goals set by UNO, concept of small e to big E. career choices for an engineer, types of industries, academia and research as career choices, entrepreneurship as a career choice, various departments in engineering industries, roles available in engineering industries. innate skills, learnt skills (competencies), graduate attributes, roles of engineers and the corresponding competencies, career opportunities in engineering in terms of roles & competencies

Unit II Developing Specific Skills and Competencies 5 Hours

OBE Model, PEOs and POs, technical POs, professional POs, mapping with Graduate attributes, Classification of courses, resources available in the campus and e-resources, resources and facilities available to acquire specific competencies, on-campus and off-campus activities, the methods by which students can systematically involve in activities, significance of professional skill courses, plan for utilizing the resources and facilities to develop specific competencies.

Unit III Staying Relevant through Continuous Improvement / 7 Hours
Environmental Versatility

Rate of change, technology life cycle (TLC), features of a dynamic and complex environment in which students operate or will operate, impact of globalization & technical advancements, importance of remaining, relevant and versatile in a dynamic and complex environment with the help of technology life cycle, activities/process to remain relevant and versatile, environmental scanning, Life- long learning.

Unit IV Observe every Product And Processes with an Engineering 4 Hours
Perspective and Inquisitiveness

Product -Need, purpose - primary and secondary function, various stages of manufacturing and its processes. Product - assembly of several simple engineering devices/systems. Product- Parts, principles and laws (mechanical, electrical and electronics), functional relationship between the parts, role of programming in engineering products. Significance of materials and their advancements in improvements in product.

Unit V Learning and Development Leveraging the Resources and 6 Hours
Infrastructure

Process Of Learning, Situated Learning with Examples, Own Learning (Not Copying), Differences between Real Life and Simulated Environment, the Sprit Of Experimentation, Various Learning Enablers, Measure the performance against the plan.

**Unit VI Unsafe Conditions and Acts and following Environment
Friendly Practices**

3 Hours

Safety-definition, importance of personal safety. Statistics of road accidents. Unsafe condition and unsafe act- definition, cause and effects, identification of the unsafe conditions and acts in home/hostel, labs, class rooms, public places. Importance of environment friendly practices.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the career opportunities in engineering in terms of roles & competencies	Understand
CO2: Explain how a student can acquire the competencies	Understand
CO3: Explain how to remain, relevant and versatile in a dynamic and complex environment	Understand
CO4: Observe every product and processes with an engineering perspective and inquisitiveness	Apply
CO5: Choose to take ownership for his/her learning and development leveraging the resources and infrastructure	Understand
CO6: Identify and rectify unsafe conditions and acts and follow environment friendly practices	Understand

Text Book(s):

T1.Worksheets and Handouts prepared by MCET team.

Reference Book(s):

R1. L. A Bloomfield, "How things work: The physics of everyday life", Wiley, 5th Edition, 2013.

R2. C. Mason, "How things work," Usborne Publishing Ltd 2009.

R3. D.K. Publishing, "How things work encyclopedia", 2010.

R4. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor" Princeton University Press; With a New introduction by Philip Ball, 2018.

R5. R.P. Feynman, "Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher", Basic Books; 4th Edition 2011.

Web References:

1. https://en.wikibooks.org/General_Engineering_Introduction/Engineering_Science
2. <https://science.howstuffworks.com/engineering-channel.html>

List of Lab Exercises**30 Hours**

1. Career opportunities with roles and responsibilities
2. Observe every product and processes with an engineering perspective and inquisitiveness
 - a) Primary and Secondary functions of products and their equivalents
 - b) Primary and Secondary functions of parts of the products, their manufacturing processes and materials
 - c) Structural and functional relations of the product
3. Safe and unsafe acts and conditions in day-to-day life and professional practices.
4. Skills for Hobby project (At least TWO)
 - a) Soldering and de-soldering practices
 - b) Circuit and component testing using multi-meter & CRO
 - c) Battery operated circuit connections and testing
 - d) Simple switching circuits using relays and transistors
 - e) Adhesives used in part assembly

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	1	3	1	-	1	-	-
CO2	2	1	-	-	-	2	2	1	3	1	-	1	-	-
CO3	2	1	-	-	-	2	2	1	3	1	-	1	-	-
CO4	3	2	1	1	-	2	2	1	3	1	-	1	-	-
CO5	2	1	-	-	-	2	2	1	3	1	-	1	-	-
CO6	2	1	-	-	-	2	2	1	3	1	-	1	-	-

High-3; Medium-2; Low-1

Semester II

Course Code:19MABC1201		Course Title: Ordinary Differential Equations and Complex Variables (Common to AU,CE,EC,EE,EI and ME)	
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week)3: 1: 0	Credits:4	Total Contact Hours:60	Max Marks:100

Pre-requisites

- 19MABC1101-Matrices and Calculus

Course Objectives

The course is intended to:

1. Explain the concepts of vector differentiation and integration
2. Determine the solution of second and higher order ordinary differential equations
3. Construct analytic functions
4. Use the concept of complex integration to evaluate definite integrals
5. Apply Laplace transform techniques to solve ordinary differential equations

Unit I	Vector Calculus	9+3 Hours
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Gradient – Divergence – Curl – Line integrals – Surface integrals – Volume integrals – Theorems of Green, Gauss and Stokes (without proof) and their applications.

Unit II	Complex Variables (Differentiation)	9+3Hours
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Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping ($w=z+a$, $w=az$, $w=1/z$) – Mobius transformation and their properties.

Unit III	Complex Variables (Integration)	9+3 Hours
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Contour integrals – Cauchy Integral formula (without proof) – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series–Residues – Cauchy Residue theorem (without proof) – Evaluation of real definite integrals around unit circle and

semi-circle (Excluding poles on the real axis).

Unit IV Ordinary Differential Equations of Higher Orders

9+3 Hours

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation–Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations

Unit V Laplace Transform

12 Hours

Laplace Transform – Properties of Laplace Transform – Laplace transform of integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method– Applications on engineering problems.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the concepts of vector differentiation and integration.	Apply
CO2: Use the concept of complex variables to construct analytic functions	Apply
CO3: Use the concept of complex integration to evaluate definite integrals	Apply
CO4: Determine the solution of second and higher order ordinary differential equations	Apply
CO5: Apply Laplace transform techniques to solve ordinary differential equations	Apply

Text Book(s)

T1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

T3. Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

Reference Book(s)

R1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.

R2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2008.

R3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Web References

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. <https://nptel.ac.in/courses/122101003/2>
3. <https://nptel.ac.in/courses/111105035/22>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	2	-
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	-
CO3	3	2	1	1	-	1	-	1	1	1	1	2	2	-
CO4	3	2	1	1	-	1	-	1	1	1	1	2	2	-
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	-

High-3; Medium-2;Low-1

Course Code:19ENHG2201		Course Title:Communication Skills - II	
CourseCategory: Humanities		CourseLevel: Introductory	
L:T:P(Hours/Week)2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Pre-requisites

- 19ENHG2101-Communication Skills I

Course Objectives

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level
2. Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level
3. Read and infer a given text on par with B2 of CEFR level
4. Draft basic formal written communication on par with B2 of CEFR level

Unit I Listening

15 Hours

Importance and purpose of extensive listening and intensive listening -Body Language – Listening tasks on complex and abstract themes- Correlating Ideas related to listening input – importance of empathetic- listening for main ideas – Paraphrasing- Listening to native speakers English –Compound and Complex sentences - Developing ideas – Listening to compose paragraphs.

15 Hours

Unit II Speaking

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues - Preparing simple hand - outs.

15 Hours

Unit III Reading

Reading strategies – Skimming & Scanning – Inferring meaning- Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques - Reading different types of texts and their contexts with speed – Note making – Reading a review – Paraphrasing – Reading to comprehend

15 Hours

Unit IV Writing

Reported speech & Concord (Subject - verb Agreement) - Report writing - Different kinds of Report - Structure of the report - Writing Proposal - Plagiarism – References – Appendices – Techniques for Report writing – Registers.

List of Tasks

1. BEC Vantage Listening Test – I & Speaking Test – 1
2. BEC Vantage Listening Test – 2 & Speaking Test – 2
3. BEC Vantage Listening Test – 3 & Speaking Test – 3
4. BEC Vantage Listening Test – 4 & Speaking Test – 4
5. BEC Vantage Listening Test – 5 & Speaking Test – 5
6. BEC Vantage Listening Test – 6 & Speaking Test – 6

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics	Apply
CO2: Express one's views coherently, fluently and confidently highlighting the significant points with supporting details	Apply
CO3: Read and comprehend different types of texts and their contexts reasonably at moderate speed	Understand
CO4: Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CUP Publications, 2nd Edition, 2014

Reference Book(s):

R1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

Web References:

1. <http://www.grammarinenglish.com> -Jan 23, 2018
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html- Jan 23, 2018

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	1	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	1	-	3	-	2	-	-

High-3; Medium-2;Low-1

Unit IV Electromagnetic Induction**9 Hours**

Faraday's law – Lenz's law – Time varying magnetic field - self Inductance - self Inductance of a solenoid- Mutual inductance- Mutual inductance of two solenoids. Charge conservation law - continuity equation- displacement current- Maxwell's equations.

Unit V Electromagnetic Waves**9 Hours**

Electromagnetic waves in free space - Poynting vector - Propagation of electromagnetic waves in dielectrics – Phase velocity- Propagation of electromagnetic waves through conducting media- penetration or skin depth.

List of Experiments**30 Hours**

1. Verification of Ohms' law.
2. Test the Faraday's hypothesis of magnetic field induction.
3. Determination of inductance using Maxwell's bridge.
4. Determination of specific resistance of the given material using Carey foster's bridge.
5. Determination of wavelength of the given light source using spectrometer.
6. Determination of Dielectric constant of a given material.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the laws and concepts of static electric field	Understand
CO2: Explain the laws and concepts of static magnetic field	Understand
CO3: Explain the behavior of materials in electric and magnetic fields	Understand
CO4: Explain time varying electric and magnetic fields using Maxwell's equation	Understand
CO5: Explain the phenomenon of Electromagnetic wave propagation in different media	Understand

Text Book(s)

- T1.R.K.Gaur and S.L.Gupta, "Engineering Physics", DhanpatRai publications, New Delhi, 8thEdition, 2011.
- T2.M.N.Avadhanulu and P.G.Kshirsagar, "Text Book of Engineering Physics", S. Chand & Company Ltd., New Delhi, 2014.
- T3.W. H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, New Delhi. 6thEdition, 2014.

Reference Book(s)

- R1. David Griffiths, "Introduction to Electrodynamics", 4th Edition, Pearson Education, 2013
- R2. D. Halliday., R. Resnick and J. Walker, "Fundamentals of Physics", Wiley Publications, 2008.
- R3. K. A. Gangadhar and P. M. Ramanathan, " Electromagnetic Field Theory", Khanna Publishers, New Delhi, 5th Edition, 2013.
- R4. Mathew. N. O. Sadiku, " Elements of Electromagnetics", 4th Edition, Oxford University Press, 2009
- R5. John D. Kraus and Daniel A. Fleisch, " Electromagnetic with Applications", Tata McGraw Hill, New Delhi. 5th Edition, 2010.

Web References

1. <http://openems.de/start/index.php>
2. <http://nptel.iitm.ac.in>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	1	2	3	1	-	1	-	-
CO2	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO3	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO4	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO5	2	1	1	-	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code:19ECSN2201		Course Title: Electric circuits and Electron Devices	
Course Category :Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week):3:0:2	Credits:4	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- 19ECSN2101-Fundamentals of Electrical and Electronics Engineering

Course Objectives

The course is intended to:

- 1.Analyze DC Circuits
2. Analyze AC Circuits
- 3.Analyze steady state and transient response of Electric circuits
- 4.Explain the characteristics, biasing techniques and application of bipolar Junction Transistor
5. Explain the characteristics, biasing techniques and application of Field Effect Transistor

Unit I DC Analysis of Electric Circuits 9 Hours

Mesh current and node voltage method of analysis-Network Theorems: Superposition theorem - Thevinin's theorem - Norton's theorem - Maximum power transfer theorem.

Unit II AC Analysis of Electric Circuits 9 Hours

Mesh current and node voltage method of analysis-Network Theorems: Superposition theorem - Thevinin's theorem - Norton's theorem - Maximum power transfer theorem.

Unit III Steady State and Transient Analysis 9 Hours

Steady state and Transient response - DC response of an R-L,R-C and R-L-C circuits - AC response of an R-L,R-C and R-L-C circuits.

Unit IV Bipolar Junction Transistors 9 Hours

Characteristics of BJT - Transistor as a switch and Amplifier - Transistor Biasing: Q-point - AC and DC load line analysis - Voltage divider Bias - Bias stability - Bias compensation techniques.

Unit V Field Effect Transistors 9 Hours

Characteristics of FET-FET biasing: Voltage divider bias-Applications of FET as

VVR - Comparison of BJT and FET-MOSFET: Symbol- Structure - Operation -Drain and transfer characteristics- MOSFET Biasing: Voltage Divider Bias- Introduction to CMOS.

List of Experiments

30 Hours

1. Verification of Super position theorem.
- 2.Verification of Thevenin's theorem.
- 3.Verification of Maximum Power transfer theorem.
- 4.Verification of Series and Parallel RLC circuits under resonance condition
- 5.Characteristics of BJT under CE mode
- 6.Characteristics of FET under CS mode

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Analyze Electric circuits under DC conditions using Appropriate Network theorems.	Analyze
CO2. Analyze Electric circuits under AC conditions using Appropriate network theorems.	Analyze
CO3.Analyze steady state and transient response of Electric circuits using step and sinusoidal signals	Analyze
CO4. Explain the characteristics, biasing techniques and applications of Bipolar Junction Transistor.	Understand
CO5. Explain the characteristics, biasing techniques and applications of Field Effect Transistor	Understand

Text Book(s)

- T1. M.Armugam and N.Premkumar,"Electric Circuit Theory",4th Edition, Kanna Publishers,2010
- T2. Millman J, Halkias.C and Sathyabratajit, "Electronic Devices and Circuits" 2nd edition, Tata McGraw-Hill, New Delhi, 2007

Reference Book(s):

- R1. Circuits and Networks, Sudhakar & Shyammohan, 4th Edition, Tata McGraw-Hill, 2010.
- R2. Networks and systems, D. Roy Choudhary, 1st Edition, New Age International Publishers
- R3. Solid State Electronic Devices, G. Streetman, and S.K. Banerjee, 6th Edition Pearson, 2006.
- R4. Donald A Neaman, - Semiconductor Physics and Devices II, 4th Edition, Tata McGraw Hill Inc. 2012.
- R5. Salivahanan.S, Suresh Kumar.N, Vallavaraj.A, - Electronic Devices and circuits. 3rd Edition, Tata McGraw- Hill, 2008.

Web References:

- 1. <https://nptel.ac.in/downloads/108105053/>
- 2. [https://nptel.ac.in/courses/108105053/pdf/L-10\(GDR\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/courses/108105053/pdf/L-10(GDR)(ET)%20((EE)NPTEL).pdf)
- 3. <https://www.btechguru.com/courses--nptel--metallurgy-and-material-science--electronic-materials,-devices,-and-fabrication-video-lecture--MMS--MM113106062V.html>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	1	1	1	3	1	-	1	3	2
CO2	3	3	2	2	-	1	1	1	3	1	-	1	3	2
CO3	3	3	2	2	-	1	1	1	3	1	-	1	3	2
CO4	3	2	2	2	-	1	1	1	3	1	-	1	3	2
CO5	3	2	2	2	-	1	1	1	3	1	-	1	3	2

High-3; Medium-2; Low-1

Unit IV Pointers, Structures & Union**9 Hours**

Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays –Structures: Features– Operations on Structures–Array of structures – Unions.

Unit V Files and Pre-Processor Directives**9 Hours**

Introduction to Files –Stream and File Types–File operations (Open, close, read, write) – Command line arguments–Pre-processor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

List of Exercises:**30 Hours**

1. Programs to process data types, operators and expression evaluation (any 1)
 - a. To find area of rectangle/ circle/ square
 - b. To find the simple interest and compound interest
2. Programs using decision and looping statements (any 2)
 - a. To find the maximum number among 3 given numbers
 - b. To check whether given year is leap year or not
 - c. To display the Fibonacci series
 - d. To find the factorial of a number
3. Programs using Arrays
 - a. To search for particular number among N numbers (1D array)
 - b. To compute matrix addition (2 D array)
4. Programs using Functions and Strings (any 2)
 - a. To swap two numbers using call by reference
 - b. To find the cube of a number
 - c. To manipulate strings using string functions
 - d. To check whether the string is palindrome or not
5. Programs using Pointer, Structure & Union
 - a. To perform arithmetic operations using pointers
 - b. To display the information of N students using Structure
 - c. To display the employee details using Union
6. Programs using Files (any 1)
 - a. To read the contents of a text file
 - b. To copy the contents from one file into another

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain about computer organization and problem solving techniques	Understand
CO2: Write programs for the given scenario using appropriate programming constructs	Apply
CO3: Develop programs using arrays, functions & strings for the given scenario	Apply
CO4: Implement programs for given application using pointers, structures & unions	Apply
CO5: Write programs using files & preprocessor directives for simple problems	Apply

Text Book(s)

T1. Ashok N. Kamthane, Amit. N. Kamthane, "Programming in C", Third Edition, Pearson Education, 2015.

Reference Book(s)

R1. Ajay Mittal, "Programming in C-A Practical Approach", Third Edition, Pearson Education, 2010.

R2. Yashavant P. Kanetkar, "Let Us C", 16th Edition, BPB Publications, 2018

R3. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013

Web References

1. <http://www.cprogramming.com/>

2. <http://www.c4learn.com/>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	-	1	2	2
CO3	3	2	2	2	2	1	1	2	3	2	-	1	2	2
CO4	3	2	2	2	2	1	1	2	3	2	-	1	2	2
CO5	3	2	2	2	2	1	1	2	3	2	-	1	2	2

High-3; Medium-2; Low-1

Course Code:19MESC4001	Course Title: Engineering Drawing (Common to AU,ME,EC,EI,CS,IT, AD&SC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week)1: 0: 3	Credits:2.5	Total Contact Hours:60	Max Marks:100

Pre-requisites

➤ NIL

Course Objectives

The course is intended to:

- 1.Develop skills for communication of concepts and ideas.
- 2.Expose them to existing national standards related to technical drawings.

Unit I Orthographic Projection 12 Hours

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning. Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Visualization principles -conversion of pictorial into orthographic views.

Unit II Projection of Solids 12 Hours

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

Unit III Projection of Sectioned Solids 12 Hours

Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other - Orthographic views of sections of simple solids.

Unit IV Development of Surfaces 12 Hours

Development of lateral surfaces of simple and truncated solids - Prisms, pyramids, cylinders and cones.

Unit V Isometric Projection and Computer Aided Drafting**12 Hours**

Principles of isometric projection - Isometric scale -Isometric projections of simple solids and truncated solids.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Sketch the orthographic projections of the given pictorial view of the object using first angle projection	Apply
CO2: Sketch the projections of simple solids such as prism, pyramid, Apply cylinder and cone using rotating object method	Apply
CO3: Sketch the projections of simple sectioned solids with all necessary dimensions meeting the standards	Apply
CO4: Sketch the lateral surface of simple solids using straight line and radial line development methods	Apply
CO5: Sketch the isometric view of simple solids and truncated solids using principles of isometric projection	Apply

Text Book(s):

T1. Cenci! Jensen, Jay D.Helsel and Dennis R. Short," Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 7th Edition (2017).

T2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 53rd edition (2015).

T3. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 48th edition (2018).

Publications of Bureau of Indian Standards

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1)- 2001: Technical products Documentation - Lettering
3. IS 10714 (Part 20)-2001 & SP 46- 2003: Lines for technical drawings
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4)- 2001: Technical drawings - Projection Methods.

Reference Book(s):

R1.Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd edition, 2013.

R2.John K.C., "Engineering Graphics", PHI Learning, Delhi, 151t edition 2009.

R3.Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD"
Tata McGraw India, New Delhi, 3rd edition,2008,.

Web References:

- <http://nptel.ac.in/courses/112103019/>
- https://en.wikipedia.org/wiki/Engineering_drawing

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO2	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO3	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO4	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO5	3	2	2	2	-	-	-	2	3	2	-	1	-	-

High-3; Medium-2;Low-1

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the measures for conservation and equitable use of natural resources	Understand
CO2: Describe the measures for pollution prevention and disaster management	Understand
CO3: Brief the importance of environmental legislation in India	Understand
CO4: Explain the general environmental issues in relevant to human health	Understand
CO5: Demonstrate innovative measures for day to day environmental issues	Understand

Text Book(s):

T1.Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2.Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3rd Edition, 2014.

Reference Book(s):

R1.Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.

R2.Cunningham, W.P.Cooper,T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	-	-	1	2	2	1	-	-	1	-	-
CO2	1	-	1	-	-	1	2	2	1	-	-	1	-	-
CO3	1	-	1	-	-	1	2	2	1	-	-	1	-	-
CO4	1	-	1	-	-	1	2	2	1	-	-	1	-	-
CO5	1	-	1	-	-	1	2	2	1	-	-	1	-	-

High-3; Medium-2; Low-1

Course Code:19PSHG6001	Course Title: Wellness for Students (Common to all B.E/B.Tech Programmes) (2020 Batch onwards)		
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week)0: 0: 2	Credits:1	Total Contact Hours:30	Max. Marks:100

Pre-requisites

➤ NIL

Course Objectives

The course is intended to:

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life.
4. Understand the dimensions of wellbeing and relevant practices

Unit I Goal Setting

6 Hours

Understanding Vision and mission statements - Writing personal mission statements – ‘Focus’ as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

Unit II Time Management - Tools and Techniques

6 Hours

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying ‘NO’ – Managing procrastination

Unit III Practices for Physical Wellness

6 Hours

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

Unit IV Practices for Mental Wellness**6 Hours**

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas

Unit V Putting into Practice**6 Hours**

Practical's: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	Cognitive/ Affective
At the end of this course, students will be able to:	
CO1.Set well-articulated goals for academics, career, and personal aspirations	Apply
CO2.Apply time management techniques to complete planned tasks on time	Apply
CO3. Explain the concept of wellness and its importance to be successful in career and life	Apply
CO4. Explain the dimensions of wellness and practices that can promote wellness	Apply
CO5. Demonstrate the practices that can promote wellness	Valuing

Text Book(s)

T1. Reading material, workbook and journal prepared by PS team of the college.

Reference Book(s):

R1.Stephen R Covey, “First things first”, Simon & Schuster Uk, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster Uk, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuition Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Edition. (2010).

R4. Dr. R. Nagarathna, Dr.H.R. Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, Edition(2008).

R5.Tony Buzan, Harper Collins, The Power of Physical Intelligence (English).

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	1	-	1
CO2	-	-	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	-	-	-	-	1	-	-	1
CO4	-	-	-	-	-	-	-	-	1	-	-	1
CO5	-	-	-	-	-	1	1	-	1	-	-	1

High-3; Medium-2; Low-1

Course Code: 19PSHG6003		Course Title:HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:50

Pre-requisites

➤ NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை, நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள், திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

CO.2 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

தமிழர் மரபு

அலகு 1 - மொழி மற்றும் இலக்கியம்

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2 - மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3 - நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4 - தமிழர்களின் திணைக் கோட்பாடுகள்**3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக் கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 - இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுய மரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிக்கல்- தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

TOTAL : 15 PERIODS

Course Outcomes		Cognitive Level
மாணவர்கள் இப்பாடத்தை கற்றபின்		
CO.1	மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19PSHG6003		Course Title:HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:50

Pre-requisites

➤ NIL

Course Objectives

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinaï Concept.
2. Understand the Contribution of Tamils to Indian National Movement and Indian Culture.

HERITAGE OF TAMILS

UNIT I LANGUAGE AND LITERATURE

3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS**3**

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS**3**

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.	Understand
CO.2 Understand the Contribution of Tamils to Indian National Movement and Indian Culture.	Understand

TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

Semester-III

Course Code:19MABC1302	Course Title: Numerical Methods and Linear Algebra (common to EC,EE,EI & MC)		
Course Category: Basic science		Course Level: Introductory	
L:T:P(Hours/Week):3:1:0	Credits:4	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- 19MABC1102-Matrrices and Calculus
- 19MABC1201-Ordinary Differential Equation and Complex Variables

Course Objectives

The course is intended to:

1. Solve the system of linear equations, nonlinear equation & calculate the dominant Eigen value
2. Determine the unknown values from the given set of data & compute derivatives and integrals
3. Solve first ordinary differential equation
4. Apply the concept of vector spaces to electrical network problems
5. Apply the concept of inner product spaces in Fourier approximation

Unit I Solution of equations And Eigen value Problems

9+3Hours

Solution of system of linear equations-Direct methods: Gaussian elimination method-indirect methods: Gauss Jacobi Method, Gauss-Seidel method-sufficient conditions for convergence-solution of nonlinear equation: Newton Raphson method- Power method to find the dominant Eigen value and the corresponding Eigen vector. Application of Eigen value and the corresponding Eigen vector.

Unit II Interpolation, Numerical Differentiation And Integration

9+3Hours

Newton's forward, backward interpolation –Lagrange's interpolation. Numerical Differentiation and Integration-Trapezoidal rule- Simpson's 1/3 rule- Double integration using trapezoidal rule.

Unit III Numerical Solution of Ordinary Differential Equation**9+3Hours**

Numerical solution of first order ordinary differential equation- Single step method: Taylor's series- Euler's method- Runge - kutta method of fourth order- Multi step method: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations.

Unit IV Vector Spaces**9+3Hours**

System of Linear equations-Vector spaces-Subspace of a vector space-basis and dimension of vector space –linear combination and spanning sets of vectors- linear independence and linear dependence of vectors- Row space, Column space and Null space- Rank and nullity of subspaces. Applications to linear equations; Simple electrical network problems to find loop current using Kirchhoff's voltage law.

Unit V Orthogonally And Inner Product Spaces**9+3Hours**

Inner Product of vectors: length of a vector, distance between two vectors, and orthogonality of vectors- orthogonal projection of a vector-gram- Schmidt process to product orthogonal and orthonormal basis- inner product spaces- Fourier approximation of continuous functions using inner product spaces.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Solve the system of linear equations, nonlinear equations & calculate the dominant Eigen value	Apply
CO2. Determine the unknown values from the given set of data & compute derivatives and Integrals	Apply
CO3. Solve first ordinary differential equation	Apply
CO4. Apply the concept of vector spaces to electrical network problems	Apply
CO5. Apply the concept of Inner product spaces in Fourier approximation	Apply

Text Book(s)

- 1 Grewal, B.S. and Grewal, J.S., "Numerical Methods in Engineering and Science", Eleventh Edition, Khanna Publishers, New Delhi, 2013.
- 2.David C Lay, "Linear Algebra and its Applications", Fifth Edition, Pearson Education, 2015.

Reference Book(s):

1. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Seventh Edition, Pearson Education Asia, New Delhi, 2006.
2. Jain M. K., Iyengar, S. R. and Jain, R. K, "Numerical Methods for Scientific and Engineering Computation', New Age Publishers,2012.
3. Sastry.S.S, "Introductory Methods of Numerical Analysis".3 Edition PHI,2003.
4. GibertStrang, "Linear algebra and its Applications', Fourth Edition, Cengage Learning Indian Private Limited, 2012.

Web References:

1. <http://nptel.ac.in/courses/122104018/node2.html>
2. <http://nptel.ac.in/courses/111105038/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	2	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	2
CO3	3	2	1	1	-	1	-	1	1	1	1	2	2	2
CO4	3	2	1	1	-	1	-	1	1	1	1	2	2	2
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	2

High-3;Medium-2;Low-1

Course Code:19ECCN1301		Course Title: Analog Circuits- I	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week): 3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECSN2101- Fundamentals of Electrical and Electronics Engineering
- 19ECSN2201- Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Analyze BJT and FET Amplifiers
2. Select the appropriate Power Amplifier for a given application
3. Analyze various feedback amplifiers
4. Analyze Tuned Amplifier
5. Explain the characteristics of Operational Amplifier

Unit I Analysis of BJT and FET Amplifiers 9 Hours

Analysis of BJT amplifier: LF response of CE, CB and CC Amplifier using h-parameter model. HF response of Common emitter amplifier-Hybrid TT model - Definition of Cut off frequencies and bandwidth. High frequency response of Common source FET amplifier.

Unit II Large Signal Amplifiers 9 Hours

Classification of Large signal amplifiers: Class A- direct coupled and transformer coupled. Class B- push pull and complementary symmetry -Cross over distortion- Class AB Power amplifier

Unit III Feedback Amplifiers 9 Hours

Types of Feedback- The four basic feedback topologies - Input and Output resistances with Negative feedback - Method of identifying feedback topologies.

Unit IV Tuned Amplifiers 9 Hours

Single tuned amplifier- Effect of cascading single tuned amplifiers on bandwidth - Stagger tuned amplifiers -Class C tuned amplifier. Neutralization - Hazeltine neutralization and Rice neutralization.

Unit V OP-AMP and Its Characteristics 9 Hours

Block Diagram of Op-amp -CMRR- Ideal Op-amp characteristics and its equivalent circuit - DC

characteristics - AC characteristics - Concept of frequency compensation-methods of improving slew rate

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Analyze BJT and FET Amplifiers at low and high frequency using h-parameter and hybrid- TT model	Analyze
CO2. Select the appropriate Power Amplifier for a given application	Analyze
CO3. Analyze various Feedback Amplifiers using appropriate feedback topologies	Analyze
CO4. Analyze the frequency response characteristics of Tuned Amplifier and its neutralization techniques	Analyze
CO5. Explain the characteristics of Operational Amplifier in terms of AC and DC parameters	Understand

Text Book(s)

- T1. Anil K.Maini and VarshaAgarwal, "Electronic Devices and Circuits", Wiley India Private Ltd, New Delhi, 2009.
- T2. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", Second Edition, Tata McGraw-Hill, New Delhi, 2007.

Reference Book(s):

- R1. Roy Choudhary.D., Sheil.B.Jani, "Linear Integrated Circuits", Second Edition, New Age, 2003.
- R2. Robert L. Boylestad and Louis Nasheresky, "Electronics Devices and Circuit Theory", Ninth Edition, Pearson Education/ PHI, New Delhi 2002
- R3. David A. Bell, "Electronics Devices and Circuits", Fifth Edition, Oxford University Press, 2008.
- R4. Sedra/ Smith, "Micro Electronic Circuits" Oxford University Press, 2004

Web References:

1. <https://nptel.ac.in/courses/117/107/117107094/>
2. [https://nptel .ac. in/courses/117 /106/117106088/3](https://nptel.ac.in/courses/117/106/117106088/3)

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	-

High-3;Medium-2;Low-1

Course Code: 191TSN2302		Course Title: Data Structures and Algorithms - I	
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- 19CSSC2001- C Programming

Course Objectives

The course is intended to:

- 1 . Construct programs using pointers
2. Write programs using structures and unions
3. Implement linear data structures
4. Develop programs using stack and queue
5. Demonstrate a familiarity with sorting and searching techniques in data structures

Unit I Pointers 9 Hours

Introduction to pointers- Accessing the address of a variable- Declaring & Initializing pointer Variable- Accessing a variable through its pointers- Pointer & Arrays- Array of pointers- Pointers as Function arguments- Pointers to Functions

Unit II Structures and Union 9 Hours

Structures: Declaration & Initialization of Structures - Structure within Structure - Array of Structures -Pointer to Structures - Structure and Functions -Typedef- Union: Declaration & Initialization of Union -Operations on Union -Enumerations

Unit III Linear Data structure - List 9 Hours

Data Structures types - Abstract Data Types - List ADT: Array and Linked List Implementation -Doubly Linked List - Circularly Linked List-Applications of List: Radix sort

Unit IV Linear Data structures-Stack and Queue 9 Hours

Stack ADT: Stack Model - Array and Linked List Implementation of Stack - Applications :Balancing Symbols - Postfix Expressions- Infix to Postfix Conversion - Queue ADT: Queue Model -Array and Linked List Implementation of Queue - Applications of Queue.

Unit V Sorting and Searching Techniques 9 Hours

Sorting Techniques: Bubble sort - Merge sort - Quick sort - Applications of Sorting - Searching

Techniques: Linear Search - Binary Search- Applications of Searching.

List of Exercises

30 Hours

1. Develop C program using array of pointers
2. Develop C program using Structure pointers
3. Create a C program to implement Singly Linked list using Linked list implementation
4. Create a C program to implement Stack using array and linked list implementation
5. Create a C program to implement Queue using array and linked list implementation
6. Create a C program to implement Merge Sort / Quick Sort / Bubble Sort

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Construct programs using pointers for given scenario	Apply
CO2: Write programs using structures and unions for various real time applications	Apply
CO3: Implement Linear data structures such as Linked List using C	Apply
CO4: Develop programs using stack and queue for given application	Apply
CO5: Implementation of Sorting and Searching Techniques	Apply

Text Book(s)

- T1. E.Balagurusamy, "Programming in ANSI C", 4th Edition, Tata McGraw-Hill Education, 2017. (UNIT I,II)
- T2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, New Delhi, 2011. (UNIT III,IV,V)

Reference Book(s):

- R1. Ajay Mittal, "Programming in C - A Practical Approach", 3rd Edition, Pearson Education, 2010.
- R2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education; Third edition, 2017.

Web References:

1. <https://www.coursera.org/specializations/data-structures-algorithms>

2. <http://www.csse.monash.edu.au/~lloyd/tildeAlgDS>
3. <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms>
4. <http://www.c41earn.com>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO2	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO3	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO4	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO5	3	2	1	1	2	-	-	2	3	2	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECCN2301		Course Title: Transmission Lines and Waveguides	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites

- 19PHBC2001- Physics for Electrical Sciences

Course Objectives

The course is intended to:

1. Analyze two port network and transmission line parameters
2. Analyze power measurement in transmission lines
3. Select appropriate matching sections for impedance matching
4. Analyze various modes of propagation in parallel plane and rectangular waveguides
5. Analyze various modes of propagation in circular waveguides and cavity resonator

Unit I **Transmission Line Theory** **9 Hours**

Introduction - Definition of Two Port Network parameters - The Lumped element circuit model for a transmission line - General solution of transmission line-propagation constant, characteristic impedance - reflection on a line not terminated by Z_0 - Waveform distortion, condition for distortion less line.

Unit II **High Frequency Transmission Lines** **9 Hours**

Approximations at high frequencies - Line of zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Standing Wave Ratio - Input impedance of the dissipation less line - Open and short circuited lines - Power and impedance measurement on lines.

Unit III **Impedance Matching in Transmission Lines** **9 Hours**

Impedance matching: Quarter wave transformer, Half wave line, Eighth wave line - Smith chart-transmission line calculations using Smith chart - Single stub matching.

Unit IV **Parallel Plane and Rectangular Waveguides** **9 Hours**

Parallel Plane Waveguides: Waves between parallel planes - TE, TM and TEM waves Characteristics, Velocities of propagation.

Rectangular Waveguides: TE and TM waves - characteristics, Impossibility of TEM waves in hollow wave guides- Dominant Mode - definition of Wave Impedance

Unit V **Circular Waveguides and Rectangular Cavity Resonator** **9 Hours**

Circular Waveguides: Bessel's function, Solution of the field equation in cylindrical co-

ordinates, TE and TM waves, Characteristics.

Rectangular Cavity Resonator: Rectangular cavity, TE and TM mode, resonant frequency, dominant mode, Q factor - Unloaded Q for TE₁₀₁ mode.

List of Experiments

30 Hours

1. Measurement of cut-off frequency and attenuation in a coaxial line
2. Determination of SWR and reflection coefficient of a device using VNA
3. Determination of line parameters using Smith chart utility software
4. Design of Quarter wave transformer
5. Determination of VSWR and Reflection coefficient using slotted line section
6. Measurement of frequency and wavelength of dominant mode in RWG

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
C01:Analyze the basic transmission line parameters using the analogy between lumped and distributed model	Analyze
C02: Analyze power measurement in transmission lines at high frequencies by approximating their parameters	Analyze
C03:Select appropriate matching sections to minimize the impedance mismatch in a transmission line	Analyze
C04:Analyze various modes of propagation in parallel plane and rectangular waveguides by using wave equations	Analyze
CO5:Analyze various modes of propagation in circular waveguides and cavity resonator by using wave theory approach	Analyze

Text Book(s)

- T1. A Sudhakar, S Shyam mohan and Palli, Circuits and Network (Analysis and synthesis) Tata McGraw-Hill, 2010
- T2. John D Ryder, "Networks, Lines and Fields", PHI, 2nd Edition New Delhi, 1999
- T3. Jordan. E.C. and Balmain.K.G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, New Delhi, 1995.

Reference Book(s):

- R1. Alexander C. and Sadiku M. N. O., -Fundamentals of Electric Circuits ", Tata McGraw Hill, New Delhi, 2013.
- R2. Umesh Sinha, "Transmission Lines and Networks", Satya Prakashan (Tech. India Publications, New Delhi), 2001
- R3. David M. Pozar, "Microwave Engineering", Third Edition, John Wiley, 2009.
- R4. David K. Cheng, "Field and Wave Electromagnetics", Pearson Education, Second Edition, 2004
- R5. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005.

Web References:

1. <http://www.nptel.ac.in/courses/117101057/>
2. <http://www.amanogawa.com/arc1ive/transmissionB.html>
3. <http://www.falstad.com/circuit/e-tl.html>
4. <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-fall-2005/lecture-notes/>
5. <http://www.indiabix.com/electronics-circuits/simple-transmission-lines/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	2	3	2	-	2	2	-
CO2	3	3	2	2	2	-	-	2	3	2	-	2	2	-
CO3	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO4	3	3	2	2	2	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	2	-	-	2	3	2	-	2	2	-

High-3: Medium-2.Low-1

Course Code: 19ECCN1302		Course Title: Title: Digital Principles and System Design	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week):3: 1: 0	Credits:4	Total Contact Hours: 60	Max Marks:100

Pre-requisites: The student should have undergone the course(s):

- 19ECSN2201- Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Illustrate the number systems and boolean laws
2. Explain minimization techniques and operation of logic families
3. Develop combinational logic
4. Design synchronous sequential circuits
5. Design asynchronous sequential circuits

Unit I Basic Concepts in Boolean Algebra 10 Hours

Number System: Review of decimal, binary, octal and hexadecimal numbers -Complements: 1 's and 2's - Arithmetic operation of Signed binary numbers - Digital Logic Gates - Universal gate Implementation.

Boolean algebra: Basic Theorems, properties and- Representation of Boolean functions in Canonical and standard forms.

Unit II Minimization Techniques and Logic Families 12 Hours

Minimization Techniques: Simplifications of Boolean expression using 3 and 4 variable K map method and Mc-Cluskey method

Logic Families: Characteristics and operation of TTL, ECL, CMOS logic.

Unit III Combinational Logic 12 Hours

Combinational Circuits: Design Procedure of adder-half adder, full adder,4-bit RCA, Subtractor: half subtractor, full subtractor,4-bit subtractor, Comparator: 4-bit magnitude comparator, code converters-binary to excess-3,binary to gray,Encoders-8 to 3, Decoders- 3 to 8, Multiplexers-8 X 1 and De-multiplexers-1 X 8.

Unit IV Synchronous Sequential Logic 13 Hours

Flip flops: SR, JK, T, D - Level and Edge Triggering - Analysis of sequential circuits - Design of sequential circuits- Registers: Shift registers - SISO, SIPO, PISO, PIPO -Counters: Design of 3-bit synchronous and ripple counter.

Unit V Asynchronous Sequential Logic

13 Hours

Analysis of Asynchronous Sequential Circuits - Design of Asynchronous Sequential Circuits with primitive flow table, state reduction and state assignment - Races, Cycles and Hazards: Static, Dynamic, Essential, Hazards elimination.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Illustrate the number systems and boolean laws used in digital design	Understand
CO2. Explain minimization techniques in boolean algebra and logic Families	Understand
CO3. Develop combinational circuits using simplification techniques	Apply
CO4. Design synchronous sequential circuits using flip-flops	Apply
CO5. Design an asynchronous sequential circuit eliminating hazards and races	Apply

Text Book(s)

T1. Morris Mano. M., "Digital Design", Third Edition, Pearson Edn.,2001

T2. William I. Fletcher, "An Engineering Approach to Digital Design ", Prentice-Hall of India, 1980.

Reference Book(s):

R1. Donald D. Givone, "Digital Principles and Design", TMH, 2003

R2. Salivahanan. Sand Arivazhagan. S., "Digital Circuits and Design", Fourth Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.

R3. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007

Web References:

1. [http://www.learnabout-electronics.org/Digital/dig1 O.php](http://www.learnabout-electronics.org/Digital/dig1_O.php)

2. <http://nptel.ac.in/courses/117103064/>

3. <https://nptel.ac.in/courses/108105132/>
4. <http://www.allaboutcircuits.com/textbook/digital/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	2	3	2	-	2	-	3
CO2	3	2	1	1	2	-	-	2	3	2	-	2	-	3
CO3	3	3	2	2	2	-	-	2	3	2	-	2	-	3
CO4	3	3	2	2	2	-	-	2	3	2	-	2	-	3
CO5	3	3	2	2	2	-	-	2	3	2	-	2	-	3

High-3; Medium-2; Low-1

Course Code: 19ECCN3301		Course Title: Analog Circuits-I Laboratory	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week): 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- 19ECSN2101- Fundamentals of Electrical and Electronics Engineering
- 19ECSN2201- Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Construct BJT amplifiers and draw their frequency response characteristics
2. Construct FET amplifier in CS configuration and draw its frequency response characteristics
3. Construct Power Amplifiers using BJT and estimate their efficiencies
4. Construct Feedback amplifiers using BJT and draw its frequency response characteristics
5. Construct and test simple electronic circuits using BJT

LIST OF EXPERIMENTS:

1. Frequency response characteristics of CE amplifier
2. Frequency response characteristics of CC amplifier
3. Frequency response characteristics of CS amplifier
4. Two stage RC coupled amplifier
5. Class A power amplifier
6. Complementary symmetry class-B amplifier
7. Feedback amplifiers using BJT
8. Class C tuned amplifier
9. Relay driver using BJT/FET amplifier
10. Fixed voltage Power supply

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Construct BJT amplifiers in both CE and CC configurations and draw their frequency response characteristics	Apply
CO2. Construct FET amplifier in CS configuration and draw its frequency response characteristics	Apply
CO3. Construct Power Amplifiers using BJT and estimate their efficiencies.	Apply
CO4. Construct Feedback amplifiers using BJT and draw its frequency response characteristics.	Apply
CO5. Construct simple electronic circuits and test its performance	Apply

Reference(s)

R1 . Analog Circuits I Laboratory Manual

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO2	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO3	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO4	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO5	3	2	2	2	-	-	-	2	3	2	-	1	2	-

High-3; Medium-2;Low-1

Course Code: 19ECCN3302		Course Title: Digital Principles and System Design laboratory	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECSN2201- Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Understand number representations and conversion between different representations in digital electronic circuit.
2. Understand simplification of Boolean expressions and operation of logic families.
3. Understand various combinational circuits
4. Understand concepts of asynchronous sequential circuits
5. Understand different concepts of synchronous sequential logic circuits.

LIST OF EXPERIMENTS:

1. Realization and logic verification of full adder and full subtractor using gates.
2. Implementation of 4*1 multiplexer and 1 *4 demultiplexer using gates.
3. Design and logic verification of 3-bit comparator using gates.
4. Design and logic verification of binary to BCD converter and BCD to seven segment display using gates.
5. Design and logic verification of 4-bit Serial In-Parallel out shift register using gates.
6. Design and logic verification of 3-bit synchronous Counter using gates.
7. Design and simulation of 3 to 8 decoder and 8 to 3 encoder using Verilog HDL code.
8. Design and simulation of 4-bit RCA using Verilog HDL code.
9. Design and simulation of JK Flip flop using Verilog HDL code
10. Design and simulation of synchronous counter which counts for specified states using Verilog HDL code.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Build different types of codes and number systems which are used in digital Communications.	Apply
CO2. Apply minimization techniques to simplify digital circuits and compare different types of loQic families.	Apply
CO3. Analyze and design Combinational Circuits.	Analyze
CO4. Analyze and design Synchronous Sequential logic circuits.	Analyze
CO5. Analyze and design Asynchronous Sequential logic circuits.	Analyze

Reference Book(s):

R1. Laboratory manual prepared by the department of ECE

R2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis, Second edition, Prentice Hall, 2003.

R3. Donald E.Thomas, Philip R.Moorby, " The Verilog Hardware description Language", Fifth Edition, Kluwer Academic Publishers, 2002.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	2	3	2	-	2	-	3
CO2	3	2	1	1	2	-	-	2	3	2	-	2	-	3
CO3	3	3	2	2	2	-	-	2	3	2	-	2	-	3
CO4	3	3	2	2	2	-	-	2	3	2	-	2	-	3
CO5	3	3	2	2	2	-	-	2	3	2	-	2	-	3

High-3; Medium-2;Low-1

Course Code: 19PSHG6004		Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:50

Pre-requisites

➤ NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

- CO.1** நெசவு மற்றும் பாணைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.
- CO.2** அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

தமிழரும் தொழில்நுட்பமும்

அலகு 1 - நெசவு மற்றும் பாணைத் தொழில்நுட்பம்

3

சங்க காலத்தில் நெசவுத் தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கிறல் குறியீடுகள்

அலகு 2 - வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்

3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ஷ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு 3 - உற்பத்தித் தொழில்நுட்பம்

3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்**3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு 5 - அறிவியல் தமிழ் மற்றும் கணினித் தமிழ்**3**

அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

Course Outcomes	Cognitive Level
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 நெசவு மற்றும் பாணைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

TEXT - CUM REFERENCE BOOKS

- 1 தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

Course Code: 19PSHG6004		Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:50

Pre-requisites

➤ NIL

Course Objectives

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY

3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY

3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY

3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY**3**

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING**3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Understand Weaving and Ceramic Technology, Designand Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.	Understand
CO.2 Understand the Scientific Tamil & Tamil Computing.	Understand

TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

Semester IV

Course Code: 19MABG1401	Course Title: Probability and Statistics (common to all B.E/B.Tech programmes)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week): 3:1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Calculate expectations and variances of random variables
2. Apply the concepts of standard distributions to solve practical problems
3. Calculate the correlation and regression for two variables
4. Test the samples based on hypothesis
5. Analyze the samples based on variance

Unit I Probability and Random Variables 9+3 Hours

Axioms of Probability- Conditional Probability- Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Function- Properties- Moments- Moment generating functions and their properties

Unit II Standard Distributions 9+3 Hours

Binomial- Poisson- uniform- Exponential- Normal Distributions and their properties- Functions of a random variable.

Unit III Two Dimensional Random Variables 9+3 Hours

Joint distributions- Marginal and conditional distributions- Covariance- Correlation and regression- Transformation of random variables.

Unit IV Testing of Hypotheses 9+3 Hours

Sampling Distribution - Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions- Tests for independence of attributes and Goodness of fit.

Unit V Design of Experiments**9+3 Hours**

Analysis of Variance (ANOVA)- One way Classification- Completely Randomized Block Design (RBD)- Latin square.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Calculate expectations and variances of random variables	Apply
CO2. Apply the concepts of standard distributions to solve practical problems	Apply
CO3. Calculate the correlation and regression for two variables	Apply
CO4. Test the samples based on hypothesis	Apply
CO5. Analyze the samples based on variance	Apply

Text Book(s):

- T1. Veerarajan T, "Probability, Statistics and Random process", 4th Edition, Tata McGraw-Hill, New Delhi, 2013.
- T2. Dr.J.Ravichandran, "Probability and Statistics for Engineers", 1st Edition, Wiley India Pvt.ltd, 2010

Reference Book(s):

- R1. R.E. Walpole,R.H Myers S.L Myers and K ye, Probability and Statistics for Engineers and Scientists", 9th Edition Pearson Education, Asia, 2016.
- R2. M.R. Spiegel.J Schiller and R.A Srinivasan"Schaum's Outlines Probability and Statistics, 3rd Edition, Tata McGraw Hill edition, 2009
- R3. Morris DeGroot, Mark Schervish, "Probability and Statistics", Pearson Educational Ltd, 4th Edition,2014
- R4. Johnson and C.B Gupta, " Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.

Web References:

- 1. Unit I to Unit IV: <https://onlinecourses.nptel.ac.in/111105041/>
- 2. Unit I to Unit IV: <https://nptel.ac.in/courses/111105090/>
- 3. Unit V : <https://nptel.ac.in/courses/111104075/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO3	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO4	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	1

High-3; Medium-2;Low-1

Course Code:19ECCN1401		Course Title: Analog Circuits-II	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week): 3: 1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites

- 19ECCN1301- Analog Circuits I

Course Objectives

The course is intended to:

1. Design arithmetic, calculus and rectifier circuits using op-amps
2. Design comparators and data converters using op-amps
3. Design Oscillators using op-amps/BJT
4. Design Wave shaping circuits using op-amps and BJT
5. Analyze the applications of special function ICs

Unit I Application of OP-AMP 9+3 Hours

Inverting and Non-inverting amplifier - Voltage follower - Summing amplifier - Subtractor - Instrumentation Amplifier- OP-AMP circuits using diodes: Half wave, full wave rectifiers and precision rectifiers.- integrator - Differentiator

Unit II Comparators and Converters 9+3 Hours

Comparator- Zero crossing detector, DAC and ADC - specifications -Weighted resistor type and R-2R ladder type - Flash type, Successive approximation type and dual slope type.

Unit III Oscillators 9+3 Hours

RC Oscillators using OP-AMP: RC phase shift and Wein bridge. LC oscillators using BJT: Hartley and Colpitt's oscillator. Crystal oscillator.

Unit IV Wave shaping Circuits 9+3 Hours

Multivibrators: Astable, Monostable and Bistable - Schmitt trigger using BJT and OP-AMP.

Unit V Special Function ICs and its Applications 9+3 Hours

IC 555 timer and IC 565 PLL - applications. Fixed and variable voltage regulators

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Design arithmetic, calculus and rectifier circuits using op-amps	Apply
CO2. Design comparators and data converters using op-amps	Apply
CO3. Design RC Oscillators using op-amps and LC Oscillators using BJT	Apply
CO4. Design wave shaping circuits using op-amps and BJT	Apply
CO5. Analyze the applications of special function ICs such as timer, PLL and voltage regulator	Analyze

Text Book(s):

- T1. Roy Choudhary.D., Sheil.B.Jani, "Linear Integrated Circuits", Second Edition, New Age, 2003.
- T2. S.Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", Second Edition, Tata McGraw-Hill, New Delhi, 2007.
- T3. RamakantA.Gayakward, "Op-amps and Linear Integrated Circuits", Fourth edition, Pearson Education, 2003.

Reference Book(s):

- R1. Anil K.Maini and Varsha Agarwal, "Electronic Devices and Circuits", WileyIndia Private Ltd, New Delhi, 2009.
- R2. Robert L. Boyelstad and Louis Nasheresky, "Electronics Devices and Circuit Theory", Ninth Edition, Pearson Education/ PHI, New Delhi 2002.
- R3. David A. Bell, "Electronics Devices and Circuits", Fifth Edition, Oxford University Press, 2008
- R4. Sedra/ Smith, "Micro Electronic Circuits" Oxford University Press, 2004

Web References:

1. <https://nptel.ac.in/courses/117101106/>
2. <https://freevideolectures.com/course/2915/linear-integrated-circuits>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO2	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	1	2	-

High-3; Medium-2;Low-1

Course Code: 191TSN2401		Course Title: Data Structures and Algorithms - II	
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week): 3: 0: 2	Credits:4	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- 191TSN2302-Data Structures and Algorithms - I

Course Objectives

The course is intended to:

1. Write java programs using appropriate programming paradigm
2. Understand the principles of inheritance, polymorphism and interfaces
3. Obtain code reusability and explore exception handling mechanism
4. Perform various operations on trees
5. Implement the traversal methods on graphs

Unit I INTRODUCTION

9 Hours

Introduction to java - Basics of OOPS Concepts - Java Virtual Machine - Structure of Java Program -Java Tokens - Constants - Variables -Data Types - Scope of Variables - Operators - Java Statements -Defining a Class - Defining Methods -Creating Objects - Accessing Class Members-Arrays-Applications of Java: Server, Client and Embedded Devices.

Unit II OBJECT ORIENTED PROGRAMMING USING JAVA

9 Hours

Constructors - Garbage Collection - Method Overloading -Static Members -Inheritance: Extending a Class -Overriding Methods - Super Keyword -Final Variables and Methods - Final Classes - Abstract Classes and Methods - Interfaces- Extending Interfaces - Implementing Interfaces.

Unit III PACKAGES, STRING AND EXCEPTION HANDLING

9 Hours

Packages -Creating and Importing Packages - Visibility Control - String Class -String Buffer - Exception Types -Uncaught Exceptions -Using Try Catch -Multiple Catch -Nested Try -Throw - Throws - Finally

Unit IV TREES

8 Hours

Tree - Preliminaries - Binary tree - Tree traversal - Applications - Expression tree - Binary Search tree - BST Operations - AVL tree.

Unit V GRAPHS

10 Hours

Representation of graph - Graph Traversals: Depth first and Breadthfirst traversal - Applications of graphs - Topological sort - Shortest path algorithms: Dijkstra's & Floyd's algorithms -

Minimum Spanning Tree: Prim's and Kruskal's algorithms.

List of Exercises

30 Hours

1. Creation of classes and use of different types of functions
2. Programs using Inheritance
3. Developing user defined interfaces
4. Creation of User defined package with appropriate usage of access modifiers
5. Implementation of Binary search tree
6. Implementation of Dijkstra's algorithm

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Write java programs to solve simple business problems	Apply
CO2. Apply inheritance and interfaces in order to attain code minimization and reusability	Apply
CO3. Create user defined packages and exception handling mechanism to obtain data encapsulation	Apply
CO4. Implement various operations on trees for real world applications	Apply
CO5. Implement the graph traversal methods	Apply

Text Book(s)

- T1. Schildt. H., "Java - The complete Reference", 10th Edition, McGraw Hill Education, 2014. (Unit 1, 2 & 3)
- T2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in Java", Pearson Education Asia, New Delhi, Third Edition, 2012. (Unit 4 & 5)

Reference Book(s):

- R1. Deitel and Deitel," Java How to Program", Prentice Hall, 10th Edition, 2014
- R2. Bert Bates & Kathy Sierra," Head First Java: A Brain-Friendly Guide", 2nd Edition, O'Reilly Media, 2009
- R3. Lafore, "Data Structures & Algorithms in Java", 2nd Edition, Pearson, 2007
- R4. Goodrich MT and Tamassia R, "Data Structures and Algorithms in Java", 5th edition, Wiley publication, 2010.

Web References:

1. <https://nptel.ac.in/courses/106105191/>
2. <https://nptel.ac.in/courses/106102064/>

3. <https://www.coursera.org/learn/object-oriented-java?specialization=java-object-oriented>

4. <https://www.coursera.org/learn/data-structures>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO2	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO3	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO4	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO5	3	2	1	1	2	-	-	2	3	2	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECCN1402		Course Title: Signals and Systems	
Course Category: Professional Core		Course Level: Level: Practice	
L:T:P(Hours/Week): 3: 1: 0	Credits:	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- 19MABC1201 -Ordinary Differential Equations and Complex Variables

Course Objectives

The course is intended to:

1. Classify various continuous time and discrete time signals
2. Classify various continuous time and discrete time systems
3. Interpret the spectral characteristics of continuous time periodic and aperiodic signals
4. Analyse Linear Time Invariant (L TI) continuous time systems
5. Understand the sampling process

Unit I Classification of Signals

9+4 Hours

Continuous Time (CT) and Discrete Time (OT) signals - Deterministic and Random signals
Periodic and Aperiodic signals - Even and Odd signals - Energy and Power Signals - Unit step and Unit ramp Unit impulse signals - Operation on signals: Time shifting, scaling and folding.

Unit II Classification of Systems

9+4 Hours

Continuous time systems - Discrete time systems - Linear system - Time invariant system - causal system - BIBO stable system - system with and without memory - L TI system.

Unit III Analysis of Continuous Time Signals

9+4 Hours

Fourier Series - Representation of Continuous time Periodic signals - properties of Continuous Time Fourier Series - Fourier Transform - Representation of Continuous time signals - properties of Continuous Time Fourier Transform.

Unit IV Analysis of Continuous Time Systems**9+4 Hours**

System modelling: Differential equation - impulse response - convolution integral - Laplace transform - properties of Laplace transform - Analysis and characterization of LTI systems using Laplace transform.

Unit V Sampling and Reconstruction**8 Hours**

Sampling of continuous time signals - Frequency domain representation of sampling - Sampling theorem - Effects of under sampling - Aliasing - Reconstruction of continuous time signals from samples

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Apply mathematical operations to classify various continuous time and discrete time signals based on their properties	Apply
CO2. Apply mathematical operations to classify various continuous time and discrete time systems based on their properties	Apply
CO3. Interpret the spectral characteristics of continuous time periodic and aperiodic signals using Fourier analysis	Apply
CO4. Apply Laplace Transform to represent and study the characteristics of Linear Time Invariant (LTI) continuous time systems	Apply
CO5. Understand the process of sampling and the effects of under sampling	Understand

Text Book(s):

T1. Allan V. Oppenheim, S. Wilsky and S.H.Nawab "Signals and System", Pearson Education, 2007

T2. Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley & Sons, 2004.

Reference Book(s):

R1. H P Hsu, RakeshRanjan, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007

R2. Edward W Kamen, Bonnie S Heck, "Fundamentals of Signals and Systems Using the Web and MATLAB", Pearson Education, 2007

R3. Vinay K Ingle, John G Proakis, "Digital Signal Processing using MATLAB", Cengage Learning, 3rd edition, 2011

R4.Sanjit K Mithra, "Digital Signal Processing Laboratory using MATLAB", Tata McGraw Hill, 1999

Web References:

1. <https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/>
2. [http://www.ws.binghamton.edu/fowler/Fowler%20Personal%20Page/EECE301 %20-%20Flipped.htm](http://www.ws.binghamton.edu/fowler/Fowler%20Personal%20Page/EECE301%20-%20Flipped.htm)
1. <https://nptel.ac.in/courses/117/104/117104074/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO2	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO3	3	2	1	1	1	-	-	1	-	1	-	1	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO5	2	1	1	1	-	-	-	1	-	1	-	1	1	-

High-3; Medium-2;Low-1

Course Code:19ECCN3401		Course Title: Analog Circuits -II Laboratory	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1301-Analog Circuits - I
- 19ECCN3301-Analog Circuits - I laboratory

Course Objectives

The course is intended to:

- 1.Design and Verify arithmetic and Calculus operations using op-amp circuits
2. Design and verify Digital to Analog Converters
3. Design and verify RC and LC oscillators
- 4.Construct and test square wave generator and squaring circuit and voltage regulator circuit
- 5.Design and verify simple electronic circuits

LIST OF EXPERIMENTS:

1. Arithmetic operations using op-amp.
2. Calculus circuits using op-amp.
3. Comparator circuits using op-amp.
4. Digital to Analog converter
5. RC Phase shift oscillator using Op-amp
6. LC oscillators using BJT
7. Application of Astable Multivibrator
8. Regenerative comparator
9. Applications of 555
10. Voltage regulator

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Design and Verify arithmetic and Calculus operations using op-amp circuits	Apply
CO2. Design and verify Digital to Analog Converters	Apply
CO3. Design and verify RC and LC oscillators	Apply
CO4. Construct and test square wave generator and squaring circuit and Voltage regulator circuit using op-amp	Apply
CO5. Design and verify simple electronic circuits using timer and PLL	Apply

Reference Book(s):

R1. Analog Circuits -II Laboratory Manual

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO2	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO3	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO4	3	2	2	2	-	-	-	2	3	2	-	1	2	-
CO5	3	2	2	2	-	-	-	2	3	2	-	1	2	-

High-3; Medium-2.Low-1

Course Code:19ECPN6401		Course Title: Mini-Project	
Course Category: Project		Course Level: Practice	
L:T:P(Hours/Week):0: 0: 4	Credits:2	Total Contact Hours: 60	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Identify the practical problems and develop a novel solution.
2. Design a Software/hardware prototype based on the solution.
3. Demonstrate time management y following a proper time line to execute the project.
4. Effectively communicate the results of projects in a written and oral format.

The object of mini-project is to enable the student to take up investigative study in the board field of Electronics and Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

This is expected to provide a good initiation for the student(s) in R&D work. The assignments normally included as given below:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Oral Presentation before a department committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Identify the problem statement by doing literature survey.	Apply
CO2. Development an ability to prepare a proposal with the novel solution for the problem statement.	Apply
CO3. Practice the time management ability by preparing and executing a work plan.	Apply
CO4. Design a hardware/software prototype based on the solution	Create
CO5. Demonstrate the results by making presentation and reports	Apply

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	3	3	3	-	3	-	-	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	-	3	3	3
CO3	-	-	-	-	-	3	-	3	3	-	3	3	-	-
CO4	3	3	3	3	3	3	3	3	3	-	3	3	3	3
CO5	3	3	-	-	3	3	3	3	3	3	-	3	3	3

High-3; Medium-2; Low-1

Course Code:19PSHG6002		Course Title: Universal Human Values 2 : Understanding Harmony	
Course Category: Humanities		Course Level: Practice	
L:T:P(Hours/Week): 2:1:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19SHMG6101-Induction Program (UHV1)

Course Objectives

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection.
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
4. Development of commitment and courage act.

Unit I Introduction to Value Education 6+3 Hours

Need for the Value Education; Self -exploration as the process for value education ; Continuous Happiness and Prosperity; A look at basic Human Aspirations; Right understanding ; Relationship and Physical Facilities ; Happiness and Prosperity; current scenario ; Method to fulfill the Basic human aspirations

Unit II Harmony in Human Being 6+3 Hours

Human being as a co-existence of self ('I') and the material 'Body'; needs of self ('I') and 'Body'; The Body as an instrument of 'I' ; Harmony in the self ('I'); Harmony of the self ('I'); with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III Harmony in the Family and Society 6+3 Hours

Harmony in the Family the basic unit of human interaction; Values in human relationship; Trust as the foundational values of relationship; respect as the evaluation; Understanding harmony in the society (society being an extension of family); Vision for the universal human order

Unit IV Harmony in the Nature**6+3 Hours**

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

Unit V Harmony on Professional Ethics**6+3 Hours**

Natural acceptance of human values ; Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics ; Case study; holistic technologies, management models and production systems; Strategy for transition towards value based life and profession.

Course Outcomes	Affective Level
At the end of this course, students will be able to:	
CO1. Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2. Appraise physical, mental and social well being of self and practice techniques to promote well being.	Responding
CO3. Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4. Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO5. Appreciate ethical behaviour as a result of value system in personal and professional situations	Receiving

Text Book(s)

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Book(s):

- R1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- R2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
- R3. The story of stuff, Annie Leonard, Free Press, New York 2010.

Web References:

1. <https://aktu.ac.in/hvpe/ResourceVideo.aspx>
2. <http://hvpenotes.blogspot.com/>
3. <https://nptel.ac.in/courses/109/104/109104068/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2; Low-1

Semester- V

Course Code:19ECCN1501		Course Title: Analog and Digital Communication	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)3:1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites

- 19ECCN1301 - Analog Circuits -I
- 19ECCN1401 - Analog Circuits -II
- 19ECCN1402 - Signals and Systems

Course Objectives

The course is intended to:

1. Analyze and compare different analog modulation techniques.
2. Analyze and compare different pulse modulation techniques.
3. Analyze the different baseband and pass band transmission systems.
4. Analyze various error control codes.
5. Analyze the behaviour of digital communication system using spread spectrum modulation.

Unit I **Analog Modulation Systems**

9+3 Hours

Amplitude Modulation : AM power distribution - Generation of AM waves: DSBSC - SSB - VSB
Detection of AM waves: Super heterodyne Receiver. Angle Modulation Systems: Narrow band and wideband FM - Generation of FM waves: Direct and Indirect methods - Detection of FM waves: Foster Seeley Discriminator - Principle of Phase Modulation systems - Noise in Analog Modulation systems.

Unit II **Pulse Modulation Systems**

9+3 Hours

Sampling Process - Quantization and its types - Analog Pulse Modulation systems: PAM - PWM - PPM -Digital pulse Modulation systems: Pulse Code Modulation - Concept of Linear Prediction filtering - DPCM - Delta Modulation - Adaptive Delta Modulation - Noise consideration in Pulse - Code Modulation and Delta Modulation systems.

Unit III Baseband and Passband Systems**9+3 Hours**

Baseband transmission: Line codes & its properties - ISI - Nyquist Criteria for distortion less transmission - Correlative coding - Eye Pattern - Principle of Equalization technique. Pass band transmission: Generation, Detection & BER of Coherent BFSK, BPSK, QAM - Principle of DPSK.

Unit IV Error Control Coding**9+3 Hours**

Channel coding theorem - Linear Block codes - Hamming codes - Convolutional codes - Viterbi decoding - Trellis coding.

Unit V Spread Spectrum Modulation**9+3 Hours**

Pseudo noise sequences - properties of spread spectrum - Direct sequence spread spectrum - Direct sequence spread spectrum: Signal space dimensionality, Probability of error, processing gain - Frequency hopping spread spectrum, Overview of spread spectrum modulation in 4G & 5G Technologies.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze and compare different analog modulation techniques in time and frequency domains.	Analyze
CO2: Analyze and compare different pulse modulation techniques in terms of Signal to Quantization Noise Ratio.	Analyze
CO3: Analyze and compare different baseband and pass band transmission systems.	Analyze
CO4: Analyze and compare various error control codes.	Analyze
CO5: Analyze the behaviour of digital communication system using spread spectrum modulation.	Analyze

Text Book(s)

T1.Simon Haykin, "Communication Systems" ,John Willey and Sons, Inc, Fourth edition,2010.

T2.Simon Haykin, "Digital Communications",John Willey and Sons,Inc,First Edition,2013

Reference Book(s):

R1. George Kannedy and Bernad Davis,"Electronic Communication Systems", Tata McGraw Hill, Fourth Edition,2008

R2. Wayne Toms,:"Electronic Communication Systems: Fundamentals through Advanced ",

- R3. Proakis J. G. and Salehi M, "Communication Systems Engineerin", Pearson Education, 2002.
- R4. Bernard Sklar, Pabitra Kumar Ray, " Digital Communications: Fundamentals and Applications" , Pearson Education, Second Edition, 2009.
- R5. Leon W Couch , "Digital and Analog Communication Systems" , Sixth Edition, Prentice Hall, 2001.
- R6. M.Bala Krishna, Jaime Lloret Maur, "Advances in Mobile Computing and Communications Perspectives and Emerging Trends in 5G Network". CRC Press; First edition, 2016.

Web References:

1. <https://nptl.ac.in/courses/117/105/117105143>
2. <https://nptl.ac.in/courses/117/101/117101051/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code:19ECCN1502		Course Title: Control Systems	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)3:1: 0	Credits:4	Total Contact Hours: 60	Max Marks: 100

Pre-requisites

- 19MABC1201 - Ordinary Differential Equations and complex Variables
- 19ECCN1402 - Signals and Systems

Course Objectives

The course is intended to:

1. Compute the transfer function of electrical and mechanical control systems.
2. Calculate the time response and time domain specifications.
3. Determine the frequency domain specifications from frequency response curves.
4. Analyze the stability of control system.
5. Derive various state space models and test controllability and observability of the given system.

Unit I Control System Modelling

9+3 Hours

Basic elements of control systems - Open and close loop systems - Transfer function - Mathematical modelling of electrical and mechanical systems - Analogies between electrical and mechanical systems - Block diagram reduction technique - Signal flow graph.

Unit II Time Domain Analysis

9+3 Hours

Standard test signals - Type and order of the systems - Impulse and step response of first and second order systems - Transient and steady state response - Time domain specifications - Steady state errors and error constants - Analytical design for PD,PI,PID control systems - Industrial application of PID controllers.

Unit III Frequency Domain Analysis

9+3 Hours

Frequency response - Frequency domain specifications - correlation between time and frequency domain specifications - Bode plot - polar plot - Basic concepts of lag - lead compensators.

Unit IV Stability Analysis

9+3 Hours

Stability - characteristic equation - location of roots in s-plane - Routh Hurwitz stability criterion - Concept of Root locus technique - Construction of Root locus - Effect of Pole-Zero additions on the root loci- Nyquist stability criterion.

Unit V State Variable Analysis of Continuous Time Systems

9+3 Hours

Concepts of state - State variable - State model - Controllable canonical form and Observable canonical form - State transition matrix -Properties of state transition matrix - Solution of state equations - Concepts of controllability & observability.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Compute the transfer function of electrical and mechanical systems through block diagram reduction technique and Signal flow graph.	Apply
CO2 :Calculate the time response and time domain specifications of first and second order systems.	Apply
CO3 :Determine the frequency domain specifications from frequency response curves of the given system using Bode plots and Polar plots.	Apply
CO4 :Analyze the stability of control system by using Root locus, Routh Hurwitz and Nyquist stability criteria.	Analyze
CO5 :Derive various state space models and test Controllability and Observability of the given system.	Apply

Text Book(s)

- T1. Benjamin.C.Kuo,"Automatic Control Systems",PHI, New Delhi,7Edition,1995
T2. Nagrath.J and Gopal.M,'Control System Engineering',New Age International Publishers, 5th Edition ,2007

Reference Book(s):

- R1. Norman.S.Nise,'Control Systems Engineering',Wiley,4th Edition,2003
R2. Gopal.M,'Control System - Principles and Design',TMH, New Delhi, 2nd Edition, 2002
R3. Ogata.K, 'Modern Control Engineering", 5th Edition, Pearson Education India, New Delhi,2010.
R4. S.Palani,"Control Systems Engineering",TMH, New Delhi, 2nd Edition,2020.

Web References:

1. <https://WWW.electrical4u.com/mathematical-modelling-of-various-system/>
2. <https://nptel.ac.in/courses/108/106/108106098/>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/lecture-notes-labs/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO2	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code:19ECCN2501		Course Title: Digital Signal Processing	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)3:0: 2	Credits:4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites

- 19ECCN1402 - Signals and Systems

Course Objectives

The course is intended to:

1. Analyze Discrete Time systems.
2. Compute Discrete Fourier Transform (DFT) and Inverse Discrete Time Fourier Transform (IDFT).
3. Design Linear Phase Finite Impulse Response (FIR) digital filters.
4. Design infinite Impulse Response (IIR) digital filters.
5. Analyze the effects of finite word length.

Unit I Z Transform

9 Hours

Z transform - properties - Inverse Z transform - Difference equation - impulse response convolution sum - Transfer function - poles and zeros - Analysis of LTI system using Z transform

Unit II Fast Fourier Transform

9 Hours

Discrete Fourier Transform (DFT)- relationship between DTFT and DFT- Magnitude and phase spectrum- properties of DFT - Radix-2 FFT algorithms: Decimation in time (DIT-FFT) and Decimation in Frequency (DIF-FFT)algorithms. Fast convolution-Overlap add method-Overlap save method

Unit III Finite Impulse Response Digital Filters

9 Hours

Introduction to linear phase filters – Window functions Rectangular, Hamming and Hanning Design of Linear phase FIR filters using windowing techniques – Realization of FIR filters: Direct, Linear phase structures.

Unit IV Infinite Impulse Response Digital Filters**9 Hours**

Introduction to Butterworth and Chebyshev Filters – Design of analog IIR Filters – Analog to digital filter transformation – Design of digital IIR filters – Realization of IIR filters: Direct form I, Direct Form II

Unit V Finite Word Length Effects**9 Hours**

Fixed point and Floating Representation – Quantization – Truncation and Rounding – Quantization of Filter Coefficients – Quantization noise power – Product Quantization – Limit Cycle Oscillations.

List of Exercises

1. Generation of basic signal: unit impulse & unit step
2. Spectral analysis of sinusoidal signals using FFT
3. FIR and IIR Low pass digital filter design
4. Effect of coefficient quantization on the frequency response of digital filters.
5. Notch and comb filter design based on pole – Zero placement
6. Implementation of FFT using Digital Signal Processor

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze discrete time LTI systems represented by difference equations using Z transform	Analyze
CO2: Compute Discrete Fourier Transform(DFT) and Inverse Discrete Fourier Transform(IDFT) of a given discrete time sequence using Fast Fourier Transform algorithms.	Apply
CO3: Design linear phase Finite Impulse Response (FIR) digital filters using windowing techniques	Apply
CO4: Design Infinite Impulse Response (IIR) digital filters from analog Butterworth filters for a given specification.	Apply
CO5: Analyze the effects of finite word length on filter implementation.	Analyze

Text Book(s)

- T1. Allan V. Oppenheim and Ronald W. Schaffer, "Discrete Time Signal processing", Prentice Hall, Third Edition, 2002
- T2. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Third Edition, Pearson Educational/Prentice Hall, 2003
- T3. Lonnie C. Ludeman, "Fundamentals of Digital Signal Processing", John Wiley and Sons

Network,2004

Reference Book(s):

- R1. Emmanuel C.Ifeachor and Barrie W.Jervis,"Digital Signal Processing',Second Edition,Pearson Education/Prentice Hall,2002.
- R2. Li Tan,;Digital Signal Processing: Fundamentals and Applications",Academic Press 2008
- R3. Johnny R.Johnson,"Introduction to Digital Signal Processing",Presentice Hall of India 2001
- R4. Steven W.Smith, "The Scientist and Engineer's Guide to Digigtal Signal Processing",California Technical Publications,1999.
- R5. Sanjit K.Mitra,"Digital Signal Processing:A computer based approach",TataMcGraw Hill,2011
- R6. Ashok Ambardar,"Digital Signal Processing: A Modern Introduction",Thomson Learning,2007

Web References:

1. <https://nptel.ac.in/courses/117102060>
2. <https://nptel.ac.in/courses/108/105/108105055/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	2	3	2	-	2	2	-
CO2	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO3	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO4	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	2	-	-	2	3	2	-	2	2	-

High-3; Medium-2; Low-1

Course Code:19ECCN3501		Course Title: Analog and Digital Communication Laboratory	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)0:0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- 19ECCN3401 - Analog Circuits –II Laboratory

Course Objectives

The course is intended to:

1. Analyze the various analog modulation systems
2. Categorize different pulse modulation techniques
3. Verify various error control coding schemes
4. Analyze the various digital modulation schemes
5. Analyze the various analog and digital modulation methods using software tools

List of Experiments

1. Simulate and Perform Amplitude modulation/Demodulation
2. Simulate and perform Frequency modulation /Demodulation
3. Carry out Pre-Emphasis and De-Emphasis
4. Verify sampling theorem in the hardware and simulate
5. Carry out PAM,PPM and PWM
6. Perform PCM encoding/decoding operation
7. Simulate and Perform ASK and FSK
8. Simulate and perform BPSK and QPSK
9. Simulate CRC Error control coding and carry out in the hardware
10. Simulate Convolutional coding and carry out in the hardware.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Analyze and various analog modulation systems with various modulation index.	Analyze
CO2:Categorize different pulse modulation techniques based on its characteristics.	Analyze
CO3: Verify various error control coding schemes by using a suitable encoding and decoding methods.	Analyze
CO4: Analyze the various digital modulation schemes using their appropriate characteristics.	Analyze
CO5:Analyze the various analog and digital modulation methods using Matlab.	Analyze

Reference Book(s):

- R1. John.Prokias, Masoud Salehi and Gerhard Bauch,"Contemporary Communication Systems using MATLAB",3rd Edition,Cengage learning,2012.
- R2. "Communication Systems Laboratory manual",prepared by ECE Department.
- R3. Kwonhue Choi,Huaping Liu,"Problem-Based Learning in Communication Systems using MATLAB and Simulink",Wiley IEEE Press,2016.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO2	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO3	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO4	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	3	-	-	2	3	2	-	2	2	-

High-3; Medium-2; Low-1

Course Code:19ECCN3502		Course Title: Data Science Laboratory	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)0:0: 3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- 19CSSC2001 – C Programming
- 19MABG1401 – Probability and statistics

Course Objectives

The course is intended to:

1. Analyze the dataset and its features
2. Extract the useful information from the data
3. Apply visualization techniques
4. Analyze the time series data
5. Apply data science concepts in Raspberry Pi

List of Experiments

1. Study the software packages for data science
2. Read and write the different file types of datasets.
3. Handle and manipulate the data
4. Convert unstructured dataset in to structured dataset
5. Perform pre-processing steps in the Data
6. Analyze time serious Data.
7. Carry out analysis of data using visualization techniques.
8. Identify the scores and ranking of data
9. Calculate and visualize the correlation and co-variance of given dataset
- 10.Perform Dimensionality reduction in data.
- 11.Interfacing Raspberry Pi with sensors.
- 12.Convert unstructured sensor data in to structured data

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the dataset and its features with Python packages..	Analyze
CO2: Extract the useful information by correlate, summarize and visualizing the data.	Analyze
CO3: Apply visualization techniques for analyzing the data.	Analyze
CO4: Analyse the time series data with python packages.	Analyze
CO5: Apply data science concepts in Raspberry Pi for real time sensor data.	Analyze

Text Book(S):

- T1. Jake VanderPlas, "Python Data Science Handbook: Essential Tool for working with Data", O'Reilly, United States, 2016
- T2. Steven S. Skiena, "The Data Science Design Manual", Second Edition, Springer, Switzerland, 2017.

Reference Book(s):

- R1. John Paul Mueller, Luca Massaron, "Data Science Programming All-in-One For Dummies", Wiley, 2020.
- R2. Chirag Shah, "A Hands – on Introduction to Data Science", Cambridge University Press, 2020.
- R3. Joel Grus, "Data Science from Scratch: First Principles with Python", O'R.
- R4. Prabhanjan Tattar, Tony Ojeda, Sean Patrick Murphy, "Practical Data Science Cookbook"

Web References:

1. <https://www.edx.org/course/subject/data-science>
2. <https://www.coursera.org/degrees/master-of-data-science-hse>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO2	3	2	2	2	3	-	-	2	3	2	-	2	2	-
CO3	3	2	2	2	3	-	-	2	3	2	-	2	2	-
CO4	3	2	2	2	3	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	3	-	-	2	3	2	-	2	2	-

High-3; Medium-2; Low-1

Course Code:19PSHG6501		Course Title: Employability Skills 1: Teamness and Interpersonal Skills	
Course Category: Professional Skills		Course Level: Introductory	
L:T:P(Hours/Week)0:0: 2	Credits:1	Total Contact Hours: 30	Max Marks: 100

Pre-requisites

➤ NIL

Course Objectives

The course is intended to

1. Enrich effective communicative attributes and facilitate presentation and public speaking skills.
2. Identify and explore the true self and handle negatives.
3. Develop interpersonal skills and to groom as a professional
4. Educate the importance of Nonverbal skill set to attain perfection
5. Build teamness and its ethics to facilitate corporate working

UNIT I EFFECTIVE COMMUNICATION & PRESENTATION SKILLS 6 Hours

Barriers of Communication –Fear of English – Handling Social Factors – Handling Psychological Factors – Handling Practical Problems – Do's & Don't's – Effective Presentation – Presentation Importance of Presentation – Slide orientation – Introduction in a presentation – Style slide – Slide Templates – Font,Color,Background – Graph Diagrammatic representation Delivery of presentation – Body language & Gestures – Verbal Attributes – Communication. Handling stammers and breaks – Handling fear of stage – Maintaining Confidence –content delivery methods – Do's and Don'ts in a presentation – Tips to handle it-Effective Conclusion.

UNIT II POSITIVE ATTITUDE & HANDLING REJECTIONS 6 Hours

A,B,C's of Attitude – Influencing Factors – Individual Factors – Character comparison – Strategies to handle ourselves – Benefits of Positive Attitude – Do's & Don't's – Handling Rejections – Identifying Negativities – Nuances of handling it – Necessary changes – To do list – creating One's self – Self Qualifiers.

UNIT III INTERPERSONAL SKILLS 6 Hours

Life skills – Core IP Skills – Importance of IP Skills – Tips to improve IP Skills-Necessity of IP Skills

UNIT IV BODY LANGUAGE,DRESSING 7 GROOMING**6 Hours**

Unconscious Physical moments – Metrics of Body Language – Good Posture – Head Motion – Facial expression – Eye contact – Gestures – Dressing – Grooming & Outlook – Necessity of good body language.

UNIT V TEAM ETHICKS**6 Hours**

Team Ethics – Necessity of Team work – Teams everywhere – benefits of team culture – Reason for team failure – conflicts – Handling conflicts – Being a team player – Work difference from college.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills.	Apply
CO2 : Identify and explore the true self and handle negatives..	Apply
CO3: Develop interpersonal skills and to groom as a professional.	Apply
CO4 : Explain the importance of Nonverbal skill set to attain perfection.	Understand
CO5 : Build team ness and its ethics to facilitate corporate working .	Apply

Text Book(S):

T1. John C Maxwell,"The 17 Indisputable laws of Teamwork: Embrace them and Empower your team",Harper Collins Leadership Publishers,2013

Reference Book(s):

- R1. Patrick Lencioni,"The five Dysfunctions of a Team: A leadership fable"Jossey Bass Publishers,2006.
- R2. Malcolm Gladwell,"Talking of Strangers: What we shoud know about the people we Don't know"Penguin Publishers,2019.
- R3. Harvey Segler,"Body Language:Discovering & Understanding the Psychological secrets behind reading & Benefiting from body language"Kindle Edition, 2016.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	1	1
CO2	-	-	-	-	-	-	-	-	2	-	-	1	1	1
CO3	-	-	-	-	-	-	-	-	2	1	1	1	1	1
CO4	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO5	-	-	-	-	-	-	-	2	1	-	-	1	1	1

High-3; Medium-2; Low-1

Semester-VI

Course Code: 19ECCN1601		Course Title: VLSI System Design	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)4:0: 0	Credits:4	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- 19ECCN1301- Analog Circuits-I
- 19ECCN1302- Digital Principles and System Design

Course Objectives

The course is intended to:

1. Explain the VLSI design flow and CMOS design processes
2. Describe the characteristics of MOSFET and FINFET.
3. Apply the various CMOS logic styles to design digital circuits.
4. Design digital sub systems using HDL.
5. Implement digital sub systems on FPGA.

Unit I Introduction 10 Hours

VLSI Design process: Design specification- design entry – functional simulation – planning, placement and routing – timing simulation, Flip-flop and Latch related timing issues, fabricating into chip- CMOS processing technologies - nWell - pWell - Twin tub - Silicon on insulator.

Unit II MOS Transistors and Inverters 12 Hours

Basic MOS Transistors and Operation: NMOS enhancement transistor - PMOS enhancement transistor - Threshold Voltage-Derivation of drain current- Channel length modulation- Body Effect –Trans conductance – MOSFETs as Switches - CMOS Inverter – Latch-up in CMOS Circuit - Power dissipation in CMOS Circuits. Basics of FINFET Technology and Operation SPICE simulations on NMOS and PMOS characteristics.

Unit III Logic Design with CMOS 14 Hours

Combinational Circuit Design: Logic gates in Static CMOS - Transistor sizing – Stick diagram, Layout diagrams and design rules – Rationed circuits: Pseudo NMOS – cascade voltage switch logic - Dynamic CMOS logic: domino logic, dual rail domino logic – Transmission gate - pass-transistor circuits - Basic gates and D-Flip Flop using Multiplexer-Moore's law, Basics and recent trends in scaling. CMOS design and Functional Verification of Basic logic gates.

UNIT IV Subsystem Design**12 Hours**

Synthesis and simulation using HDLs – Logic synthesis using Verilog, System Verilog – Introduction, Design hierarchy, Data types, Memories, Tasks and Functions, Interfaces, OOPS Basics. Logic Synthesis of Adder Circuits.

Unit V System Design using FPGA**12 Hours**

Introduction to FPGA fabrics: FPGA architectures – SRAM-based FPGAs – Permanently programmed FPGAs – Circuit design of FPGA fabrics – Architecture of FPGA fabrics – Logic implementation of FPGAs – Physical design for FPGAs - FPGA design cycle using Xilinx ISE webpack. FPGA Implementation of Half Adder and Full Adder circuits.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the VLSI design flow and CMOS design processes with appropriate fabrication technologies.	Understand
CO2. Describe the characteristics of MOSFET with relevance to power dissipation and basics of FINFET operation.	Understand
CO3. Apply the various CMOS logic styles to design digital circuits and address the effects of scaling.	Apply
CO4. Model digital sub systems using Verilog and System Verilog HDL.	Apply
CO5. Employ FPGA to implement digital sub systems.	Apply

Text Book(s):

- T1. Weste and Harris, "CMOS VLSI Design", Third edition, Pearson Education, 2005.
- T2. Samir Palnitkar, "Verilog HDL", Second edition, Pearson Education, Ninth Impression 2010.
- T3. Neil H.E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education ASIA, 2nd edition, 2000.
- T4. Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004

Reference Book(s):

- R1. John P.Uyemura "Introduction to VLSI Circuits and Systems", John Wiley and Sons, Inc., 2002
- R2. Eugene D. Fabricius, "Introduction to VLSI Design", McGraw Hill International Edition, 1990
- R3. Pucknell, "Basic VLSI Design", Prentice Hall of India Publication, 1995
- R4. Wayne Wolf, "Modern VLSI Design System on chip", Pearson Education, 2002

Web References:

1. <http://nptel.ac.in/downloads/117101058/>
2. <http://www.nptel.ac.in/downloads/117106093/>
3. <https://www.youtube.com/watch?v=VUSTLyPtPgk>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	1	1	-	1	1	2
CO3	3	2	1	1	-	-	-	1	1	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	1	1	-	1	1	2
CO5	3	2	1	1	-	-	-	1	1	1	-	1	1	2

High-3; Medium-2;Low-1

Course Code: 19ECCN1602		Course Title: Internet Of Things	
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain the concepts of Internet of Things (IoT)
2. Describe basic knowledge of RFID Technology, Sensor Technology and Satellite Technology
3. Interpret communication protocols in IoT
4. Illustrate the challenges due to privacy and security in IoT
5. Design IoT applications in Business domain

Unit I Introduction of IOT 9 Hours

Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges- Planning, Costs and Quality ,Security and Privacy, Risks.

Unit II Fundamental IoT Mechanisms and Key Technologies 9 Hours

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology.

Unit III Communication under IoT 9 Hours

IoT Protocols: MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, Wi-Fi, Interfacing of wifi, RFID, Zigbee and NFC with development board.

Unit IV Privacy, Security and Governance 9 Hours

Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Security model for IoT.

Unit V Business Models for IoT**9 Hours**

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Application: Smart Metering, Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the fundamental concepts on Internet of Things (IoT)	Understand
CO2. Describe basic knowledge of RFID Technology, Sensor Technology and Satellite Technology	Understand
CO3. Interpret communication protocols in IoT	Understand
CO4. Illustrate the challenges due to privacy and security in IoT	Understand
CO5. Design IoT applications in Business domain	Understand

Text Book(s):

T1. A.McEwen, H.Cassimally," Designing the Internet of Things ", Wiley, 2013.

T2. A Bahaga, V Madiseti, " Internet of Things – Hands on approach", VPT Publisher, 2014

Reference Book(s):

R1. Cuno P fister, "Getting started with Internet of Things", 1st Edition, Maker Media, 2011.

R2. Samuel Greenguard,"Internet of things", MIT Press, 2015.

R3. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw-Hill Education, 2017.

R4. David Hanes, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", Cisco Press, 2017.

Web References:

1. Introduction to Internet of Things – [https://nptel.ac.in/courses/106105166/-](https://nptel.ac.in/courses/106105166/)

2. <https://online.stanford.edu/courses/xee100-introduction-internet-things>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO2	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO3	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO4	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	1	1	-	1	2	-

High-3; Medium-2;Low-1

Course Code: 19ECCN2601		Course Title: Microcontroller And Its Interfacing Techniques	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week)3: 0: 2	Credits:4	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- 19ECCN1302- Digital Principles and System Design

Course Objectives

The course is intended to:

1. Explain the microprocessor and microcontroller architecture.
2. Discuss the microcontroller instruction set with programming concepts
3. Explain the on-chip peripheral interfacing techniques
4. Develop Embedded program for on – chip peripherals-I
5. Develop Embedded program for on – chip peripherals-II

Unit I Introduction to 8-Bit Microprocessor and Microcontroller 9 Hours

Evolution of Microprocessor - 8 bit Microprocessor Architecture, Microprocessor and Microcontrollers, Architecture of 8051- Hardware, input/output pins ports and circuits, timer/counter, serial data input/output, interrupts

Unit II Instruction Set And Programming Techniques 9 Hours

Addressing modes- Data transfer, Arithmetic, logic instructions and programs, Jump, loop and call instructions, Boolean and bit manipulation- Simple Assembly language programs.

Unit III On-Chip Peripherals And Interfacing Techniques 9 Hours

Parallel Port and bit-manipulation programming, timer/counter: Programming 8051 Timers - Counter Programming, Serial Communication: UART-Operating Modes-RS232 Standards- 8051 connection to RS232-Serial Port Programming. Interrupt: Programming timer Interrupts, external hardware interrupts and serial communication interrupts

Unit IV Off-Chip Peripherals Interfacing and Programming- I 9 Hours

LED 7-segment and multiplexing techniques, LCD Interfacing, Push-to-On switch and Matrix Keyboard Interfacing

Unit V Off-Chip Peripherals Interfacing And Programming - II 9 Hours

ADC, DAC and Sensor Interfacing, RTC interfacing, Relay Interfacing, DC Motor, stepper

motor and PWM.

MICROCONTROLLER LABORATORY

30 Hours

Assembly Language:

1. Single byte arithmetic operation using 8051(ADD, SUB, MUL, DIV)
2. Multi-byte arithmetic operation using 8051(ADD, SUB)
3. Sorting of data a) Ascending order b) Descending order
4. Searching a given number in an array

Embedded C:

5. On and Off the LED with time delay using inbuilt timer in 8051
6. Switch and 7 segment display interfacing
7. Transmitting and receiving a byte of data using on-chip UART

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the architecture of 8 bit microprocessor and microcontroller	Understand
CO2: Discuss the 8051 instruction set with programming concepts	Understand
CO3: Explain the various on –chip peripheral and interfacing techniques	Understand
CO4: Develop Embedded 'C' program for Off-Chip Peripherals-I	Apply
CO5: Develop Embedded 'C' program for Off-Chip Peripherals-II	Apply

Text Book(s):

- T1. The 8051 Microcontroller, Kenneth J. Ayala, 3rd Edition, Thompson Delmar Learning, New Delhi, 2007.
- T2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, —The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson education, 2011

Reference Book(s):

- R1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.
- R2. Robert L. Boylestad and Louis Nasheresky, "Electronics Devices and Circuit Theory", 9th Edition, Pearson Education/ PHI, New Delhi 2002.
- R3. David A. Bell, "Electronics Devices and Circuits", 5th Edition, Oxford University Press, 2008
- R4. Sedra/ Smith, "Micro Electronic Circuits" Oxford University Press, 2004.

Web References:

1. <https://nptel.ac.in/courses/117/104/117104072/>
2. <https://nptel.ac.in/courses/108/105/108105102/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	-	2	-	1	2	1
CO2	2	1	-	-	2	-	-	2	-	2	-	1	2	1
CO3	2	1	-	-	2	-	-	2	-	2	-	2	2	1
CO4	3	2	1	1	2	-	-	2	-	2	-	2	2	1
CO5	3	2	1	1	2	-	-	2	-	2	-	2	2	1

High-3; Medium-2; Low-1

Course Code: 19ECPN6601		Course Title: Innovative and Creative Project	
Course Category: Project		Course Level: Practice	
L:T:P(Hours/Week): 0: 0: 4	Credits:2	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Identify the problem statement by doing literature survey
2. Develop a novel solution for the problem statement and design a software/hardware prototype based on the solution
3. Demonstrate time management by following a proper time line to execute the project
4. Effectively communicate the results of projects in a written and oral format

The objective of Project is to enable the student to take up investigative study in the broad field of Electronics and Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignments normally included as given below

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Oral Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Define problem statement in the opted domain by doing statement in the opted domain by doing	Apply
CO2. Develop a novel solution for the identified problem statement with the help of engineering knowledge.	Apply
CO3. Demonstrate time management by following a proper time line to execute the project	Apply
CO4. Design a hardware/software prototype based on the solution developed for the problem.	Create
CO5. Demonstrate the results by making presentations and preparing reports	Apply

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	3	3	3	-	3	-	-	3	3	3
CO2	3	3	3	3	3	3	3	3	3	-	3	3	3	3
CO3	-	-	-	-	-	3	-	3	3	-	3	3	-	-
CO4	3	3	3	3	3	3	3	3	3	-	3	3	3	3
CO5	3	3	-	-	3	3	3	3	3	3	-	3	3	3

High-3; Medium-2; Low-1

Unit IV Interview Etiquette(Netiquette)**6 Hours**

Definition of interview-Types of interview- Prior interview- Know the company - Employer's perspective in interview - Non Verbal etiquette- Dressing - Verbal communication in interview- Facing Rejection in interview - Do's & Don'ts in interview- common interview questions- Handling Stress Questions- Handling Telephonic Interviews

Unit V Leadership skills and Time Management**6 Hours**

Leadership - Leadership Traits - Leadership styles- Types of Leaders- Qualities of a leader- Developing Perspectives

Time Management - Necessary of Time Management - Types of time - Estimation of time - Process of Time Management- Efficient utilization of time - Time wasting culprits - Tips to manage time - Goal setting in Time Management

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Understand the emotions and necessity to handle them	Understand
CO2. Build effective resumes to project the positives to be employable	Apply
CO3. Facilitate collaborative work environment and engage in healthy agreements for building person's professional facet	Understand
CO4. Formulate the growth attribute to outperform, initiate and grow in professional arena	Apply
CO5. Explain time management and impart leadership skills	Understand

Text Book(s)

T1. Thea Kelley."Get That Job! The Quick and Complete Guide to Winning Interview"
Plover crest Press, 2017

Reference Book(s):

- R2. Daniel Goleman. " Emotional Intelligence Reader's Guide", BANTAM PUBLISHERS, 1997
- R3. Daniel Goleman, Richard Boyatzis & Annie McKee, " Primal Leadership :

Unleashing the Power of Emotional Intelligence" Harvard Business Review Press; Anniversary edition, 2013

- R4. Stephen R Covey. " The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" Simon & Schuster , Anniversary edition, 2013

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	-	1	-	1	1	1
CO2	-	-	-	-	-	-	-	-	-	2	-	1	1	1
CO3	-	-	-	-	-	-	-	-	1	1	-	1	1	1
CO4	-	-	-	-	-	-	-	-	1	-	-	1	1	1
CO5	-	-	-	-	-	-	-	1	-	-	1	1	1	1

High-3; Medium-2; Low-1

Semester-VII

Course Code: 19ECCN1701	Course Title: RF and Microwave Engineering		
Course Category: Professional Core	Course Level: Mastery		
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- 19PHBC2001 - Physics for Electrical Sciences
- 19CCN2301 - Transmission line and Wave guides

Course Objectives

The course is intended to:

1. Analyze the given High Frequency networks
2. Classify the Microwave Passive Components
3. Analyze the characteristics of Microwave solid state devices
4. Classify the Microwave tubes and Measuring techniques
5. Design impedance Matching networks

Unit I Two Port Network Theory

9 Hours

Review of Low frequency parameter; Impedance, admittance, hybrid and ABCD parameters- High Frequency parameters, Formulation of S parameters for a Two port network, Scattering Matrix representation of N port network, Properties and proof of S parameters; Reciprocal and lossless Network, Components at high frequencies - Wire, Resistor, Capacitor, Inductor, Transmission lines.

Unit II Microwave Passive Components

9 Hours

Microwave frequency range, Application -Principles of Operation and S Matrix derivation of Microwave junctions: E-plane Tee, H-plane Tee, Magic Tee -Microwave Power Dividers- corners, bends, Twists and matched terminations -Directional couplers- Two hole directional coupler-Phase Shifters -Isolator-Three port Circulator -Attenuator

Unit III Microwave Solid State Devices

9 Hours

Microwave Transistor: Construction and Functionality of FETs, HEMT- Principal of Schottky Barrier diodes - Transferred Electron Devices: Gunn diode- Avalanche Transit time devices; IMPATT Diode - RF MEMS. Parametric devices: Principles of operation, Applications of parametric amplifier -Microwave monolithic integrated circuit (MMIC): Materials and fabrication techniques

Unit IV Microwave Tubes And Measurements

9 Hours

Microwave tubes- High frequency limitations - Principle of operation of two cavities Klystron,

Reflex Klystron, Helix Traveling Wave Tube and cylindrical Magnetron. Microwave measurements: Measurement of VSWR, Power, Impedance and EMI/EMC

Unit V Microwave Amplifier Design And Matching Networks

9 Hours

Amplifier power relation, stability considerations, Stabilization Methods, principle of single stage Transistor Amplifier Design for maximum Gain, Noise figure, Impedance matching network: Impedance Matching Using Discrete Components -T and n matching networks- Microstrip line matching networks

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the given High Frequency network using S Parameters	Analyze
CO2: Classify the Microwave Passive Components based on its operating principle	Apply
CO3: Analyze the characteristics of Microwave solid state devices with its Application	Analyze
CO4: Classify the Microwave tubes and measuring techniques based on device construction	Apply
CO5: Design Impedance matching networks for Single Stage Transistor Amplifiers	Apply

Text Book(s)

T1. Liao, S.Y., "Microwave Devices & Circuits", Prentice Hall of India, 2006

T2. Ludwig, R and Bogdanov, G., "RF Circuit Design: Theory and Applications", Pearson Education, Inc., 2009

Reference Book(s):

R1. Robert E. Collin, "Foundations for Microwave Engineering", 2nd edition, John Wiley & Sons, 2009

R2. Annapurna Das and Das, S.K., "Microwave Engineering", Tata McGraw Hill Inc., 2009

R3. Radmanesh, M.M., "RF & Microwave Electronics Illustrated", Pearson Education, 2007

R4. Pozar, D.M., "Microwave Engineering", 4th Edition John Wiley & Sons, 2012.

R5. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley and Sons Inc., 2009

Web References:

1. <http://home.sandiego.edu/~ekim/e194rfs01/>
2. <http://nptel.ac.in/courses/117105130/>
3. <http://nptel.ac.in/syllabus/117105029/>
4. <http://nptel.ac.in/courses/117101119/23>
5. <http://www.microwaves101.com>
6. <http://www.iec.ch/emc/explained/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	1	1	-	2	2	-
CO2	3	2	1	1	-	-	-	1	1	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	1	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	1	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	1	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ECCN1702		Course Title: Machine Learning	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week): 3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19MBAC1202-Calculus and Transforms
- 19CSCN4401-Python Programming Laboratory
- 19ECCN3502-Data Science Laboratory

Course Objectives

The course is intended to:

1. Describe the types and challenges in Machine learning
2. Illustrate the machine learning framework
3. Interpret the supervised learning techniques
4. Demonstrate the un-supervised learning methods
5. Construct the Neural network and deep learning models

Unit I INTRODUCTION

9 Hours

Introduction to Machine Learning -Types of Machine Learning systems - Challenges in Machine Learning- Over fitting and Under fitting - Testing and Validating the model - Bias and Variance

Unit II MACHINE LEARNING FRAMEWORK

9 Hours

Problem Formulation - Get the data -analyze and visualize the data -Prepare the data for ML algorithms - sample complexity - Hypothesis space -Model evaluation and Improvement :Cross validation - Grid search - Evaluation Metrics -Kernel functions

Unit III SUPERVISED LEARNING

9 Hours

Linear and Logistic Regression -Eigen Values and Eigen vectors - Naive Bayes Classifier :Maximum Likelihood, Minimum Description Length - Gradient Descent- Decision trees - Ensembles of Decision Trees Support Vector Machine (SVM)

Unit IV UNSUPERVISED LEARNING

9 Hours

Clustering :k - Means clustering -Agglomerative Clustering - DBSCAN-Gaussian Mixtures-precision and recall -Collaborative filtering and Content Filtering

Unit V NEURAL NETWORK AND DEEP LEARNING

9 Hours

Biological Neuron -Logical computation with Neuron -Perceptron -Sigmoid and softmax functions-Multi Layer Perceptron (MLP)with Back propagation -Regression MLPs - Classification MLPs - Fine Tuning NN models - Convolutional Layers - Stacking Multiple Feature Maps - CNN architectures

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Describe the types and challenges in Machine learning for exploring the machine learning concepts	Understand
CO2.Illustrate the machine learning framework for implementation of machine learning projects	Apply
CO3.Interpret the supervised learning techniques for classification	Apply
CO4.Demonstrate the un-supervised learning methods for clustering and classification	Apply
CO5.Construct the Neural network and deep learning models for classification	Apply

Text Book(s)

T1.AurelienGeron,"Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Second edition ,O'Reilly Media Inc,2019

T2.Andress C.Muller and Sarah Guido , Introduction to Machine Learning with Python a Guide for Data Scientists ',First Edition ,O'Reilly,2017

Reference Book(s):

R1. Ethem Alpaydin,"Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series),3rd Edition,MIT press ,2014

R2. Jason Bell, "Machine learning - Hands on for Developers and Technical Professionals", 1st Edition,Wiley,2014

R3. Peter Flach, "Machine Learning: The Art and Science of Alogorithms that Make Sense of data", 1st Edition, Cambridge University Press,2012

Web References:

1. <https://www.kaggle.com/kanncaa1/machine-learning-tutorial-for-beginners>
2. <https://nptel.ac.in/courses/160/160160139/>
3. <https://archive.ics.uci.edu/ml/datasets.php>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ECCN3701		Course Title: RF and Microwave Laboratory	
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 0 :0 :3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19PHBC2001 -Physics for Electrical Sciences
- 19ECCN2301 -Transmission Line and wave Guides
- 19ECEN1003 -Antenna and Wave Propagation

Course Objectives

The course is intended to:

- 1.Measure the losses in optical fibre and its numerical aperture
- 2.Examine the characteristics of optical sources
- 3.Analyze the working Principal of Microwave sources
- 4.Analyze the characteristics of optical fibre.
- 5.Measure the performance parameters of microwave components and devices

LIST OF EXPERIMENTS

1. Measurement of Numerical Aperture and bending losses in Optical Fiber.
 2. Measurement of power Distribution in directional coupler and Magic tee.
 3. VI characteristics of LED and LASER Diode.
 4. Characteristics of Gunn diode Oscillator.
 5. characteristics of Reflex Klystron Oscillator
 - 6.Measurement of Antenna parameters and RF passive component characteristics using Vector Network Analyzer
 7. Radiation pattern measurement of Horn Antenna.
 8. Optical Time Domain Reflect meter.
 9. Design of low pass and high pass filters using ADS
 - 10.Discover the source of EMI emission in With near- field probes
-

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Measure the losses in optical fiber its numerical aperture	Analyze
CO2:Examine the characteristics of optical sources used in optical communication systems	Analyze
CO3: Analyze the working Principle of Microwave sources with its design	Analyze
CO4: Analyze the characteristics if optical fiber using OTDR	Analyze
CO5: Measure the performance parameters of microwave Components and devices using an appropriate equipment	Analyze

Reference Book(s):

Lab manual prepared by the department.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO2	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO3	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO4	3	3	2	2	3	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	3	-	-	2	3	2	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ECCN3702		Course Title: VLSI Laboratory	
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 0 :0 ;3	Credits:1.5	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- 19ECCN1302- Digital Principles and System Design

Course Objectives

The course is intended to:

- 1.Design and simulate Combinational and sequential Circuits.
- 2.Design and Verify Combinational and sequential circuit.
- 3.Implement Combinational and sequential circuit on FPGA.
- 4.Design and simulate inverter and universal gates using SPICE too.

LIST OF EXPERIMENTS:

- 1.Design and Simulate of Adders (4 bit Half adder, 4 bit full adder, 4 bit Ripple carry adder).
- 2.Design and Simulation of Flip-Flops.(S-R Flip-Flops, JK Flip-Flops, D Flip-Flops,T Flip-Flops).
3. Design & Verification of 4bit Adder using System verilog.
4. Design & Verification of D flipflop using system verilog
- 5.FPGA Implementation of 4 bit Synchronous Counter.
- 6.FPGA Implementation of 4 bit Asynchronous Counter.
- 7.Schematic design and simulation of Inverter
- 8.Schematic design and simulation of 2 input NAND and NOR gate.
- 9.Layout Design of Inverter.
- 10.Layout Design of 2 input NAND and NOR gate.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Develop and verify functionality of Combinational and sequential circuits.	Apply
CO2.Solve errors in Combinational and Sequential circuit design.	Apply
CO3.Apply FPGA implementation for combinational and sequential circuits.	Apply
CO4.Construct and simulate inverter and universal gates using SPICE tool.	Apply
CO5.Model physical design of inverter and universal gates using SPICE tool	Apply

Reference Book(s):

1. "VLSI Laboratory manual ", prepared by the ECE department.
- 2.Morris Mano.M, "Digital Design", 3rd edition, prentice Hall of India Pvt.ltd, Education Pvt.Ltd,2003.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	-	-	2	3	2	-	2	1	3
CO2	3	3	2	2	3	-	-	2	3	2	-	2	1	3
CO3	3	3	2	2	3	-	-	2	3	2	-	2	1	3
CO4	3	3	2	2	3	-	-	2	3	2	-	2	1	3
CO5	3	3	2	2	3	-	-	2	3	2	-	2	1	3

High-3; Medium-2; Low-1

Semester VIII

Course Code: 19ECPN6801	Course Title: Project		
Course Category: Project		Course Level: Practice	
L:T:P(Hours/Week):0: 0: 16	Credits:8	Total Contact Hours:240	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Identify the problem statement by doing literature survey
2. Develop a novel solution for the problem statement and design a software/hardware prototype based on the solution
3. Demonstrate time management by following a proper time line to execute the project
4. Effectively communicate the results of projects in a written and oral format

The objective of Project is to enable the student to take up investigative study in the broad field of Electronics and Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignments normally included as given below:

1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Oral Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Define problem statement in the opted domain by doing literature survey	Apply
CO2: Develop a novel solution for the identified problem statement with the help of engineering knowledge	Apply
CO3: Manage time by following a proper planning to execute the project	Apply
CO4: Design a hardware/software prototype based on the solution developed for the problem	Create
CO5: Demonstrate the results by making presentations and preparing reports	Apply

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	3	3	3	-	3	-	-	3	3	3
CO2	3	3	3	3	3	3	3	3	3	-	3	3	3	3
CO3	-	-	-	-	-	3	-	3	3	-	3	3	-	-
CO4	3	3	3	3	3	3	3	3	3	-	3	3	3	3
CO5	3	3	-	-	3	3	3	3	3	3	-	3	3	3

High-3; Medium-2; Low-1

NETWORKING ELECTIVES

Course Code:19ECEN1001	Course Title: Computer Communication Networks		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ITSN2302 - Data Structures and Algorithms - I

Course Objectives

The course is intended to:

1. Compare the layers of OSI model with TCP/IP protocol suite.
2. Illustrate error control techniques in networks.
3. Analyze the network routing algorithms.
4. Apply the congestion control algorithms in Communication networks.
5. Analyze the Application layer services.

Unit I Physical Layer

9 Hours

Data Communications – Network Edge - Network Core – Performance metrics - Networks models: OSI model – TCP / IP protocol suite – Addressing – Transmission Media: Twisted pair, Coaxial Cable – Error detection: Parity Checks, Cyclic Redundancy Check (CRC)

Unit II Data Link Layer

9 Hours

Framing – Flow Control and Error control techniques: Stop and wait – Go back N ARQ – Selective repeat ARQ – sliding window techniques – Multiple Access Techniques: Random access protocol, Controlled access protocol – Ethernet: IEEE 802.3 – Wireless LANS: IEEE802.11.

Unit III Network Layer

9 Hours

Internetworking devices: hub, repeater, bridge, switch, router, Gateway – Basic Internetworking (IP, ARP, DHCP, ICMP), IPV4, IPV6 – Routing: Link State Routing, Distance Vector Routing

Unit IV Transport Layer**9 Hours**

Process – to – Process delivery – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control -Quality of services (QoS) – Techniques to improve QoS– Integrated Services – Differentiated Services.

Unit V Application Layer**9 Hours**

Traditional Applications: Domain Name System (DNS) – E-mail (MIME, SMTP, POP3, IMAP) – WWW – HTTP – SNMP – Telnet.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Compare the layers of OSI model with TCP/IP protocol suite using their functions	Understand
CO2. Illustrate error control techniques in networks using appropriate Protocols	Understand
CO3. Analyze the network routing algorithms using appropriate protocols	Analyze
CO4. Apply the congestion control algorithms in Communication Networks to improve the quality of service	Apply
CO5. Analyze the Application layer services based on its protocols.	Analyze

Text Book(s)

- T1. Behrouz A. Forouzan, “Data communication and Networking”, 4th edition, Tata McGraw- Hill, 2007
- T2. James .F. Kurose & Keith W. Ross, “Computer Networking: A Top down Approach Featuring the Internet”, 3rd Edition, Pearson Education, 2007

Reference Book(s):

- R1. Andrew S. Tanenbaum, “Computer Networks”, Pearson Education, 4th Edition, 2003.
- R2. Larry L.Peterson and Peter S. Davie, “Computer Networks” 4th edition, Harcourt Asia Pvt. Ltd, 2007.
- R3. Wayne Tomasi, “Introduction to Data Communication and Networking”, 1st Edition, Pearson Education, 2007.
- R4. William Stallings, “Data and Computer Communication”, 8th Edition, Pearson Education, 2007.

Web References:

1. <https://nptel.ac.in/courses/106/105/106105183>
2. <http://www.cse.iitk.ac.in/users/dheeraj/cs425>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	2	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	2	-	-	1	-	1	-	2	2	-

Course Code: 19ECEN1010		Course Title: Cryptography and Network Security	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week): 3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19MABG1401 - Probability and Statistics

Course Objectives

The course is intended to:

1. Apply evolutionary encryption and decryption techniques
2. Apply the concept of number theory
3. Analyze the role of MAC functions
4. Explain the various authentication algorithms
5. Identify an appropriate security system

Unit I Introduction to Cryptography 9 Hours

Security goals – Cryptographic attacks – Services and mechanisms – Classical encryption techniques – Block Cipher Design Principles and Modes of Operation – Data Encryption Standard – Triple DES, Advanced Encryption Standard.

Unit II Number Theory and Public Key Cryptography 9 Hours

Introduction to number theory: Prime numbers, Fermat and Euler's theorem, testing of primality, Chinese Remainder theorem, Quadratic Congruence, Exponentiation and logarithm –Public Key Cryptography and RSA – Key management: Diffie-Hellman key Exchange.

Unit III Authentication and Hash Function 9 Hours

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions –Security of Hash Functions and MACs – MD5 message Digest Algorithm – Secure Hash Algorithm.

Unit IV Network Security 9 Hours

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME – IP Security – ISAKMP.

Unit V System Level Security**9 Hours**

Worms, Viruses, Intrusion Detection System(IDS) – Firewall Design Principles, Case Studies: Single Sign On(SSO), Denial of Service attack(DoS), IP spoofing attack.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Apply known encryption and decryption techniques for network security.	Apply
CO2. Apply the concept of number theory in cryptography.	Apply
CO3. Analyze the role of MAC functions in information security.	Analyze
CO4. Explain the various authentication algorithms for network security.	Understand
CO5. Identify an appropriate security system to provide system level security.	Apply

Text Book(s)

- T1. William Stallings, "Cryptography and Network Security - Principles and Practice", Prentice Hall of India, 3rd Edition, 2003
- T2. Behrouz A Forouzan, "Cryptography and Network Security", Tata McGraw Hall, 2nd Edition, 2011

Reference Book(s):

- R1. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
- R2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms and Source Code in C",
- R3. John Wiley and Sons Inc, 2nd edition, 1996
- R4. Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", 3rd Edition, Pearson Education, 2003

Web References:

1. <https://nptel.ac.in/courses/106/105/106105162/>
2. <https://www.cse.iitk.ac.in/users/braman/cs425/slides/security-overview.pdf>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	2	1	1	2	-	-	1	-	1	-	2	2	-
C02	3	2	1	1	-	-	-	1	-	1	-	2	2	-
C03	3	3	2	2	-	-	-	1	-	1	-	2	2	-
C04	2	1	-	-	-	-	-	1	-	1	-	2	2	-
C05	3	2	1	1	2	-	-	1	2	1	-	2	2	-

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the basic concepts of WSN and applications	Understand
CO2. Explain the wireless sensor technology	Understand
CO3. Analyze various Medium access and routing protocols for WSN	Analyze
CO4. Analyze various Transport control protocols for WSN	Analyze
CO5. Explain the operating system design issues and performance of WSN	Understand

Text Book(s)

- T1.Kazem Sohraby, Daniel Minoli, Taieb Znati "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley interscience, 2007
- T2.Waltenegus Dargie , Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory And Practice", John Wiley & Sons Publications ,2011

Reference Book(s):

- R1.Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication, 2nd edition, 2009
- R2.Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004
- R3. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009

Web References:

1. <https://www.intechopen.com/books/wireless-sensor-networks-technology-and-protocols/overview-of-wireless-sensor-network>
2. <http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	-
CO3	3	3	2	2	-	-	-	1	-	1	-	1	1	-
CO4	3	3	2	2	-	-	-	1	-	1	-	1	1	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	-

Unit V – Spectrum Awareness**9 Hours**

Interference avoidance problem, cognitive radio role, spectrum sensing, Channel awareness and multiple signals in space, adaptive spectrum implications for Cognitive Radio hardware.

Course Outcomes:	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the basics of the Software defined Radio using its functional architecture.	Understand
CO2: Explain the concepts Software defined radio architecture and spectrum management in Software defined Radio	Understand
CO3: Identify the need for cognitive radio communication technologies	Understand
CO4: Explain the concept of Cognitive Radio Architecture and their functions	Understand
CO5: Analyze the impact of interference in Cognitive Radio	Analyze

Text Book(s):

- T1. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
- T2. Software Radio: A Modern Approach to Radio Engineering by Jeffrey H. Reed
Pearson Education, 2002.

Reference Book(s):

- R1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley and Sons Ltd.2000.
- R2. Thomas W. Rondeau, Charles W. Bostain,"Artificial Intelligence in Wireless communication", ARTECH HOUSE, 2009.
- R3. Markus Dillinger, KambizMadani, Nancy Alonistiotic," Software Defined Radio", John Wiley, 2003.
- R4. Alexander M. Wyglinski, Maziarnekov, Y.ThomasHu,"Cognitive Radio Communication and Networks", Elsevier, 2010.

Web References:

- 1. http://link.springer.com/chapter/10.1007/978-1-4020-5542-3_2

2. <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4644051>

Course Articulation matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	-	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	-	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	-	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	-	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	-	2	-

Course Code: 19ECEN1028		Course Title: Advanced Networking Technologies	
Course Category:	Professional Elective	Course Level: Mastery	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECEN1001 - Computer Communication Networks

Course Objectives

The course is intended to:

1. Explain the difference and security issues of IPV6 & IPV4
2. Explain the need for MPLS based VPN
3. Analyze the QOS requirements in multimedia applications
4. Explain the various client layers of Synchronous optical networks
5. Explain the various survivability techniques used in WDM networks

Unit I Internetworking

9 Hours

IPV6-Design Issues-scalability - Addressing – headers – Routing - Auto configuration -IPV4 Vs IPV6, Transition from IPV4 to IPV6 – Interoperability - QOS in IPV6 - Multicast report - ICMPV6 - Security in IPV6

Unit II MPLS and VPN

9 Hours

Virtual private network-Remote access VPN, site-to-site VPN, tunneling and PPP, Security in VPNs, Multiprotocol Label Switching-MPLS operation, Routing in MPLS domains, Tunneling and use of FEC, Traffic engineering, MPLS based VPNs.

Unit III Quality of Service

9 Hours

Application requirements – VOIP - RT video conferencing - Entertainment video - QOS taxonomy - Resource allocation – Scheduling - Queuing disciplines - Integrated Services - Differentiated Services – RSVP

Unit IV Client Layers of the Optical Networks

9 Hours

SONET/SDH- Multiplexing, VCAT and LCAS, SONET/SDH layers, SONET frame structure, SONET/SDH Physical layer, Elements of a SONET/SDH Infrastructure- Optical transport Network – Frame structure , Multiplexing – Generic framing procedure.

Unit V WDM Networks**9 Hours**

WDM: Traffic grooming WDM-Network survivability- Survivability techniques or optical WDM networks-Restoration strategies in optical WDM networks

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the difference and security issues of IPV6 & IPV4	Understand
CO2. Explain the need for MPLS based VPN	Understand
CO3. Analyze the QOS requirements in multimedia applications	Analyze
CO4. Explain the various client layers of Synchronous optical networks	Understand
CO5. Explain the various survivability techniques used in WDM networks	Understand

Text Book(s)

- T1. Larry L.Peterson, Bruce S.Davie, "Computer Networks A Systems Approach", Fifth edition, Morgan Kaufmann publishers, 2011
- T2. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Third Edition, Morgan Kaufmann publishers, 2010.

Reference Book(s):

- R1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, 1st Edition, 2002
- R2. J.F. Kurose and K.W. Ross, "Computer Networking- A top down approach Featuring the internet", Pearson, 2nd edition, 2003
- R3. Hersent Gurleand Petit, "IP Telephony, packet Pored Multimedia Communication Systems", Pearson education, 2003.
- R4. Nader F.Mir , "Computer and Communication Networks", 1st edition, Pearson education, 2003.

Web References:

- 1.http://www.networktutorials.info/networkhowto/what_is_optical_networking.html
- 2.<https://www.cse.iitb.ac.in/~varsha/allpapers/network-misc/mplsvpns.pdf>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	-

Course Code:19ECEN1004		Course Title: High Speed Networks	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECEN1001- Computer Communication Networks

Course Objectives

The course is intended to:

1. Describe ATM and Frame relay operation
2. Analyse the queuing models
3. Explain TCP and ATM Congestion Control Techniques
4. Explain the architecture of Integrated and Differentiated Services
5. Identify different protocols for Quality of Service

Unit I Introduction to High Speed Networks 9 Hours

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

Unit II Congestion and Traffic Management 9 Hours

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control

Unit III TCP and ATM Congestion Control 9 Hours

TCP Flow control – TCP Congestion Control — KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes –Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management

Unit IV Integrated and Differentiated Services 9 Hours

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services.

Unit V Protocols for QoS Support**9 Hours**

RSVP – Goals and Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching–Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Describe ATM and Frame relay operation of high speed networks	Understand
CO2. Analyse queuing models for congestion and traffic management using congestion control techniques	Analyze
CO3. Explain TCP and ATM Congestion Control Techniques using algorithms and traffic management techniques	Understand
CO4. Explain the architecture of Integrated and Differentiated Services	Understand
CO5. Identify the different protocols for Quality of Service support for different applications	understand

Text Book(s)

- T1. William Stallings, “High Speed Networks and Internet”, Pearson Education, 2nd Edition, 2002.
- T2. Uyles Black: MPLS and Label Switching Networks, Pearson Education, 2nd Edition, 2001

Reference Book(s):

- R1. Jean Walrand, Pravin Pratap Varaiya, “High performance communication networks”, 2nd Edition, Jean Harcourt Asia Pvt. Ltd., 2001.
- R2. Irvan Pepelnjk, Jim Guichard, Jeff Apcar, “MPLS and VPN architecture”, Cisco Press, Volume I and II, 2003.
- R3. Sumit Kasera and Pankaj Sethi, “ATM Networks Concepts and Protocols”, 2nd Edition, Tata McGraw-Hill- New Delhi, 2006.
- R4. Rainer Handel, Manfred N.Huber and Stefan Schroder, “ATM Networks”, 3rd Edition, Pearson Education Asia, 2002.

Web References:

1. <http://nptel.ac.in/courses/106105081/1>
2. <http://nptel.ac.in/courses/106105082/30>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

RF TECHNOLOGIES ELECTIVES

Course Code: 19ECEN1005		Course Title: Electromagnetic Interference and Compatibility	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19PHBC2001 – Physics for Electrical Sciences
- 19ECCN2301- Transmission Lines and Wave Guides

Course Objectives

The course is intended to:

1. Identify various sources of EMI and their impacts on society.
2. Discuss various EMI coupling techniques in Electromagnetic Environment
3. Differentiate the various EMI mitigation techniques
4. Select a suitable EMC standard for given products
5. Choose an appropriate EMI measurement techniques for given products

Unit I Basics Of EMI/ EMC Concepts

9 Hours

Definition of EMI and EMC, Intra and Inter system EMI, Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility, Transient and ESD, Case Histories: Radiation Hazards to humans

Unit II Coupling Mechanism

9 Hours

Coupling: Common mode coupling- Differential mode coupling- Common impedance coupling- Ground loop coupling, Field to cable coupling, Cable to cable coupling, Power mains and Power supply coupling.

Unit III EMI Control Techniques

9 Hours

Shielding – principle, choice of materials for H, E and free space fields and thickness, EMI gaskets, Bonding, Grounding: circuits- system and cable grounding, Filtering, Transient EMI control devices and applications, PCB Zoning, Component selection, mounting, trace routing.

Unit IV Standards and Regulation**9 Hours**

National and International standardizing organizations, Common EMC Standards: FCC, CISPR, ANSI, Frequency assignment, spectrum conversation

Unit V EMI Measurements**9 Hours**

Open area test site, TEM cell, EMI test shielded chamber and shielded ferrite lined anechoic Chamber, Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors, EMI Rx and Spectrum analyser.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify various sources of EMI and their impacts on society.	Apply
CO2: Discuss various EMI coupling techniques in Electromagnetic Environment	Understand
CO3: Differentiate the various EMI mitigation techniques	Apply
CO4: Select a suitable EMC standard for given products	Apply
CO5: Choose an appropriate EMI measurement techniques for given products	Apply

Text Book(s):

- T1. Kodali V. P., "Engineering EMC Principles, Measurements and Technologies", 2nd edition, IEEE Press, Newyork, 2001.
- T2. Henry W. Ott. "Electromagnetic Compatibility Engineering", 1st edition John Wiley and Sons Inc., 2009

Reference Book(s):

- R1. Keiser B., "Principles of Electromagnetic Compatibility", 3rd edition, Artech house, Norwood, 1987.
- R2. Archambeault B. R., BrenchC. And Ramahi O. M., "EMI/EMC Computational Modeling Handbook", 2nd edition, Springer, 2001.
- R3. Paul R. C., "Introduction to Electromagnetic compatibility", 2nd edition, Wiley India PVT Limited, 2010.
- R4. Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", 1st edition ,John Wiley and Sons Inc., 1997.

Web References:

- 1. https://www.nasa.gov/centers/johnson/pdf/639521main_EMI EMC_User_Test_Planning_

Guide.pdf

2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/>
3. <http://www.iec.ch/emc/explained/>
4. <https://www.dare.eu/testing/emc>
5. https://onlinecourses-archive.nptel.ac.in/noc19_ee17/course

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	1	1	-	1	-	2	2	-
CO2	2	1	-	-	-	1	1	1	-	1	-	2	2	-
CO3	3	2	1	1	-	1	1	1	-	1	-	2	2	-
CO4	3	2	1	1	-	1	1	1	-	1	-	2	2	-
CO5	3	2	1	1	-	1	1	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the cellular concepts with respect to technology.	Understand
CO2: Understand the working principles of mobile signals, how they are generated and propagated.	Understand
CO3: Analyze and understand the best sustainable multiple access techniques for effective communication.	Analyze
CO4: Analyze the antenna for mobile communication.	Analyze
CO5: Analyze the antenna receiver technology with characteristics features.	Analyze

Text Book(s)

- T1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1998.
- T2. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, Second Edition, 2000

Reference Book(s):

- R1. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, Second Edition, 1993
- R2. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995
- R3. VK Garg, Wireless Communication & Networking, The Morgan Kaufmann Series in Networking

Web References:

- 1. <https://nptel.ac.in/courses/117/102/117102062/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	-	3	-
CO2	2	1	-	-	-	-	-	1	-	1	-	-	3	-
CO3	3	3	2	2	-	-	-	1	-	1	-	-	3	-
CO4	3	3	2	2	-	-	-	1	-	1	-	-	3	-
CO5	3	3	2	2	-	-	-	1	-	1	-	-	3	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1027		Course Title: OFDM and MIMO Concepts	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501-Analog and Digital Communication
- 19MABG1401- Probability and Statistics

Course Objectives

The course is intended to:

1. Explain the concepts of OFDM technique
2. Analyze Orthogonal Frequency Division Multiple Access Techniques
3. Apply the diversity principles
4. Analyze various channel models
5. Analyze the multiuser MIMO model

Unit I Introduction to OFDM

9 Hours

Orthogonal Frequency Division Multiplexing(OFDM): Basics, Generation of Subcarriers using IFFT, Guard Time and Cyclic Extension, Windowing, Choice of OFDM Parameters, OFDM Signal Processing, Implementation Complexity of OFDM Versus Single carrier Modulation.

Unit II Orthogonal Frequency Division Multiple Access

9 Hours

Introduction to Multiple Access Techniques, OFDMA, Frequency Hopping OFDMA, Differences between OFDMA and MC-CDMA, OFDMA System Description, Application of OFDM- Digital Radio Broadcasting, IEEE 802.11, HiperLAN/2, MMAC WLAN standard.

Unit III Antenna Diversity and Space-Time Coding Techniques

9 Hours

Antenna Diversity, Space-Time Coding (STC): Overview- System Model, Pairwise Error ProbabilitySpace-Time Code Design, Space-Time Block Code (STBC)-Alamouti Space-Time Code, Generalization of Space-Time Block Coding, Decoding for Space-Time Block Codes, Space-Time Trellis Code.

Unit IV Wireless Channel Models**9 Hours**

SISO Channel Model: Indoor Channel Models - IEEE 802.11 Channel Model, UWB Channel Model, Outdoor Channel Models-FWGN Model, Frequency-Selective Fading Channel Model, SUI Channel Model, MIMO Channel Models - Statistical MIMO Model - Spatial Correlation, I-METRA MIMO Channel Model.

Unit V MULTIUSER MIMO**9 Hours**

Mathematical Model for Multi-User MIMO System, Channel Capacity of Multi-User MIMO System- Capacity of MAC, Capacity of BC, Transmission Methods for Broadcast Channel- Channel Inversion, Block Diagonalization, Dirty Paper Coding (DPC), Tomlinson-Harashima Precoding

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the concepts of OFDM technique in Wireless Communication	Understand
CO2. Analyze Orthogonal Frequency Division Multiple Access Techniques in modern Communication systems	Analyze
CO3. Apply the diversity principles for Multiuser Communication	Apply
CO4. Analyze various channel models for Wireless Communication	Analyze
CO5. Analyze the multiuser MIMO model using different coding schemes	Analyze

Text Book(s):

- T1. Nee Richardvan, Prasad Ramjee, "OFDM For Wireless Multimedia Communications" Artech House, 2000.
- T2. Cho Yong Soo et al, "MIMO OFDM Wireless Communications with Matlab", John Wiley & Sons, 2011

Reference Book(s):

- R1. Ramjee Prasad, "OFDM for Wireless Communications Systems", Universal personal communications, 2004
- R2. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press, 2005
- R3. Andreas F. Molisch, "Wireless Communications", 2nd Edition, John Wiley and Sons, 2011.

R4. Ezio Biglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, "MIMO Wireless Communications", Cambridge University Press, 2008.

R5. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

R6. Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 2005.

Web References:

1. <https://ep.jhu.edu/programs-and-courses/525.735-mimo-wireless-communications>
2. <http://nptel.ac.in/courses/117104115/>
3. www.ee.iitm.ac.in/~giri/pdfs/EE6002/book-cho
4. www.keysight.com/upload/cmc_upload/All/20Sept2012Webcast.pdf

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ECEN1006		Course Title: Bluetooth Technology	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Explain the basic operation of Bluetooth.
2. Classify Bluetooth protocol and its functions.
3. Analyze the various operational parameters.
4. Explain the functions of logical link control and adaptation protocol
5. Illustrate the various security methods

Unit I Basic Concepts

9 Hours

Bluetooth: Origin and Advantages – Technology – Topology – Problems - Basic Concepts: Spread Spectrum - Circuit and Packet Switching - Time Division duplexing - Physical Links - Peeking into Packets - Bluetooth Packets - Logical Channels - Client Server Architecture - Service Discovery.

Unit II Bluetooth Protocol Architecture

9 Hours

Bluetooth network Architecture - Open System Interconnection - Bluetooth Protocol Stack - Bluetooth core Protocols - Cable Replacement Protocols - Adopted Protocols - Usage Models and Profiles.

Unit III Bluetooth Link Management

9 Hours

Types of PDUs - Authentication – Pairing - Changing the Link Key – Encryption - Clock offset request - Timing accuracy information Request - LMP version - Switching of Master-Slave Role - Name Request - Detach - Hold mode - Sniff mode - Park Mode - Power Control – QoS - Paging Scheme - Link Supervision - Connection establishment - Test Modes.

Unit IV Logical Link Control**9 Hours**

L2CAP Functions: Basic operation - State Machine - Data packet format – Signaling - Configuration Parameter Options - Service primitives.

Unit V Bluetooth Security**9 Hours**

Security Modes: Link level security – Implementation - Architecture overview - Security level of Services - Connection setup - Connectionless L2CAP - Security Manager - Interface to L2CAP - Interface to other Multiplexing Protocols.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the basic operation of Bluetooth using its architecture.	Understand
CO2. Classify Bluetooth protocol and its functions for the interactive services between various interconnected devices.	Analyze
CO3. Analyze the various operational parameters of Bluetooth link.	Analyze
CO4. Explain the functions of logical link control and adaptation protocol in Bluetooth baseband specification.	Understand
CO5. Illustrate the various security methods used in Bluetooth technology.	Understand

Text Book(s):

T1.Nathan J Muller, “Bluetooth Demystified”,1st Edition, Tata McGraw-Hill, New Delhi, 2001.

T2.Brent A. Miller, Chatschik Bisdikian “Bluetooth Revealed”, 2nd Edition, Prentice Hall, 2001

Reference Book(s):

R1. Jennifer Bray and Charles F. Sturman, “Bluetooth 1.1 Connect without Cables”, 2nd edition, Prentice Hall, 2006.

R2. Christian Gehrmann, Joakim Persson, Ben Smeets, “Bluetooth security”, 1st edition, Arch tech House Inc, 2004.

R3. C.S.R.Prabhu, A.Prathap Reddi, “Bluetooth Technology and its Applications with Java and J2ME”, 1st edition, Prentice -Hall of India Private Limited, New Delhi, 2004

R4. Robert Morrow, “Bluetooth operation and Use”, 1st edition, McGraw-Hill, 2002.

Web References:

1. <http://www.nptel.ac.in/courses/106105080>
2. <http://www.engineersgarage.com/articles/bluetooth-technology>
3. <http://searchmobilecomputing.techtarget.com/definition/Bluetooth>
4. <https://www.bluetooth.com>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1036		Course Title: RF Circuit Design	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week):2:0:2	Credits:3	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- 19PHBC2001 - Physics for Electrical Sciences
- 19ECCN2301 - Transmission lines and Wave guides

Course Objectives

The course is intended to:

1. Perform Transmission line analysis
2. Design Matching circuits and Biasing networks
3. Apply High Frequency concepts to active RF Components
4. Design RF filters
5. Design RF oscillators and mixers

Unit I **Transmission Line Analysis** **9 Hours**

Importance of Radio Frequency Design-RF Behaviour of passive components-Chip components and circuit board considerations-Examples of Transmission lines-Equivalent circuit representation-Microstrip Transmission lines-Terminated Lossless transmission line-Special Termination conditions

Unit II **Matching and Biasing networks** **9 Hours**

Smith Chart and its applications-Parallel and Series Connections-Impedance matching using Discrete components –Microstrip line matching networks-Amplifier classes of operation and Biasing networks

Unit III **Active RF Components** **9 Hours**

Semiconductor Basics-RF Diodes-Bipolar-Junction Transistor-RF Field effect transistors-High Electron Mobility Transistors-Diode Models

Unit IV **RF Filter Design** **9 Hours**

Basic Resonators and Filter Configurations-Filter types and parameters-Low pass filter-High pass filter-Band pass and Band stop filters-Insertion loss-Filter Implementation

Unit V Oscillators and Mixers**9 Hours**

Basic Oscillator model: Negative resistance oscillator-Feedback Oscillator design-Design steps-Quartz Oscillators-High Frequency Oscillator Configuration-Fixed frequency oscillators-Voltage Controlled Oscillator-Basic Characteristics of Mixers-Single ended Mixer Design-Single balanced mixer

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Perform Transmission line analysis at High Frequencies	Analyze
CO2. Design Matching circuits and Biasing networks for RF applications	Apply
CO3. Apply High Frequency concepts to active RF Components	Apply
CO4. Design RF filters for microwave frequency applications and Verify the filter specifications using simulation tool	Analyze
CO5. Design RF oscillators and mixers for the development of modern communication systems and wireless technologies	Apply

Text Book(s)

- T1. R. Ludwig and P. Bretchko, "RF Circuit Design-Theory and Applications", Pearson Education, Second Edition, 2008.
T2. D.M.Pozar, "Microwave Engineering", Wiley India Limited, Third Edition, 2007

Reference Book(s):

- R1. Matthew.M.Radmanesh, "Radio Frequency and Microwave Electronics Illustrated", Pearson Education, First impression, 2006
R2. Charles E. Free, Colin S. Aitchison, "RF and Microwave Circuit Design: Theory and Applications" Wiley, First edition, 2021

Web References:

1. <https://nptel.ac.in/courses/117101119>
2. <https://nptel.ac.in/courses/108101112>

List of Experiments

30 Hours

1. Design of planar transmission lines and analyze its characteristics using ADS
2. Design of impedance matching circuit for 2.4GHz RF application using ADS
3. Design and Simulation of Low Noise Amplifier
4. Design of RF filters and verification of filter specifications using ADS
5. Design and Simulation of RF oscillator
6. Design and Simulation of RF Mixer circuit

Course Articulation matrix

[illegible]

Course Code: 19ECEN1037		Course Title: Millimeter Wave Communication	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19PHBC2001 - Physics for Electrical Sciences
- 19ECCN2301 - Transmission lines and Wave guides
- 19ECCN1501-Analog and Digital Communication

Course Objectives

The course is intended to:

1. Apply the Millimeter wave characteristics
2. Analyze the devices and circuits used for Millimeter wave communication
3. Apply the knowledge of Modulation techniques
4. Apply the diversity concepts in MM Wave MIMO communication
5. Analyze the Millimeter wave antenna types

Unit I Introduction

9 Hours

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

Unit II MM Wave Devices and Circuits

9 Hours

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

Unit III MM Wave Communication Systems

9 Hours

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

Unit IV MM Wave MIMO Systems**9 Hours**

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation

Unit V Antennas for MM Wave Systems**9 Hours**

Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Apply the Millimeter wave characteristics for Radio Wave Propagation	Apply
CO2. Analyze the devices and circuits used for Millimeter wave generation and amplification	Analyze
CO3. Apply the knowledge of Modulation techniques for the design of Millimeter wave communications	Apply
CO4. Apply the diversity concepts in the design of Millimeter wave MIMO communication systems	Apply
CO5. Analyze the antenna types for Millimeter wave communication systems	Analyze

Text Book(s)

T1. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011

T2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014

Reference Book(s):

R1. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.

Web References:

1. [/http://nptel.ac.in/courses/117105130/](http://nptel.ac.in/courses/117105130/)

Course Articulation matrix

[illegible]

COMMUNICATION ELECTIVES

Course Code: 19ECEN1003		Course Title: Antenna and Wave Propagation	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN2301- Transmission Lines and Waveguides
- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Analyze the power radiation from dipole antennas.
2. Analyze Antenna Arrays.
3. Analyze the working principle of aperture antennas.
4. Select an appropriate antenna for the given application.
5. Analyze the propagation of radio waves.

Unit I Antenna Fundamentals & Dipole Antennas 9 Hours

Fundamental concepts: Radiation pattern – Radiation Intensity- Radiation Resistance – Beam Solid Angle – Antenna gain – Directivity – Efficiency – Beamwidth – Near and Far Field regions- Effective Aperture. Radiation from Dipole antennas - Principle of Loop antenna.

Unit II Antenna Arrays 9 Hours

Types of antenna arrays- Broadside array, End fire array, Hansen- Woodyard end fire array, Parasitic array, Binomial array.

Unit III Aperture Antennas 9 Hours

Huygen's Principle – Slot antenna – Radiation from sectorial and pyramidal horn antennas – Comparison between slot antenna and horn antenna - Parabolic reflector and its feed systems.

Unit IV Special Antennas**9 Hours**

Log Periodic Dipole Array – Helical antenna – Rhombic antenna – Microstrip patch antenna: Characteristics and feeding methods – Smart Antenna: Concept and benefits, fixed-weight beam forming & Adaptive beam forming.

Unit V Radio Wave Propagation**9 Hours**

Ground wave propagation: Attenuation characteristics for ground wave propagation – wave tilt. Sky wave Propagation: Structure of ionosphere – Critical frequency – Virtual height – skip distance – Refractive index- MUF. Space wave propagation: Calculation of LOS distance and field strength at a distance- Duct Propagation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Analyze the power radiation from dipole antennas in terms of their field components.	Analyze
CO2. Analyze antenna arrays using their field patterns and directivity.	Analyze
CO3. Analyze the working principle of aperture antennas using Huygen's principle.	Analyze
CO4. Select an appropriate antenna for the given application based on their characteristics.	Apply
CO5. Analyze the propagation of radio waves as ground wave, sky wave and space wave.	Analyze

Text Book(s):

- T1. Karus, J.D. and Marhefka, R., "Antennas", 3rd Edition, Tata McGraw – Hill, 2002.
- T2. Jordan, E. C and Balmain, "Electromagnetic Waves and radiating systems", 2nd Edition, PHI, 1968, Reprint 2003.

Reference Book(s):

- R1. Balanis, C.A, "Antenna Theory", 2nd Edition, John Wiley & Sons, 2003.
- R2. Collin R.E, "Antenna and Radio Wave Propagation", McGraw – Hill College, 1987.
- R3. Warren, I. S. and Gary, A.T., "Antenna Theory and Design", Second Edition, John Wiley & Sons, 1998.
- R4. Harish, A.R., and Sachidanada, M., "Antennas and Wave propagation", Oxford University Press, 2007.

Web References:

1. <https://nptel.ac.in/courses/108/101/108101092/>
2. <https://nptel.ac.in/courses/117/101/117101056/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	-	1	1	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code:19ECEN1002		Course Title: Wireless Communication	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501 - Analog and Digital Communication

Course Objectives

The course is intended to:

1. Explain the spectrum allocation for wireless Communication
2. Analyze various propagation models.
3. Design various signaling schemes
4. Analyze the performance of multipath mitigation techniques.
5. Analyze the performance of multiple antenna techniques.

Unit I Cellular Architecture

9 Hours

Multiple Access techniques: FDMA- TDMA- CDMA, Cellular concept: Frequency reuse – Channel assignment- hand off- interference and system capacity- trunking and grade of service – coverage and capacity improvement.

Unit II Wireless Channels

9 Hours

Large scale path loss: path loss models- Free space propagation model- Two Ray model, Link Budget Design, Small scale fading: parameters of mobile multipath channels: Time dispersion parameters- coherence bandwidth- Doppler spread and coherence time, Fading due to multipath time delay spread: flat fading – Frequency selective fading, Fading due to Doppler spread: fast fading – slow fading.

Unit III Digital Signaling For Fading Channels

9 Hours

Structure of a wireless communication link, Modulation formats: principles of Offset QPSK – $\pi/4$ DQPSK, Minimum shift keying, Gaussian minimum shift keying, Error performance in fading channels, OFDM: Principle - cyclic prefix – Channel estimation – PAPR.

Unit IV Multipath Mitigation Techniques

9 Hours

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

Unit V Multiple Antenna Techniques

9 Hours

Smart antenna: Capacity increase – Receiver structure, MIMO systems: Spatial multiplexing – system model – channel state information – capacity in fading and non-fading channels – diversity – pre-coding – Beam forming

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the spectrum allocation for wireless communication using Multiple access techniques	Understand
CO2. Analyze various propagation models for wireless channels	Analyze
CO3. Design various signaling schemes for wireless communication	Apply
CO4. Analyze the performance of multipath mitigation techniques for reliable wireless communication.	Analyze
CO5. Analyze the performance of multiple antenna techniques for improving channel capacity	Analyze

Text Book(s):

T1. T.S.Rappaport, “Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall of India, Tenth Impression, 2013.

T2. Andreas.F. Molisch, “Wireless Communications”, 2nd Edition, John Wiley –India, 2007.

Reference Book(s):

R1. David Tse and pramod viswanath, “Fundamentals of Wireless Communication”, 2nd Edition, Cambridge University press, 2005

R2. Upena Dalal, “Wireless Communication”, 2nd Edition, Oxford University Press, 2010.

R3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, 2nd Edition, Artech House Publisher,2000. Simon haykins and Michael Moher, “Modern Wireless Communications”, 2nd Edition, Pearson Education,2007.

Web References:

1. http://www.ifp.illinois.edu/~pramodv/Chapters_PDF/Fundamentals_Wireless_Communication_chapter1.pdf
2. <https://www.cyut.edu.tw/~yfahuang/huang/EX0387CH07.pdf>
3. <http://nptel.ac.in/courses/117102062>
4. <http://textofvideo.nptel.iitm.ac.in/video.php?courseid=117104099>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1026		Course Title: Fiber Optic Communication	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Realize construction of optical fibers
2. Analyze the transmission characteristics of optical fibers
3. Describe characteristics of optical sources and its type
4. Construct fiber optic receiver systems
5. Design optical communication systems

Unit I Introduction to Optical Fibers

9 Hours

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics- Optical Fiber Modes and Configurations –Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes –Single Mode Fibers-Graded Index fiber structure.

Unit II Transmission Characteristic of Optical Fiber

9 Hours

Attenuation-absorption --scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra modal dispersion-material dispersion-waveguide dispersion-polarization mode dispersion-intermodal dispersion-dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile- cutoff wave length-dispersion calculation-mode field diameter

Unit III Optical Sources

9 Hours

Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort.

Unit IV Optical Detectors**9 Hours**

PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing-Optical Fiber connectors..

Unit V Optical Communication Systems and Networks**9 Hours**

System design consideration Point – to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH-Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Realize basic elements in optical fibers, different modes and configurations.	Understand
CO2: Analyze the transmission characteristics associated with dispersion and polarization techniques.	Analyze
CO3: Describe characteristics of optical sources with their use in optical communication system.	Analyze
CO4: Construct fiber optic receiver systems, measurements and coupling techniques	Analyze
CO5: Design optical communication systems and its networks.	Understand

Text Book(s):

T1. GredKeiser,"Optical Fiber CommunicationII, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.

T2. John M.Senior, —Optical fiber communicationII, Pearson Education, second edition.2007

Reference Book(s):

R1. P.Chakrabarti, "Optical Fiber CommunicationII, McGraw Hill Education (India)PrivateLimited, 2016.

R2. Rajiv Ramaswami, —Optical Networks,A Practical Perspective,Morgan Kaufmann ,3rd

Edition-2009

R3. J.Gower, —Optical Communication Systemll, Prentice Hall of India, 2001.

R4.Govind P. Agrawal, —Fiber-optic communication systemsll, third edition, John Wiley & sons, 2004.

Web References:

1.<https://nptel.ac.in/courses/117/107/117107094/>

2. <https://nptel.ac.in/courses/117/106/117106088/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1007		Course Title: Multimedia Communication	
Course Category: Professional elective		Course Level: Practice	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Select different multimedia systems based on their requirements.
2. Apply various coding techniques for Audio and Video compression.
3. Apply various coding techniques for text and image compression.
4. Explain the concept of VOIP Technology.
5. Explain the process of multimedia streaming.

Unit I Multimedia Components 9 Hours

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

Unit II Audio and Video Compression 9 Hours

Audio compression–DPCM-Adaptive PCM – adaptive predictive coding - linear Predictive coding -code excited LPC - perpetual coding - Video Compression: Principles, H.261, H.263, MPEG 1, 2, and 4.

Unit III Text and Image Compression 9 Hours

Compression principles- Source Encoders and Destination Encoders- Lossless and Lossy Compression - Entropy encoding – Source encoding -Text Compression: Static and Dynamic Huffman coding – Arithmetic Coding –Lempel-ziv-welch Compression - Image Compression.

Unit IV VOIP Technology 9 Hours

Basics of IP transport, VoIP challenges, H.323/ SIP – Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods - VOIP applicability.

Unit V Multimedia Networking 9 Hours

Multimedia networking – Applications - streamed stored and audio-making the best Effort service - protocols for real time interactive Applications - distributing multimedia - beyond best

effort service - scheduling and policing Mechanisms.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Select different multimedia systems based on their requirements.	Apply
CO2: Apply various coding techniques for Audio and Video compression.	Apply
CO3: Apply various coding techniques for text and image compression.	Apply
CO4: Explain the concept of VOIP Technology.	Understand
CO5: Explain the process of multimedia streaming across networks	Understand

Text Book(s):

- T1. Fred Halshall, "Multimedia communication - Applications, Networks, Protocols and Standards", 2nd Edition, Pearson Education, 2007.
- T2. Khalid Sayood, "Introduction to Data Compression", 2nd Edition, Morgan Kauffman Harcourt India, 2000.

Reference Book(s):

- R1: Tay Vaughan, "Multimedia: Making it work", 7th Edition, TMH 2008.
- R2: Kurose and W.Ross "Computer Networking - A Top Down Approach", 6th Edition, Pearson Education, 2005.
- R3: KR. Rao, Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007.
- R4: R.Steinmetz, K.Nahrstedt, "Multimedia Computing, Communications and Applications", 6th Edition, Pearson Education, 2009.

Web References:

1. <http://nptel.ac.in/downloads/117105083/>
2. <http://nptel.ac.in/courses/117105081/>
3. <http://nptel.ac.in/courses/106105082/38>
4. <http://nptel.ac.in/courses/117105081/32>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO2	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1025	Course Title: Satellite Communication		
Course Category: Professional Elective	Course Level: Mastery		
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501 - Analog and Digital Communication

Course Objectives

The course is intended to:

1. Describe Satellite orbits and launching.
2. Analyze the components required for space and earth segment.
3. Discover the link power budget
4. Apply various modulation and multiple access techniques
5. Select an appropriate satellite based on the service

Unit I Satellite Orbits and Launching 9 Hours

Kepler's three laws of Planetary motion, orbital terms for Earth Satellites, orbital perturbations, Geo stationary orbit: Look Angle determination, limits of visibility, Earth Eclipse of Satellite, Sun transit outages, Launches and launch vehicles

Unit II Space Segment and Earth Segment 9 Hours

Space Segment: Power Supply – Attitude Control – Spinning Satellite Stabilization – Momentum Wheel Stabilization – Station Keeping – Thermal Control – TT&C Subsystem – Transponders: The wideband receiver, input Demultiplexer, power amplifier – Antenna Subsystem, Receive-Only Home TV Systems: Outdoor Unit – Indoor Unit for Analog TV -Master Antenna TV System – Community Antenna TV System

Unit III Space Link 11 Hours

Equivalent isotropic radiated power – Transmission losses – Free-space transmission – Feeder losses – Antenna misalignment losses – Fixed atmospheric and ionospheric losses –Insight on Satellite antennas - Link power budget equation – System noise – Antenna noise – Amplifier noise temperature – Amplifiers in cascade – Noise factor – Noise temperature of absorptive networks – Overall system noise temperature – Carrier to- Noise ratio – Uplink – Block Up Converter (BUC) - Saturation flux density – Input back off – The earth station - HPA – Downlink - Low Noise Block down-converter – Output back off – Satellite TWTA output

Unit IV Satellite Access**7 Hours**

Modulation and Multiplexing: Voice - Data - Video - Analog - digital transmission system, Digital video Broadcast, multiple access: FDMA - TDMA - CDMA, Assignment Methods, Spread Spectrum communication.

Unit V Satellite Applications**9 Hours**

INTELSAT Series, INSAT - VSAT, mobile satellite services: GSM- GPS- INMARSAT-LEO: Beam steering for LEO satellites, MEO, Satellite Navigational System, Direct Broadcast satellites, Direct to home Broadcast, Digital audio broadcast, GRAMSAT, Specialized services: Email -Video conferencing – Internet

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe satellite orbits and launching used in satellite communication	Understand
CO2: Analyze the components required for space and earth segment of satellite communication	Analyze
CO3: Discover the link power budget for satellite communication link	Analyze
CO4: Apply various modulation and multiple access techniques for satellite access	Apply
CO5: Select an appropriate satellite based on the service for the given application	Apply

Text Book(s):

T1.Dennis Roddy, "Satellite Communications", Fourth Edition, McGraw Hill International Editions, 2014.

T2.Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson,'Satellite Communication Systems Engineering', Second Edition,Pearson, 2007

Reference Book(s):

R1. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, New york,1990.

R2. Timothy Pratt, Charles Bostian& Jeremy Allmuti "Satellite Communications", 2nd Edition,John Wiley & Sons (Asia) Pvt Ltd, 2004.

R3. M.Richharia, "Satellite Communication Systems-Design Principles", 2nd Edition,Macmillan/BSPBooks, 2012.

R4. Bruce R.Elbert, “The Satellite Communication Applications Hand Book”, 2nd Edition
Artech House Boston, 2003

Web References:

1. <http://www.nptelvideos.com/video.php?id=507>
2. <http://nptel.ac.in/syllabus/117107036/>
3. <http://nptel.ac.in/courses/106105082/33>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1024		Course Title: Advanced Wireless Communication	
Course Category: Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECEN1002 - Wireless Communication

Course Objectives

The course is intended to:

1. Explain the various cellular networks.
2. Analyze the BER for various modulation techniques.
3. Analyze the adaptive modulation techniques.
4. Interpret OFDM and Multi antenna systems.
5. Explain Cognitive radio architecture and relaying techniques.

Unit I Cellular Systems and Standards

9 Hours

Advanced Mobile Phone Systems (AMPS), Global system for Mobile Communication: Frequency Bands and Channels, International Mobile Telecommunications(IMT-2000): Spectrum Allocation – Services provided by 3G cellular systems – Harmonized 3G systems Universal Mobile Telecommunications systems (UMTS): 3G UMTS signal processing – WCDMA – HSPA – HSPA+, Towards 4th G: LTE and LTE advanced.

Unit II Performance of Digital Modulation over Wireless Channels

9 Hours

AWGN Channels: Error probability for BPSK and QPSK – Error probability for MPSK – Error probability for FSK and CPFSK, BER analysis of fading channels: Outage probability – Average probability – Average probability of Error – Moment generating function approach to average error probability – Combined outage and average error probability.

Unit III Adaptive Modulation and Coding

9 Hours

Adaptive transmission system, Adaptive techniques,: Variable – Rate techniques – Variable – error techniques, Variable error probability, Variable Coding techniques, Hybrid techniques, Variable – Rate Variable power MQAM, General M-ary Modulations: Continuous rate adaption – Discrete rate adaption – Average BER target.

Unit IV Multiuser Communication**9 Hours**

Orthogonal Frequency Division Multiplexing (OFDM): Principle - Implementation of Transceivers - Frequency-Selective Channels - Channel Estimation: Pilot-Symbol- Based Methods, Peak-to-Average Power Ratio, Inter Carrier Interference, Multiple Access - OFDMA, Multicarrier Code Division Multiple Access, Multiantenna Systems: Smart Antennas - Multiple Input Multiple Output Systems.

Unit V Standardized Wireless Systems**9 Hours**

Cognitive Radio: Cognitive Transceiver Architecture - Principles of Interweaving - Spectrum Sensing - Spectrum Management - Spectrum Sharing - Overlay - Ultra Wide Bandwidth System Communications, Relaying: Principle of Relaying - Fundamental Protocols: Decode-and-Forward - Amplify-and-Forward - Compress-and-Forward, Relaying with Multiple, Parallel Relays.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Explain the various cellular networks used in wireless communication.	Understand
CO2.Analyze the BER for various adaptive modulation techniques used in wireless communication	Analyze
CO3.Illustrate adaptive techniques in modulation and coding	Apply
CO4.Interpret OFDM and Multi antenna systems.	Analyze
CO5.Explain Cognitive Radio Architecture and Relaying techniques.	Understand

Text Book(s):

- T1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.
- T2. Andreas F Molisch , "Wireless Communications", John Wiley & Sons, 2010.

Reference Book(s):

- R1.Dharma Prakash Agarwal and Qing- Anzeng, "Introduction to Wireless and
- R2. Singal T L, "Wireless Communications" Tata McGraw Hill, 2010.
- R3. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia, New Delhi, 2009.

Web References:

- 1.<http://nptel.ac.in/courses/117104099/>
- 2.<http://nptel.ac.in/courses/117102062/2>
- 3.<http://web.cs.ucdavis.edu/~liu/2891/Material/book-goldsmith.pdf>
- 4.<https://researchpapers4scolars.files.wordpress.com/2015/06/andreas-f-molisch-wireless-conim.pdf>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

VLSI ELECTIVES

Course Code: 19ECEN1023	Course Title : Digital System Design and Verification		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1302- Digital Principles and System Design
- 19ECCN1601- VLSI System Design

Course Objectives

The course is intended to:

1. Apply different design methodologies to design digital circuits.
2. Classify the different modelling techniques used in digital circuit design.
3. Apply various techniques and tools to verify the functionality and timing issues.
4. Use high level modelling to design digital circuits.
5. Apply test benches and simulation environment to verify the functionality and timing issues

Unit I	Introduction to Verilog HDL	9 Hours
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Introduction to Verilog HDL, Abstraction levels, Digital circuit design with Verilog HDL, Need for verification, Simulation and synthesis, 4 state logic: Top, down, Bottom and up design methodology..

Unit II	Circuit Design Using Verilog HDL	9 Hours
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Gate level modeling – Introduction, Design of gate primitives, Basic digital design at gate level; Dataflow modeling – Introduction, assignment statements, simple digital circuit design using assignments, Test bench; Behavioral modeling - Introduction, Procedural blocks, blocking and non-blocking assignments, simple digital circuit design at behavioral level; FSM design

Unit III	Verification Technologies and Tools	9 Hours
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Importance of Verification - Reconvergence Model - The Human Factor - Formal and Functional Verification Approaches - Timing Verification - Testing Versus Verification - Design and Verification Reuse - Linting - Simulation - Third Party Models - Verification Intellectual Property - Waveform Viewers - Code Coverage - Functional Coverage - Issue Tracking – Metrics - Role of the Verification Plan - Levels of Verification - Verification Strategies

Unit IV High-Level Modeling**9 Hours**

High-Level Versus RTL Thinking - Structure of High-Level Code - Data Abstraction - Object-Oriented Programming - Parallel Simulation Engine - Race Conditions

Unit V Architecting Testbenches and Simulation Management**9 Hours**

Stimulus and Response -Transaction-Level Interface - Self-Checking Test benches - Directed Stimulus - Random Stimulus - Managing Simulations – Regression

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply different design methodologies to design digital circuits using Verilog HDL.	Apply
CO2: Utilize different modelling to design digital circuits with Verilog HDL	Apply
CO3: Analyze the functionality and timing issues in digital circuits using various technology and tools.	Analyze
CO4: Utilize high level modeling to design digital circuits	Apply
CO5: Analyze the functionality and timing issues in digital circuit models using test benches and simulation environment	Analyze

Text Book(s):

- T1. T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009.
- T2. Zainalabdien Navabi, Verilog Digital System Design, TMH, 2nd Edition.
- T3. Chris Spear, Greg Tumbush, "System Verilog for Verification - A Guide to Learning the Testbench Language Features" Springer, 2012.

Reference Book(s):

- R1. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.
- R2. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
- R3. Andreas Meyer, "Principles of Functional Verification", Newnes, 2003.
- R4. Janick Bergeron, "Writing Test Benches Using System Verilog", Springer, 2009.
- R5. Kropf T, "Introduction to Formal Hardware Verification", Springer Verlag, 2010.

Web References:

1. https://onlinecourses.nptel.ac.in/noc17_cs21/preview
2. <https://nptel.ac.in/syllabus/syllabus.php?subjectId=117106092>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO3	3	2	2	2	-	-	-	1	-	1	-	1	1	3
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO5	3	2	2	2	-	-	-	1	-	1	-	1	1	3

High-3; Medium-2;Low-1

Course Code: 19ECEN1022		Course Title: Low Power VLSI Design	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECSN2201- Electric Circuits and Electron devices
- 19ECCN1302- Digital Principles and System Design
- 19ECCN1601- VLSI System Design

Course Objectives

The course is intended to:

1. Explain the sources of power dissipation in MOSFETs and its effects.
2. Discuss the circuit and logic level low power design techniques
3. Explain the power reduction design techniques in clock networks and buses
4. Explain the techniques involved in low power memory design
5. Explain the concepts of software design for low power

Unit I Introduction to Low Power Dissipation

9 Hours

Need for low power VLSI chips, Physics of power dissipation in CMOS devices, Sources of power dissipation in Digital Integrated circuits, Basic principles of low power design-probabilistic power analysis-random logic signal-probability and frequency-power analysis techniques - signal entropy

Unit II Circuit and Logic Level Low Power Design Techniques

9 Hours

Circuit: transistor and gate sizing - pin ordering - network restructuring and reorganization - adjustable threshold voltages – Logic: signal gating - logic encoding, Pre-computation logic

Unit III Special Low Power VLSI Design Techniques

9 Hours

Power reduction in clock networks -single driver Vs distributed buffers, zero skew Vs tolerable skew, chip and package co-design of clock network, CMOS floating node - low power bus - delay balancing, Switching activity reduction - parallel architecture with voltage reduction - operator reduction -Adiabatic computation

Unit IV Low Power Memory Design**9 Hours**

Basics of SRAM- Memory cell – Pre-charge and equalization circuit. Sense amplifier-Output latch - Low power SRAM technologies - types of DRAM – Basics of DRAM - Cell refresh circuit – HVG – BBG – BVG – RVG –VDC

Unit V Software Design and Power Estimation**9 Hours**

Low power circuit design style –Software power estimation - Co-design for low power

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Understand the effect of MOS device parameters on various sources of power dissipation.	Understand
CO2. Understand low power design techniques at the circuit and logic level	Understand
CO3. Explain the various power reduction methods in clock networks and buses.	Understand
CO4. Apply the techniques in low power memory design	Apply
CO5. Apply the concepts of software design for low power	Apply

Text Book(s):

- T1. Gary Yeap “Practical Low Power Digital VLSI Design”, Springer US, Kluwer AcademicPublishers,2002
- T2. Kiat-Seng Yeo, Kaushik Roy, “Low Voltage Low Power VLSI Subsystems”, Tata Mc-Graw Hill,2009.
- T3. Kaushik Roy, Sharat C. Prasad, “Low power CMOS VLSI circuit design”, Wiley IntersciencePublications",1987.

Reference Book(s):

- R1. Rabaey, Pedram, “Low power design methodologies” Kluwer Academic, 1997.
- R2. Chandrasekaran, A.P., Broadersen.R.W, “Low Power Digital CMOS VLSI Design”, Kluwer 1995.
- R3. DimitriosSoudris, Christians Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2002
- R4. AbdelatifBelaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995
- R5. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001.

Web References:

1. nptel.ac.in/courses/106105034/12
2. www.nptelvideos.com/course.php?id=422
3. <http://www.youtube.com/watch?v=ruclwamT-Ro&list>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	3

High-3; Medium-2;Low-1

Course Code: 19ECEN1035		Course Title: ASIC Design	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week)3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1302 - Digital Principles and System Design
- 19ECCN1601- VLSI System Design

Course Objectives

The course is intended to:

1. Explain the different types of ASICs and logic cells used in ASIC design
2. Explain the architecture of various programmable logic cells
3. Explain the various interconnects in programmable logic cells and design software.
4. Develop a digital circuit using HDL.
5. Explain the various functional blocks in an ASIC.

UNIT I Introduction To ASICs

9 Hours

Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell - Sequential logic cell - Transistor as Resistor - Transistor parasitic capacitance – Library cell design.

UNIT II Programmable ASIC s, Logic Cells And I/O Cells

9 Hours

Anti-fuse - Static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA, Xilinx I/O blocks –Altera MAX 5000 - Altera FLEX.

UNIT III ASIC interconnect and design software

9 Hours

Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 - Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Low level design language - PLA tools

UNIT IV Logic Synthesis

9 Hours

A logic synthesis example: Arithmetic and MUX units in Verilog HDL, FSM synthesis in Verilog, Memory synthesis in Verilog.

UNIT V Floor Planning, Placement and Routing**9 Hours**

Floor planning, Placement, Routing- Global routing-detailed routing- special routing- Parasitic extraction, LVS, DRC and GDS Extraction.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the different types of ASICs and logic cells used in ASIC design.	Understand
CO2: Explain the architecture of various programmable logic cells	Understand
CO3: Analyse the various interconnects in programmable logic cells and design software	Understand
CO4: Apply a digital circuit using HDL.	Apply
CO5: Explain the various functional blocks in an ASIC	Understand

Text Books:

- T1. Michael John Sebastian Smith, "Application Specific Integrated Circuits" Pearson education, 2008.
- T2. Norman G. Einspruch, "Application Specific Integrated Circuit (ASIC) Technology", Academic Press, 2012.

Reference Books:

- R1. Morris Mano.M, "Digital Design", 3rd edition, Pearson Education India, 2013.
- R2. Douglas L. Perry, "VHDL: Programming by Example" McGraw Hill Education, thedition, 2002.

Web References:

1. www.vlsi.wpi.edu/cds/explanations/lvs.html
2. <http://www.eng.auburn.edu/>
3. <http://www.geoffknagge.com/fyp/index.shtml#asic>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2;Low-1

Course Code: 19ECEN1020		Course Title: CMOS Analog IC Design	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECSN2201- Electric Circuits and Electron Devices
- 19ECCN1302- Digital Principles and System Design

Course Objectives

The course is intended to:

1. Explain the concept of CMOS Technology and Analog MOSFET models.
2. Explain the basic MOSFET based analog circuits.
3. Explain the design of differential amplifier and Op-amp circuit.
4. Explain the design of dynamic analog and various nonlinear circuits
5. Explain the design of various data conversion architectures.

UNIT I Introduction to CMOS Technologies and Analog MOSFET Models

9 Hours

MOSFET- Structure, MOSFET Capacitances, Threshold Voltage , IV Characteristics , SPICE modeling, DC equations , Short Channel MOSFET . MOS Passive Elements – Capacitors and Resistors, Temperature and Voltage dependence of Capacitors and Resistors. ANALOG MOSFET MODELS - Low frequency model, High frequency model, Temperature effects, Noise in MOSFET.

UNIT II Analog MOS Modeling

9 Hours

Current Mirror, Current sources, Self-biasing techniques, Voltage dividers, Common Source and Common Drain and Common Gate amplifiers, Band gap voltage references, Beta multiplier based references.

UNIT III Differential Amplifiers and OPAMP Design

9 Hours

Differential Amplifier – Source coupled pair, Source cross coupled pair, Cascode load, Wide swing differential amplifiers. Operational Amplifiers – Basic CMOS Op-amp, Fully differential Op-amp, Operational Trans-conductance amplifier.

UNIT IV Dynamic Analog and Non Linear Circuits**9 Hours**

Dynamic Analog Circuits – MOSFET switch, Switched capacitor circuit. Non Linear Analog Circuits – CMOS comparator, Analog multiplier, Level shifting circuit, Challenges in analog design.

UNIT V Mixed Signal Circuits**9 Hours**

Data Conversion Fundamentals – Analog Vs Discrete time signal, Converting analog to digital signal - Sample and hold circuit, Data Conversion Architectures – DAC, ADC.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the concept of CMOS Technology and Analog MOSFET models.	Understand
CO2. Explain the MOSFET based basic analog circuits.	Understand
CO3. Explain the design of differential amplifier and Op-amp circuits.	Understand
CO4. Explain the design of dynamic analog and various nonlinear circuits.	Understand
CO5. Explain the design of various data conversion architectures.	Understand

Text Book(s):

- T1. Sedra and Smith,"MicroelectronicCircuits",Oxford University Press, Seventh Edition,2015.
- T2. Jacob Baker.R., Li.H.W., and Boyce.D.E., CMOS Circuit Design ,Layoutand Simulation, Prentice-Hall of India,1998.
- T3. BehzadRazavi,"Design of Analog CMOS Integrated Circuits",Tata McGraw Hill,Second Edition, 2015

Reference Book(s):

- R1. Paul R. Gray and Meyer.R.G., Analysis and design of Analog Integrated circuits, John Wiley and Sons inc., USA, 3rd Edition, 1993.
- R2. David. A. Johns and Martin. K., Analog Integrated Circuit Design, Wiley, 1997.
- R3. MalcomR.Haskard, LanC.May, "Analog VLSI Design - NMOS and CMOS ", Prentice Hall, 1998
- R4. Jose E.France, YannisTsividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and signal Processing ", Prentice Hall, 1994.
- R5. Randall L Geiger, Phillip E. Allen, Noel K.Strader, "VLSI Design Techniques for Analog

and Digital Circuits ", McGraw Hill International Company, 1990.

Web References:

1. <http://nptel.ac.in/courses/117101105/>
2. <http://www.nptel.ac.in/syllabus/117101006/>
3. <http://www.siliconmentor.com/analog-vlsi-design/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	--	-	-	1	-	1	-	1	1	2

High-3; Medium-2;Low-1

Unit V Design Applications**9 Hours**

Traffic light Controller, Real Time Clock -Interfacing using FPGA: VGA, Keyboard, LCD, Embedded Processor Hardware Design.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Describe different types of programmable devices.	Understand
CO2. Explain the basic structure and different components of FPGA.	Understand
CO3. Explain the device architecture of sRAM programmable FPGA.	Understand
CO4. Explain the architecture of anti-fuse programmed FPGA device.	Understand
CO5. Implementation of combinational and sequential digital circuits in FPGA.	Apply

Text Book(s)

- T1. Wayne Wolf, 'FPGA-Based System Design' Pearson Education, 2004.
- T2. Clive Maxfield, "The Design Warriors's Guide to FPGAs", Elsevier, 2004.
- T3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2003

Reference Book(s):

- R1. John V. Oldfield, Richard C. Dorf, "Field Programmable Gate Arrays", Wiley, 2008
- R2. Ian Grout, "Digital Systems Design with FPGAs and CPLDs", Elsevier Science, 2011.
- R3. Pak K. Chan/Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays", Pearson Low Price Edition, Jan 2009.

Web References:

1. <https://www.eeweb.com/beginners-guide-to-understanding-fpga-development/>
2. <https://learn.sparkfun.com/tutorials/programming-an-fpga/all>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	2	-	1	1	2
CO2	2	1	-	-	-	-	-	1	-	2	-	1	1	2
CO3	2	1	-	-	-	-	-	1	-	2	-	1	1	2
CO4	2	1	-	-	-	-	-	1	-	2	-	1	1	2
CO5	2	1	2	2	3	-	-	1	2	2	-	1	1	2

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify the faults in digital the circuits	Remember
CO2: Create test pattern for combinational logic circuit.	Analyse
CO3: Create test pattern for sequential logic circuit.	Analyse
CO4: Explain the different testability techniques for testing.	Understand
CO5: Explain various BIST Architecture and test algorithms.	Understand

Text Books:

T1.M.Abramovici, M.A.Breuer and A.D. Friedman, "Digital systems and Testable Design",Jaico Publishing House, 2002.

T2.P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.

Reference Books:

R1.M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002.

R2.A.L.Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International, 2002.

R3.Robert J., Jr. Feugate, Steven M. McIntyre," Introduction to VLSI Testing" Prentice Hall International, 1988.

R4.Angela Krstic and Kwang-Ting Cheng,"Delay fault testing for VLSI Circuits", KluwerAcademic Publishers, 1998.

R5.Mike Tien and Chien Lee, "High-Level Test Synthesis of Digital VLSI Circuits", Artech House, Inc., 1997.

Web References:

1. <http://onlinelibrary.wiley.com/doi/10.1002/0471457787.fmatter/pdf>
2. <http://nptel.ac.in/courses/106103016/30>
3. www.cs.colostate.edu/~malaiya/530/08/resources.html

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO4	2	1	-	-	-	-	-	1	-	1	-	1	1	2
CO5	2	1	-	-	-	-	-	1	-	1	-	1	1	2

High-3; Medium-2;Low-1

SIGNAL PROCESSING ELECTIVES

Course Code: 19ECEN1018		Course Title: Information Theory and Coding	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Understand the basics of Information theory
2. Learn the principles of information coding
3. Discuss about the different statistical and dictionary based coding techniques
4. Explain the concepts of linear block codes for error detection and correction
5. Describe the notion of convolutional codes

Unit I **Concepts of Information Theory** **9 Hours**

Introduction to Information theory – Self Information – Entropy – Conditional Entropy – Characteristics of Entropy function – Mutual Information – Information rate – Channel capacity – Redundancy and Efficiency of channels – Binary symmetric channel – Binary asymmetric channel

Unit II **Source Coding** **9 Hours**

Encoding techniques – Purpose of encoding – Instantaneous codes – Kraft's Inequality – Coding efficiency and redundancy – Source coding theorem

Unit III **Statistical and Dictionary Based Coding** **9 Hours**

Statistical Methods – Shannon-Fano Algorithm, Run-length coding, Huffman algorithm, Arithmetic coding; Dictionary Methods – Static and Adaptive Dictionary – LZ77, LZ78, LZW algorithms

Unit IV **Codes for Error Detection and Correction** **9 Hours**

Parity check coding – Linear block codes – Error detecting and correcting capabilities – Generator and Parity check matrices – Hamming codes – Encoding and Decoding of cyclic codes

Unit V Convolutional Codes**9 Hours**

Introduction to convolutional codes – Encoding – State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes – Viterbi algorithm

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Understand the basic concepts of information theory related to data	Understand
CO2. Explain the principles of source coding techniques for message signals	Understand
CO3. Apply statistical and dictionary based coding to compress text data	Apply
CO4. Apply Linear block codes for error detection and correction	Apply
CO5. Apply convolutional codes for encoding and decoding of message signals	Apply

Text Book(s):

- T1. Simon Haykin and Michael Moher, "Communication systems" John Wiley & Sons, Fourth Edition, 2000
- T2. Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann, Fourth Edition, 2012
- T3. Thomas M. Cover, Joy. A. Thomas, "Elements of Information Theory", John Wiley & Sons, Second Edition, 2006

Reference Book(s):

- R1. Ranjan Bose, "Information Theory, Coding and Cryptography", McGraw Hill, 3rd Edition, 2016
- R2. David Salomon, "Data Compression: The Complete Reference", Springer, 4th Edition, 2007
- R3. Gravano Salvatore, "Introduction to Error Control Codes", Oxford University Press, 2001

Web References:

1. <https://nptel.ac.in/courses/108/102/108102117/>
2. <https://nptel.ac.in/courses/117/101/117101053/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	1	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1016		Course Title: Digital Image and Video Processing	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1402- Signals and Systems
- 19ECCN2501- Digital Signal Processing

Course Objectives

The course is intended to:

1. Analyze the digital images in frequency domain.
2. Analyze the given Digital Image by applying various filtering techniques.
3. Select the techniques for segmenting digital images.
4. Apply the various compression schemes
5. Analyze the video signals and different video coding standards

Unit I Digital Image Fundamentals

9 Hours

Elements of digital image processing systems, Digital Camera, Elements of visual perception, brightness, contrast, hue, saturation, Mach band effect, Color image fundamentals - RGB, YUV, HSI models, Image sampling, Quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. 2D transforms - DFT, DCT and KLT

Unit II Image Enhancements And Filtering

9 Hours

Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, frequency domain filters – low-pass and high-pass.

Unit III Image Segmentation

9 Hours

Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Unit IV Image Compression

9 Hours

Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Still image compression standards – JPEG

Unit V Fundamentals of Video Coding**9 Hours**

Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Analyze the digital images in frequency domain by applying 2D transforms	Apply
CO2: Analyze the given Digital Image by applying various filtering techniques in both spatial and frequency domains.	Apply
CO2: Select the appropriate techniques for segmenting digital images.	Apply
CO3: Apply the various compression schemes for the given image.	Apply
CO4: Analyze the video signals and different video coding standards	Apply

Text Book(s):

- T1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- T2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India 2nd edition 2004
- T3. Murat Tekalp, Digital Video Processing, Prentice Hall, 2nd edition 2015
- T4. Jack Keith, Video Demystified Third Edition, Penram International, 2010

Reference Book(s):

- R1. Dr. Jayaraman, S., Essakirajan, S., and Veerakumar, T., "Digital Image Processing", Tata McGraw Hill, New Delhi, 2012
- R2. David Salomon, "Data Compression – The Complete Reference", 3rd edition, Springer Verlag New york, 2004.
- R3. William K-Pratt, "Digital Image Processing", 4th edition, John Wiley and Sons, 2007.
- R4. Kenneth R.Castleman, "Digital Image Processing", Pearson Education, 1996.

Web References:

- 1. <https://nptel.ac.in/courses/117/105/117105079/>
- 2. <https://nptel.ac.in/courses/117/104/117104020/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1017		Course Title: Speech and Audio Processing	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN2501- Digital Signal Processing

Course Objectives

The course is intended to:

1. Describe the mechanism of speech production
2. Discuss the time domain parameters of speech signal
3. Explain various frequency domain techniques used for speech signal processing
4. Explain various speech coding techniques
5. Describe the concepts of perceptual audio coding

Unit I Speech Signal Modelling 9 Hours

Mechanism of speech production – Categorization of speech sounds – Discrete time modeling of speech production: Vocal tract, Radiation, Excitation, The complete model – Human Auditory System

Unit II Time Domain methods for Speech Processing 9 Hours

Time domain parameters of speech: Short-time Energy and Average Magnitude, Short-time Average Zero-Crossing Rate – Speech vs. Silence discrimination using Energy and Zero-Crossings – Short-time Autocorrelation function – Pitch period estimation using the autocorrelation function

Unit III Frequency Domain methods for Speech Processing 9 Hours

Short-Time Fourier Transform – Analysis and Synthesis – Homomorphic Filtering – Cepstrum of voiced and unvoiced – Pitch Detection – Formant Estimation

Unit IV Speech Coding 9 Hours

Scalar Quantization – Vector Quantization – Subband Coding – Sinusoidal Coding – Linear Predictive Coding (LPC) – Mixed Excitation LPC (MELP) – Code-Excited Linear Prediction (CELP) – Acoustics: Echo, Reverberation – Echo Cancellation

Unit V Audio Coding**9 Hours**

Transparent Audio Coding – Perceptual Masking – Noise Shaping: subband analysis, temporal noise shaping – Example coding schemes: MPEG-1 Audio layers I and II, MPEG-1 Audio Layer III (mp3), MPEG-2 AAC

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Describe the mechanism of speech production and auditory perception	Understand
CO2. Analyze speech signals using time domain parameters for voiced and unvoiced signal classification	Understand
CO3. Explain various frequency domain techniques used for processing and extracting information from speech signals	Understand
CO4. Explain the different coding techniques used for speech signals	Understand
CO5. Describe the concepts of perceptual audio coding for lossy compression of audio signals	Understand

Text Book(s):

- T1. R.Rabiner and R.W.Schafer, "Digital Processing of Speech signals", Pearson Education – India, New Delhi, 2010
- T2. Thomas.F.Quatieri, "Discrete-Time Signal Processing", Pearson Education - India, New Delhi, 2011.
- T3. Ben Gold, Nelson Morgan and Dan Ellis, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", 2nd Edition, John Wiley & Sons, 2011.

Reference Book(s):

- R1. Wai C. Chu, "Speech Coding Algorithms – Foundation and Evolution of Standardized Coder", John Wiley & Sons, 2003
- R2. J.L.Flanagan, "Speech Analysis, Synthesis and Perception", Springer-Verlag, 1972
- R3. E.S.Gopi, "Digital Speech Processing using Matlab", Springer, 2014

Web References:

1. <https://nptel.ac.in/courses/117/105/117105081/>
2. <https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/speech%20course.html>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	2	-

High-3; Medium-2;Low-1

Course Code:19ECEN1039		Course Title: Multirate Signal Processing	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week):3:0:0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN2501- Digital Signal Processing

Course Objectives

The course is intended to:

1. Understand the need of multi-rate systems and its applications.
2. Understand the theory of two channel filter banks
3. Understand the theory of uniform m-channel filter banks
4. Provide knowledge of filter banks with polyphase structure
5. know about multirate filter banks and applications of multirate signal processing

Unit I Decimation and Interpolation

9 Hours

Introduction – Representation of discrete signals –Reducing the sampling rate – Increasing the sample rate. Decimation with transversal filters – Interpolation with transversal filters – Decimation with Polyphase filters – Interpolation with polyphase filters – Decimation and Interpolation with Rational sampling factors

Unit II Two Channel Filter Banks

9 Hours

Analysis and synthesis filter banks – Quadrature mirror filter banks – Filter banks with perfect reconstruction – Paraunitary filter banks – Biorthogonal and linear phase filter banks – Transmultiplexer filter banks.

Unit III Uniform M-Channel Filter Banks

9 Hours

Filter banks with tree structure – Filter banks with parallel structure – complex modulated filter banks –cosine modulated filter banks – Transmultiplexer filter banks.

Unit IV Filter Banks with Polyphase Structure

9 Hours

Fundamental polyphase structures – polyphase QMF banks – General two channel polyphase filter banks – General M-channel polyphase filter banks – Paraunitary

polyphase filter banks – DFT polyphase filter banks. Application: Digital audio.

Unit V Applications

9 Hours

FSK Modems-Orthogonal Multicarrier (OMC) Data transmission-Digital Audio mixing-Asynchronous Conversion of sampling rates-Speech and audio coding

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Analyze multirate systems	Analyze
CO2. Design two channel filter banks	Analyze
CO3. Design uniform m-channel filter banks	Analyze
CO4. Design and Analyze filter banks with polyphase structure	Analyze
CO5. Design and analyze a Multirate filter bank..	Analyze

Text Book(s)

- T1. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson-Education, Delhi, 2004.
- T2. Fliege N J, "Multirate Digital Signal Processing", John Wiley and sons, 1994.

Reference Book(s):

- R1. Proakis J G and Manolakis D G, "Digital Signal Processing Principles, Algorithms and Applications", Prentice Hall of India, 2002.
- R2. Sanjit K Mitra, "Digital Signal Processing-A Computer Based Approach", Tata McGraw Hill, 2003.
- R3. Vikram Gadre & Aditya Abhyankar, Multiresolution and Multirate Signal Processing:
- R4. Introduction, Principles and Applications, McGrawHill Education, First edition, 2017.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_ee21
2. https://onlinecourses.nptel.ac.in/noc19_ee50

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	2	3	2	-	2	2	-
CO2	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO3	3	2	1	1	2	-	-	2	3	2	-	2	2	-
CO4	3	2	1	1	3	-	-	2	3	2	-	2	2	-
CO5	3	3	2	2	3	-	-	2	3	2	-	2	2	-

High-3, Medium-2, Low-1

Course Code: 19ECEN1033		Course Title: Adaptive Signal Processing	
Course Category:	Professional Elective	Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1402-Signals and Systems
- 19ECCN2501-Digital Signal Processing

Course Objectives

The course is intended to:

1. Illustrate the basic concepts of adaptive systems
2. Illustrate the concept of optimal Wiener filtering
3. Explain the design of LMS Filters for adaptive systems
4. Explain the concepts of vector space framework
5. Explain the design of RLS Filters for adaptive systems

Unit I Introduction to Adaptive Filters

9 Hours

General concept of adaptive filtering and estimation- applications and motivation- Review of probability- random variables and stationary random processes-Correlation structures-properties of correlation matrices.

Unit II Wiener Filtering

9 Hours

Optimal FIR (Wiener) filter-Applications: Linear Prediction, Noise Cancellation – Lattice Representation for FIR Wiener Filter. IIR Wiener Filter – Non causal IIR Wiener Filter – Causal IIR Wiener Filter.

Unit III LMS Filters

9 Hours

Method of steepest descent- extension to complex valued signals-The LMS algorithm (real, complex)- convergence analysis- weight error correlation matrix-excess mean square error and misadjustment - Variants of the LMS algorithm-Normalized LMS algorithm- Block LMS and FFT based realization.

Unit IV Vector Space Framework for Optimal Filtering**9 Hours**

Signal space concepts - Introduction to finite dimensional vector space theory- Gram Schmidt orthogonalization-concepts of orthogonal projection- orthogonal decomposition of vector spaces Vector space of random variables-correlation as inner product-forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit V RLS Lattice Filters**9 Hours**

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Illustrate the basic concepts of adaptive systems using random process and random variables	Apply
CO2. Analyze optimal Wiener filtering design for adaptive systems	Analyze
CO3. Analyze LMS algorithm design for signal processing applications	Analyze
CO4. Analyze Vector space framework for optimal filtering	Analyze
CO5. Analyze RLS Lattice Filters design for adaptive systems	Analyze

Text Book(s):

- T1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986
- T2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
- T3. Monson H Hayes, "Statistical Digital Signal Processing and Modelling", Wiley, 2004

Reference Book(s):

- R1. Todd K. Moon, Wynn C. Stirling, "Mathematical Methods and Algorithms for Signal Processing" Prentice Hall, First edition, 1999.
- R2. John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, "Theory and Design of Adaptive Filters", Prentice Hall India Private Limited, 2004

R3. Bernard Widrow and Samuel. D. Stearns, “Adaptive Signal Processing”, Pearson Education, 2001.

Web References:

1.<https://nptel.ac.in/courses/117/105/117105075/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	1	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	1	2	-

High-3; Medium-2; Low-1

Course Code: 19ECEN1015		Course Title: Wavelets and Its Applications	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1402- Signals and Systems
- 19ECCN2501- Digital Signal Processing

Course Objectives

The course is intended to:

1. Understand the need for wavelet transform
2. Analyze the multirate system
3. Understand the concept of continuous time wavelet transform
4. Analyze the relationship between the filter bank and wavelet
5. Understand the application of wavelets

Unit I Fundamentals And Fourier Analysis

9 Hours

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence. Fourier basis & Fourier Transform – Need for Time-Frequency Analysis – Heisenberg's Uncertainty principle – Short time Fourier transform (STFT) – short comings of STFT– Need for Wavelets

Unit II Introduction To Multirate Systems

9 Hours

Decimation and Interpolation in Time domain - Decimation and Interpolation in Frequency domain – Multi rate systems for a rational factor.

Unit III CWT And Multi Resolution Analysis

9 Hours

Wavelet basis – Continuous time Wavelet Transform (CWT) – need for scaling function – Multi Resolution Analysis – important wavelets: Haar– Mexican hat– Meyer– Shannon– Daubachies.

Unit IV Filter Banks And DWT

9 Hours

Two channel filter bank – Perfect Reconstruction (PR) condition – relationship between filter banks and wavelet basis – DWT – Filter banks for Daubachies wavelet function

Unit V Wavelets Applications**9 Hours**

Wavelet denoising- Speckel removal-Edge detection and noise removal- Image fusion-object detection- discrete wavelet multitone modulation- Image compression

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Understand the need for wavelet transform through time–frequency analysis	Understand
CO2. Analyze the multirate system for rational factor.	Analyze
CO3. Understand the concept of continuous time wavelet transform and multi resolution analysis	Understand
CO4. Analyze the relationship between the filter bank and wavelet from perfect reconstruction condition	Analyze
CO5. Understand the application of wavelets through various example applications	Understand

Text Book(s):

- T1.K.P.Soman , K.I. Ramachandran, N.G. Rasmi, "Insight Into Wavelets: From Theory to Practice" PHI Learning Private Limited, 3rd Edition, 2010
- T2. Rao R M and A S Bopardikar, Wavelet Transforms -Introduction to theory and Applications, Pearson Education, Asia, 2000.

Reference Book(s):

- R1. Stephane G Mallat, A Wavelet Tour of Signal Processing:The sponse way" Academic Press, Third edition, 2008
- R2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
- R3. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
- R4. C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.
- R5. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	3	3	-
CO2	3	3	2	-	-	-	-	1	-	1	-	3	3	-
CO3	2	1	-	-	-	-	-	1	-	1	-	3	3	-
CO4	3	3	2	-	-	-	-	1	-	1	-	3	3	-
CO5	2	1	-	-	-	-	-	1	-	1	-	3	3	-

High-3; Medium-2;Low-1

DIVERSIFIED ELECTIVES

Course Code: 19ECEN1008		Course Title: Telecommunication and Digital Switching Techniques	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1401- Analog Circuits II
- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Explain Various multiplexing and switching techniques
2. Analyze different digital switching systems
3. Analyze the need for network synchronization and management
4. Explain the essential concepts of ISDN and various types of Digital subscriber loops
5. Apply traffic theory to understand the characteristics of the telephone systems

Unit I Evolution of Switching Systems 9 Hours

Digital Transmission: Frequency Division Multiplexing – Time Division Multiplexing – Message Switching – Circuit Switching – Packet Switching – Manual Switching system, Strowger or Step by Step System, Electronic Switching, Control of Switching systems.

Unit II Digital Switching 9 Hours

Switching functions: Space Division Switching – Time Division Switching, Two-dimensional Switching: STS Switching – TST Switching, No. 4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment, Elements of SSN 07 Signalling.

Unit III Network Synchronization Control And Management 9 Hours

Timing: Timing Recovery – Phase Locked Loop, Clock Instability, Jitter Measurements: Systematic Jitter, Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

Unit IV Digital Subscriber Access

ISDN :L ISDN Basic Rate Access Architecture – ISDN D Channel Protocol - Digital Subscriber Loops: High Data Rate DSL - Asymmetric DSL – VDSL.

Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems – Integrated Digital Loop Carrier Systems – Next Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Coax Systems, Voice Band Modems, PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.

Unit V Traffic Analysis

Traffic Characterization, Traffic Measurements: Arrival Time Distributions – Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential Service Times - Constant Service Times, Finite Queues, Tandem Queues.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain various multiplexing and switching techniques involved in Telecommunication	Understand
CO2. Analyze different digital switching systems for reliable Telecommunication	Analyze
CO3. Analyze the need for network synchronization and management in Telecommunication	Analyze
CO4. Explain the essential concepts of ISDN and various types of Digital subscriber loops based on their characteristics	Understand
CO5. Apply traffic theory to understand the characteristics of the telephone systems using probability	Apply

Text Book(s):

- T1. Thiagarajan Viswanathan, “Telecommunication Switching Systems and Networks”, 2nd Edition, PHI Learning Pvt. Ltd., 2015.
- T2. Bellamy John, “Digital Telephony”, 3rd Edition, John Wiley and Sons, 2000.

Reference Book(s):

- R1: D N Krishna Kumar, "Telecommunication and Switching", Sanguine Technical Publishers, Bangalore, 2008.
- R2: J.E.Flood, "Telecommunication Switching, Traffic and Networks", 1st Edition, Pearson Education Ltd., 2011.
- R3: Syed R Ali, "Digital Switching Systems", Mc Graw Hill, 1998.
- R4: Behrouz A. Forouzan, "Data Communication and Networking", 5th Edition, Tata Mc Graw Hill, 2016.

Web References:

1. <https://nptel.ac.in/courses/117/104/117104128/>
2. <https://nptel.ac.in/courses/117/105/117105076/>
3. <https://nptel.ac.in/courses/106/105/106105082/>
4. <https://nptel.ac.in/courses/117/104/117104104/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2

High-3; Medium-2;Low-1

purity and convergence - automatic degaussing circuit, Colour signal transmission: bandwidth - modulation of colour difference signals - weighting factors - Formation of chrominance signal.

Unit IV Colour TV Systems

9 Hours

NTSC colour TV system: NTSC colour encoder and decoder - limitations of NTSC system , PAL colour TV system: cancellation of phase errors, PAL-D colour system: PAL coder - PAL-D colour receiver - chromo signal amplifier - Ident and colour killer circuits - Colour signal matrixing - merits and demerits of the PAL system, SECAM system: merits and demerits of SECAM system

Unit V Advanced Television Systems

9 Hours

Cable TV – DBS TV - Digital television: Transmission and reception – MAC Signals- DTH - DVB - Flat panel display - LCD, LED and Plasma screen receivers - 3D Stereoscopic TV Techniques -HDTV

Course Outcomes

Cognitive Level

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

CO1. Identify the basic requirements for Television broadcasting system in terms of scanning process, camera tubes, picture tubes and transmission bandwidth.	Analyze
CO2. Categorize various blocks of Monochrome TV Transmitter and Receiver with their functionalities.	Analyze
CO3. Differentiate the Monochrome and Colour Television systems with their essential requirements.	Analyze
CO4. Categorize the standards of Colour Television system with their appropriate specifications.	Analyze
CO5. Identify the modules of advanced Television system in comparison with fundamental system.	Analyze

Text Book(s):

- T1. R.R.Gulati, “ Monochrome Television Practice, Principles, Technology and servicing , 3rd Edition, New age International Publisher, 2010
- T2. R.R.Gulati, “Monochrome and Colour television “, New age International Publisher, 2003

Reference Book(s):

- R1. A.M Dhake, "Television and Video Engineering", 2nd Edition, TMH, 2003.
- R2. S.P.Bali, " Colour Television, Theory and Practice", TMH, 1994
- R3. R.G.Gupta, "Television Engineering and Video systems", 1st Edition, TMH India 2007.
- R4. Bernard Grob, "Basic Television Principles and servicing", 2nd Edition, New age International Publisher, 2004

Web References:

1. <http://www.ntsc-tv.com/>
2. <http://dmcitarsi.com/television-transmission/>
3. <http://www.tech-faq.com/how-television-broadcasting-works.html>
4. <http://2012books.lardbucket.org/pdfs/mass-communication-media-and-culture/s12-television>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	3	2	2	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1013		Course Title: Error Control Coding	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1501- Analog and Digital Communication

Course Objectives

The course is intended to:

1. Analyze the significance of Error detection/correction methods
2. Analyze the various linear codes
3. Analyze the various Cyclic codes
4. Analyze BCH and RS codes
5. Apply convolutional codes to achieve reliable data transfer

Unit I Coding Theory

9 Hours

Introduction to information theory –Information, Entropy, Mutual information, Shannon Theorems, Channel models, Hamming Distance

Unit II Linear Codes And Block Codes

9 Hours

Definition of Linear Codes, Generator Matrices, The Standard Array, Parity - Check Matrices, Error Syndromes, Error Detection and Correction, Shortened and Extended Linear Codes. Introduction to Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, Hamming Codes, Minimum Distance of Block Codes, Soft - Decision Decoding.

Unit III Cyclic Codes

9 Hours

Definition of Cyclic Codes, Polynomials, Generator Polynomials, Encoding Cyclic Codes, Decoding Cyclic Codes, Factors of $X^N + 1$, Parity-Check Polynomials, Dual Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Error Detection and Correction of cyclic codes.

Unit IV BCH and RS Codes**9 Hours**

Review on Linear Algebra, Galois Field, Definition and Construction of Binary BCH Codes, Error Syndromes In Finite Fields, Decoding- Single Error Correction (SEC) and Double Error Correction (DEC), Reed- Solomen Codes.

Unit V Convolution Codes**9 Hours**

Convolution, Encoding Convolutional Codes, Generator Matrices for Convolutional Codes, Generator Polynomials for Convolutional Codes, Graphical Representation of Convolutional Codes, The Viterbi Decoder.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the Significance of Error detection/correction methods in Data Communication	Analyze
CO2:Analyze the various linear codes for error correction and error detection	Analyze
CO3: Analyze the various Cyclic codes for error correction and error detection	Analyze
CO4: Analyze BCH and RS codes in Data Communication	Analyze
CO5: Apply convolutional codes to achieve reliable data transfer	Apply

Text Book(s):

- T1. Moreira Jorge Castineira, Farrell Patrick Guy, "Essentials Of Error Control Coding", Wiley India, 2013.
- T2. Gravano Salvatore, "Introduction to Error Control Codes", Oxford University Press, 1st Edition, 2007.

Reference Book(s):

- R1. Ranjan Bose, "Information Theory, Coding and Cryptography", 2nd Edition, TMH, 2009.
- R2. Lin Shu; Costello Daniel J, "Error Control Coding : Fundamentals And Applications", Pearson, 2011
- R3. Sklar Bernard, "Digital Communications - Fundamentals and Applications", Pearson Education-LPE, 2nd Edition, 2009.
- R4. Todd K. Moon, "Error Correction Coding – Mathematical Methods and Algorithms", Wiley India. 2006.
- R5. Man Young Rhee, "Error Correcting Coding Theory", McGraw – Hill, 1989.

Web References:

1. <https://nptel.ac.in/courses/117/104/117104121/>
2. <https://nptel.ac.in/courses/117/106/117106031/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO2	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

UNIT IV Memory System**9 Hours**

Basic concepts – semiconductor RAMs, ROMs – Speed, size and cost – cache memories - Performance consideration – Virtual memory- Memory Management requirements, Secondary storage.

UNIT V I/O Organization**9 Hours**

Computer peripherals- Input and output devices, serial communication links; Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface circuits – Standard I/O Interfaces (PCI, SCSI, and USB);

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Identify the various modules of the computer system.	Analyze
CO2. Design high speed Arithmetic unit that can perform various arithmetic Operations.	Create
CO3. Identify the basic blocks of processing unit with reference to the concept of pipelining.	Analyze
CO4. Classify various memories used in computer system based on their function.	Analyze
CO5. Classify the various i/o peripherals based on the data transfer modes.	Analyze

Text Book(s):

- T1. Carl Hamacher, Safwat Zaky, Zvonko Vranesic, “Computer Organization”, Tata McGraw-Hill Education Pvt. Ltd, 5th Edition 2011.
- T2. William Stallings, “Computer Organization and Architecture” – Designing for Performance 8th Edition Pearson Education, 2010.

Reference Book(s):

- R1. David A. Patterson and John L. Hennessey, “Computer organization and design”, Morgan Kauffman, 2014.
- R2. Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, 2nd Edition, Pearson Education, 2005.
- R3. Govindarajalu B, “Computer Architecture and Organization, Design Principles and Applications”, Second edition, Tata McGraw Hill, New Delhi, 2010.
- R4. AharonYadin, “ Computer Systems Architecture”, Chapman and Hall/CRC, 2016

Web References:

1. <http://nptel.ac.in/courses/106102062/>
2. https://www.cis.upenn.edu/~milom/cis501-Fall11/lectures/00_intro.pdf
3. <https://inspirit.net.in/books/academic/Computer%20Organisation%20and%20Architecture%20e%20by%20William%20Stallings.pdf>
4. <http://www.nptelvideos.in/2012/11/computer-architecture.html>
5. <http://www.learnerstv.com/Free-Computer-Science-Video-lectures-ltv086-Page1.html>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO2	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO3	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	3
CO5	3	2	1	1	-	-	-	1	-	1	-	1	1	3

High-3; Medium-2;Low-1

Course Code: 19ECEN1014		Course Title: Biomedical Electronics	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN1401 - Analog Circuits- II

Course Objectives

1. Explain the basic concepts of Bio Medical Electronics
2. Categorize the various technique involved in the Electro physical measurements
3. Describe Non-Electrical Biomedical parameter measurement.
4. Illustrate Bio medical imaging techniques
5. Explain the Therapeutic and Prosthetic Devices

Unit I Basic Concepts of Biomedical Electronics

9 Hours

Cells, Tissues, Organs- Structure and Properties. Epithelial tissue, Connective tissue, cartilage, bone, skin, teeth. Dermal Prosthesis, Facial Prosthesis, Soft tissue replacement, hard tissue replacement, Biocompatibility.

Unit II Electro Physical Measurements

9 Hours

Electrodes: Half Cell Potential, Electrode paste, polarizable and non-polarizable, surface, Depth, needle and micro electrodes and their equivalent circuits. Bio potential amplifiers – Basic Requirements, Medical Pre amplifiers. ECG, EEG, EMG – Lead systems and recording methods.

Unit III Non- Electrical Measurements

9 Hours

Measurement of Blood pressure, blood flow, cardiac output and heart sounds, respiratory rate, lung volumes and capacities, Plethysmography, gas volume: measurement of pH of blood, PO₂, PCO₂.

Unit IV Biomedical Imaging Techniques**9 Hours**

X-Ray and CT Imaging, PET and SPECT Imaging, Magnetic Resonance Imaging, Ultrasonic Imaging, Infra-Red Imaging, Other Imaging Techniques, Application of filtering in medical images: Noise models– Mean Filters – Order Statistics – Adaptive filters and algorithms - Recursive Least Square (RLS) - the Least Mean Square.

Unit V Therapeutic and Prosthetic Devices**9 Hours**

Cardiac Pacemakers : Energy requirements, Methods of stimulation, types : Fixed rate and Demand, Defibrillators : Internal and External : AC defibrillator and Double square Pulse defibrillator, Ventilators, Diathermy, Stimulators, Heart Lung Machine, Dialyzers, Bio sensors, Biomaterials for implantable purposes, its characteristics and testing.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Explain the basic concepts of Bio Medical Electronics	Understand
CO2. Categorize the various techniques involved in the Electro physical measurements using Bio-potential recording methods	Analyze
CO3. Describe Non-Electrical Biomedical parameter measurements	Understand
CO4. Illustrate Bio medical imaging techniques	Understand
CO5. Explain the Therapeutic and Prosthetic Devices	Understand

Text Book(s):

- T1. Khandpur R S, "Handbook of Biomedical Instrumentation ", 2nd Edition, Tata McGraw-Hill, New Delhi, 2003.
- T2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2nd Edition, prentice hall of India, New Delhi, 2004.
- T3. Hench L.L. and E.C.Ethridge, "Biomaterial: an interfacial approach", Academic Press, 1982.

Reference Book(s):

- R1. Arumugam M., "Biomedical Instrumentation", 2nd Edition, Anuradha Publications, Chennai, 2006.
- R2. Joseph J.Carr and John M. Brown, "Introduction to Biomedical Equipment Technology," 4th Edition John Wiley and sons, New York, 1997.
- R3. Geddes L A and L.E.Baker, "Principles of Applied Bio-medical Instrumentation", 3rd Edition, John Wiley and Sons, 1975.

R4. John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, John Wiley and sons, New York, 1998.

R5. Gray E Wnek and Gray L Browlin, “ Encyclopedia of Biomaterials and Biomedical Engineering “, Marcel Dekker Inc, New York, 2004.

Web References:

1. <http://nptel.ac.in/courses/117108037/15>

2. <http://nptel.ac.in/courses/1021030441>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO2	3	3	2	2	-	-	-	1	1	1	-	1	2	-
CO3	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO4	2	1	-	-	-	-	-	1	1	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	1	1	-	1	2	-

High-3; Medium-2;Low-1

Unit V RF Design Tools**9 Hours**

Design tool basics-Design languages-RF IC design flow-RF IC design flow example-simulation examples-Modelling-Printed circuit board and packaging anatomy-CAD tools for PCB design.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Explain the basics of RF circuits and analyse the noise parameters	Understand
CO2: Select the appropriate active and passive models for low Vs high frequency application	Analyze
CO3: Analyse the performance of RF amplifiers	Analyze
CO4: Explain the function of RF mixer and oscillators	Understand
CO5: Design the basic RF tools, simulation and modelling of CAD tools for PCB	Analyze

Text Book(s):

- T1. Thomas H.Lee, Design of CMOS Radio frequency Integrated circuits, Cambridge University press, 1998 (2013 reprint) ISBN 9780521639224.
- T2. Stephen H.hall, Garrett W.Hall, James A. McCall High Speed Digital System Design: Hand book of Interconnect Theory and Design Practices, Wiley IEEE press, 2000

Reference Book(s):

- R1. Chris Bowick, RF Circuit Design, Elsevier, U.S./India, 2007, 2nd Edition, ISBN: 9780750685184.
- R2. Behzad Razavi, RF Microelectronics, Pearson India, Second Edition, 2014.
- R3. Reinhold Ludwig, Gene Bogdanov, RF Circuit Design Theory And Application, Pearson India, Second Edition, 2011
- R4. Richard, RF Circuit Design, Wiley Publishers, 2012.

Web References:

- 1. https://nptel.ac.in/content/syllabus_pdf/117106089.pdf
- 2. <https://nptel.ac.in/courses/117/106/117106089/>
- 3. <https://www.youtube.com/playlist?list=PL804EBBC9541F0D5A>.
- 4. <https://www.nist.gov/programs-projects/high-speed-electronics>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	-	2	1
CO2	3	3	2	2	-	-	-	1	-	1	-	-	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	-	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	-	2	1
CO5	3	3	2	2	-	-	-	1	-	1	-	-	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1021		Course Title: Advanced Microcontrollers	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECCN2601 - Microcontroller& its interfacing techniques

Course Objectives

The course is intended to:

1. Select an appropriate microcontroller for an application
2. Discuss the features of MSP430 microcontroller
3. Explain the Architecture of MSP430 Processor
4. Program using PIC 18 Microcontroller
5. Create simple projects using PIC Microcontroller

Unit I Overview of Microcomputer Systems

9 Hours

RISC Verses CISC Processor - Microcontrollers – Types – Selection of Microcontrollers – Architecture (8048) - Resources of Microcontrollers – Applications

Unit II MSP430 microcontroller

9 Hours

The Texas Instruments MSP430: Pin-Out- Functional Block Diagram- Memory- Central Processing Unit- Memory-Mapped Input and Output- Clock Generator- Exceptions: Interrupts and Resets- Watchdog Timer.

Unit III Architecture of the MSP430 Processor

9 Hours

Central Processing Unit- Addressing Modes- Constant Generator and Emulated Instructions- Instruction Set- Examples- Resets- Clock System

Unit IV PIC Microcontroller (PIC18)

9 Hours

PIC Architecture: The WREG Register, File Register, Status Register, Data Format and Directives – PIC Programming in C: Data types and Time delays, I/O Programming, Logic Operations, Data serialization, Program ROM and Data RAM Allocation.

Unit V Applications of PIC Microcontroller-Case study and Projects

9 Hours

Model Train Traffic Light Control using a Hall Effect Sensor, Serial LCD Interfacing, Switch Matrix Key Matrix, Blinking Light and Music, TV IR Remote Control Robot, DC Motor Control Application.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Select an appropriate microcontroller for an application	Understand
CO2. Explain the features of MSP430 microcontroller	Understand
CO3. Explain the Architecture of MSP430 Processor	Understand
CO4. Write an Embedded C Program using PIC 18 Microcontroller	Apply
CO5. Create simple projects using PIC Microcontroller	Apply

Text Book(s):

- T1. Raj Kamal, "Microcontrollers – Architecture, Programming, Interfacing and System Design", Pearson Education, 2007
- T2. Muhammad Ali Mazidi , Rolin D. McKinlay , Danny Causey "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18 ",Pearson Education,2008
- T3. John H. Davies "MSP430 Microcontroller Basics"Elsevier,2008

Reference Book(s):

- R1. Daniel Tabak, "Advanced Microprocessors" McGraw Hill.Inc., 2008.
- R2. Myke Predko, "Programming and Customizing the PIC Microcontroller", Tata McGraw-Hill, 2008

Web References:

1. <https://nptel.ac.in/courses/117/104/117104072/>
2. <https://www.alldatasheet.com/datasheet-pdf/pdf/27250/TI/MSP430.html>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1031		Course Title: Introduction to MEMS	
Course Category:	Professional Elective	Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ECSN2201- Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Understand the basic principles of sensors and actuators
2. Explain the basic mechanics in MEMS design
3. Identify electrostatic design and the associated system issues
4. Illustrate the different applications of MEMS
5. Understand the working of optical and RF MEMS

Unit I Introduction to MEMS

9 Hours

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication.

Unit II Mechanics for MEMS Design

9 Hours

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

Unit III Electro Static Design and System Issues

9 Hours

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. bistable actuators. Electronic Interfaces, Feedback systems, Noise, Circuit and system issues.

Unit IV MEMS Application

9 Hours

Case studies – Capacitive accelerometer, Piezo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS.

Unit V INTRODUCTION TO OPTICAL AND RF MEMS**9 Hours**

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies- MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Mems –design basics, case study – Capacitive RF MEMS switch, performance issues.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Develop electrical and mechanical model MEMS sensors and actuators	Apply
CO2. Explain mechanics associated with MEMS design.	Understand
CO3. Analyse electrostatic circuits and issues in MEMs	Analyse
CO4. Construct electro mechanical model of MEMS	Apply
CO5. Explain the working concept of optical and RF MEMS	Understand

Text Book(s):

T2.Stephen Santerria, "Microsystems Design", Springer, 2016".

T1. Nadim Maluf,"An Introduction to Micro Electro Mechanical System Engineering, Artech House, 2004

Reference Book(s):

R1. Ai Qun Liu, "Photonic MEMS Devices", CRC press Bocaraton, 2009.

R2. Tai Ran Hsu, "MEMS & Micro Systems Design, Manufacture and Nanoscale Engineering", John Wiley, New Jersy, 2008.

Web References:

1. <https://nptel.ac.in/courses/117/105/117105082/>

2.https://onlinecourses.nptel.ac.in/noc20_ee52/preview

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	3	3	2	2	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19ECEN1032		Course Title: Nano Electronics	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19PHBC2001- Physics for Electrical Sciences

Course Objectives

The course is intended to:

1. Understand the basic concepts of quantum mechanics
2. Classify the types of harmonic oscillators and its approximations.
3. Explain nano electronic system with more than one degrees of freedom
4. Illustrate the basic concepts of statistical mechanics
5. Explain the applications of nano electronic system.

Unit I Introduction to Quantum Mechanics

9 Hours

Particles, waves, probability amplitudes, schrodinger equation, wave packets solutions, operators, expectation values, eigen functions, piecewise constant potentials.

Unit II Simple Harmonic Oscillators and Approximations

9 Hours

SHM Operators, SHM wave packet solutions, Quantum LC circuit, WKB approximations, variational methods.

Unit III Systems with Two and Many Degrees of Freedom

9 Hours

Two level systems with static and dynamic coupling, problems in more than one dimensions, electromagnetic field quantization, density of states.

Unit IV Statistical Mechanics

9 Hours

Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metals and semiconductors

Unit V Applications

9 Hours

Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Describe the basic concepts of quantum mechanics.	Understand
CO2. Classify the types of harmonic oscillators and its approximations.	Understand
CO3. Construct the nano electronic system with more than one degrees of freedom.	Apply
CO4. Illustrate the basic concepts of statistical mechanics.	Apply
CO5. Develop a nano electronic system for particular application.	Apply

Text Book(s):

T1.Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics", New York, NY: Wiley, 2004.

T2.Rainer Waser, "Nanoelectronics and Information Technology", Wiley, 3rd Edition, 2012

Reference Book(s):

R1. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.

R2. Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.

Web References:

1. <https://nptel.ac.in/courses/117/108/117108047/>

2. <https://nptel.ac.in/courses/118/104/118104008/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-			1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19CSEC1001		Course Title: Programming Using JAVA (Common to EC,EE & EI)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites The student should have undergone the course(s):

- 19CSC2001 - C Programming
- 19ITSN2302 - Data Structures and Algorithms-I

Course Objectives

The course is intended to:

1. Describe the distinct properties and features of Java.
2. Implement name spaces, concurrency and handle exceptional conditions.
3. Employ Java standard library functions.
4. Apply Java utility, input/output functions and file manipulators.
5. Develop Java applications using user interfaces and database connectivity.

9 Hours

Unit I Introduction

Overview of Java – Data types, operators, control flows –Class fundamentals, objects and constructors –Method overloading- argument passing, Returning objects, recursion – Method Overriding and Dynamic Method dispatch- Abstract class.

Unit II Packages, Exceptions and Threads

9 Hours

Packages and access protection – Interfaces and extending interfaces – Exception fundamentals and types – Try, catch, throw, throws and finally; Chained Exceptions – Thread model, Creating threads and thread priorities – Synchronization –Inter thread communication.

Unit III Java Utilities

9 Hours

String Handling –String Buffer class and functions – Library Functions – Math – Process – Clone – System Functions.

Unit IV Collections and I/O Streams

9 Hours

Collections – Classes and Interfaces – Iterators and User defined collections – String Tokenizer – Java I/O classes and Interfaces - Streams – Byte Streams - Character Streams – File concepts.

Unit V Exploring Swing**9 Hours**

Java Swing – Features –Components and Containers – Event handling – Exploring Swing – Menus – Java Database Connectivity.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Describe the distinct properties and features of Java.	Understand
CO2:Implement name spaces, concurrency and handle exceptional conditions in programs.	Apply
CO3:Employ Java standard library functions for solving complex problems.	Apply
CO4:Apply Java utility, input/output functions and file manipulators	Apply
CO5:Develop Java applications using user interfaces and database connectivity	Apply

Text Book(s):

- T1.Herbert Schildt, "Java the Complete Reference", McGraw Hill Education Ninth Edition, 2014
- T2.Mahmoud Parsian, "JDBC Metada, MySQL and Oracle Recipes: A Problem-Solution Approach", Apress Publications, 2006

Reference Book(s):

- R1. Bart Baesens, Aimee Backiel, SeppeVandenBrocke, "Beginning JavaProgramming: The Object Oriented Approach", John Wiley & Sons, 2015.
- R2. Daniel Liang, "Introduction to Java Programming, Comprehensive Version", Pearson Education, 9th Edition, 2014.
- R3. James M Slack, Programming and Problem solving with JAVA, ThomsonLearning, 2002.
- R4. C Thomas Wu, An Introduction to Object Oriented programming with Java, Tata McGrawHill, 2005.
- R5. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", 8th Edition, Sun Microsystems Press, 2008.

Web References:

1. <https://docs.oracle.com/javase/tutorial/java/index.html>
2. <http://javabeginnerstutorial.com/core-java/>
3. <http://www.w3schools.in/java/>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	1	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	1	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19CSEC1002	Course Title: Data Mining and Analytics (Common to EC,EE & EI)		
Course Category: Professional Elective	Course Level: Mastery		
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites: The student should have undergone the course(s):

- 19CSSC2001 - C Programming
- 19ITSN2302 - Data Structures and Algorithms-I

Course Objectives

The course is intended to:

1. Select the appropriate pre-processing technique.
2. Relate the techniques of association rule.
3. Evaluate the classification algorithms.
4. Apply the clustering algorithms.
5. Analyze the requirements for a big data analytics.

Unit I Data Preprocessing

9 Hours

Data Mining Overview – Data Objects and Attribute Types – Data Visualization. Data Pre-processing: Data Cleaning – Data Integration – Data Reduction – Data Transformation and Data Discretization.

Unit II Association

9 Hours

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods –Basic Concepts – Frequent Item set Mining Methods – Pattern Evaluation Methods. Advanced Pattern Mining: Pattern Mining: A Road Map – Pattern Mining in Multilevel, Multidimensional Space.

Unit III Classification

9 Hours

Basic Concepts: Decision Tree Induction – Bayes Classification Methods – Rule Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy.

Unit IV Clustering

9 Hours

Cluster Analysis: Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid

Based Methods – Evaluation of Clustering.

Unit V Introduction To Big Data

9 Hours

Introduction to Big Data: Classification of Digital Data – Characteristics, Evolution and Definition of Big data - Challenges with Big Data – Traditional Business Intelligence (BI) vs Big Data – The Big Data Technology Landscape: Hadoop. Introduction to Hadoop: Hadoop Overview – Hadoop Distributors - Hadoop Distributed File System.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1. Choose the appropriate pre-processing technique to solve the given problem.	Apply
CO 2. Apply the techniques of association rule to real world data	Apply
CO 3. Evaluate the classification algorithms with respect to their accuracy.	Apply
CO 4. Apply the clustering algorithms to group the real world data.	Apply
CO 5. Analyze the requirements for a big data analytics system for the organization.	Apply

Text Book(s):

- T1. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3rd Edition, Elsevier, 2012.
- T2. SeemaAcharya, SubhashiniChellappan, “Big Data and Analytics”, 1st Edition, Wiley India, 2015.

Reference Book(s):

- R1. Jure Leskovec, AnandRajaraman, Jeffery David Ullman, “Mining of Massive Datasets”, 2nd Edition, Cambridge University Press, 2014.
- R2. Ian H.Witten, Eibe Frank, Mark A.Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, 3rd Edition, Elsevier, 2011
- R3. EMC Education Services, “Data Science and Big Data Analytics”, Wiley, 2015
- R4. DT Editorial Services, “Black Book- Big Data (Covers Hadoop 2, MapReduce, Hive, Yarn, PIG, R, Data visualization)”, Dream tech Press edition 2016
- R5. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, 2006

Web References:

1. http://hanj.cs.illinois.edu/bk3/bk3_slidesindex.html
2. <http://www.mmds.org/>
3. <http://www.kdnuggets.com/tutorials/index.html>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	1	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19CSEC1003	Course Title: Software Testing (Common to EC,EE & EI)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

The student should have undergone the course(s):

- 19CSSC2001 - C Programming
- 19ITSN2302 - Data Structures and Algorithms-I

Course Objectives

The course is intended to:

1. Describe the software testing principles and its characteristics.
2. Choose the appropriate testing for software development.
3. Design Test cases suitable for a software development in various domains.
4. Justify the importance of planning, documenting and validating the test plan.
5. Illustrate the need for automatic testing tools.

Unit I Testing Fundamentals

9 Hours

Introduction to testing as Engineering Activity –Testing Fundamentals: Basic Definitions- Testing principles-Tester's role –Defects, Hypotheses and Tests.

Unit II Levels of Testing

9 Hours

The need for levels of Testing- Unit Test: Functions, Procedures, Classes, and Methods as Units- Unit Test: The Need for Preparation- Unit Test Planning- Designing the Unit Tests- Running the Unit Tests and Recording Results- Integration Test: Goals- Integration Strategies for Procedures and Functions- Integration Strategies for Classes- Designing Integration Tests- Integration Test Planning- System Test: The Different Types- Regression Testing- Alpha, Beta, and Acceptance Tests.

Unit III Designing Test Cases

9 Hours

Test case design strategies-Using Black Box approach to Test Case design-Random Testing – Equivalence class partitioning –Boundary value Analysis-Cause effect testing and state transition testing-Error Guessing - Using White Box Approach to Test case design – Test Adequacy Criteria –Coverage and Control Flow Graphs – Covering Code Logic – Paths –

Additional test design approaches- code complexity testing – Evaluating Test Adequacy Criteria.

Unit IV Test Management

9 Hours

Test Planning: Preparing a plan – scope management – deciding test strategy – responsibilities –resource requirements – test deliverables –testing tasks – Test management: standards – infrastructure management- People management – product release - Test Process – Test Reporting.

Unit V Test Automation

9 Hours

Test Automation – Terms – Skills required – Scope of automation- Design and Architecture for Automation – Process Model – Selecting Test tools – automation for extreme Programming- Test Metrics and Measurements.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the software testing principles and its characteristics.	Understand
CO2: Choose the appropriate testing during the phases of software development.	Apply
CO3: Design Test cases suitable for a software development in various domains.	Apply
CO4: Justify the importance of planning, documenting and validating the test plan.	Apply
CO5: Illustrate the need for automatic testing tools.	Apply

Text Book(s):

T1. Ilene Burnstein, "Practical Software Testing: A Process-Oriented Approach", Springer International Edition, 2013.

T2. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.

Reference Book(s):

R1. Ron Patton, "Software Testing", Sams Publishing, Pearson Education, 2nd Edition, 2009

- R2. Boris Bezier, "Software Testing Techniques", Dreamtech, 2nd Edition, Reprint 2009
- R3. Aditya P. Mathur, "Foundations of Software Testing: Fundamental Algorithms and Techniques", Pearson Education, 2008
- R4. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
- R5. Renu Rajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill, 2004.

Web References:

1. <http://nptel.ac.in/courses/106105150/>
2. Lecture <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-11/>
3. <http://www.testingtools.com/>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	1	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	1	1	-	2	2	-

High-3; Medium-2; Low-1

files – Static hashing, Dynamic hashing, Comparison of ordered indexing and hashing, Multiple key access - Query Processing – Overview, Measures of query cost, Selection operation, Sorting, Join operation - Query Optimization – Overview, Estimating statistics of expression results, Transformation of relational expressions

Unit V Transaction and Concurrency Control

9 Hours

Transactions – Transaction concept, Transaction state, Implementation of atomicity and durability, Concurrent executions, Serializability, Recoverability, Testing for serializability - Concurrency control – Lock based protocols, Timestamp based protocols, Validation based protocols, Multiple granularity, Multiversion schemes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Construct the Entity Relationship Model for obtaining the structure of a database	Apply
CO2. Convert ER diagram to relational database schema	Apply
CO3. Apply the normalization technique to obtain the relational database design.	Apply
CO4. Select a query evaluation and optimization technique for a given query.	Apply
CO5. Implement online transactions and control concurrency	Apply

Text Book(s):

- T1. Silberschatz, Korth, Sudarshan, "Database System Concepts", 6th Edition, McGrawHill International Edition, New Delhi 2010
- T2. Date C.J., Kannan A, Swaminathan S, "An introduction to database systems", 8th Edition, Pearson Education, New Delhi, 2009.

Reference Book(s):

- R1. Elmasri, R., Navathe, S.B., "Fundamentals of database systems", 6th Edition, Pearson Education, New Delhi, 2010.
- R2. Raghu Ramakrishnan, Johannes Gehrke. "Database Management Systems", 3rd Edition, McGrawHill International Edition, New Delhi 2007.
- R3. Bipin C Desai, "An Introduction to Database Systems", Eleventh Edition, Galgotia Publications Pvt. Ltd., New Delhi, 2001.

R4. Bipin C Desai, "An Introduction to Database Systems", 11th Edition, Galgotia Publications Pvt. Ltd., New Delhi, 2001.

R5. Jeffrey D. Ullman and Jennifer Widom, "A First Course in Database Systems", 3rd Edition, Prentice-Hall, New Delhi, 2007.

R6. C.J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05

2. <http://codex.cs.yale.edu/avi/db-book/db6/slide-dir/>

3. www.nptelvideos.in/2012/11/database-management-system.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO2	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO4	3	2	1	1	1	-	-	1	1	1	-	2	2	-
CO5	3	2	1	1	1	-	-	1	1	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ECCN1036	Course Title: Industrial Electronics		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

- 19ECSN2201 - Electric Circuits and Electron devices

Course Objectives

The course is intended to:

1. Explain various power switching devices.
2. Compute the performance parameters.
3. Identify a DC-DC converter.
4. Explain the operation of inverters and harmonic reduction.
5. Describe the operation of AC voltage controller and cyclo converter.

Unit I **Power Switches**

9 Hours

Power Diode: reverse recovery characteristics, types

SCR: Two transistor model, turn-on methods, communication techniques, dynamic behavior, types, series and parallel connection, UJT trigger circuit, protection circuits: over voltage and over current and snubber circuits, losses and cooling – TRIAC & GTO: Construction, dynamic behavior and driver circuit.

MOSFET & IGBT: Construction, dynamic behavior and driver circuit.

Unit II **Controlled Rectifiers**

9 Hours

Controlled Rectifiers: 1 pulse, 2 pulse, 3 pulse and 6 pulse converters with R and RL loads, dual converter, performance parameters, estimation of average load voltage and effect of source impedance.

Unit III **DC Converters**

9 Hours

Choppers: Principle of step-up and step-down operation, Time ratio control and current limit control, types, forced commutation techniques (voltage, current and load).

Switching regulators: Operation of Buck, Boost and Buck-boost regulators.

Unit IV **Inverters**

9 Hours

Inverter: single-phase half and full bridge, Three-phase six steps VSI and CSI, Control: voltage control of single phase inverter, output AC voltage control and harmonic reduction.

Unit V AC-AC Converter**9 Hours**

AC Voltage controller: types of control – on-off, Phase angle control and sequence control,
Single phase: with R and RL loads, Three phase: Star and delta connected loads.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Outline the overview of Power semiconductor devices their dynamic characteristics.	Understand
CO2. Compute the performance parameters of controlled rectifiers.	Understand
CO3. Identify a DC-DC converter for a given application	Understand
CO4. Explain the modulation techniques of PWM inverter and harmonic reduction methods	Understand
CO5. Describe the operation of AC voltage controller and cyclo converter.	Understand

Text Book(s):

- T1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 3rd Edition (reprint), 2011.
- T2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition, 2004.

Reference Book(s):

- R1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, 3rd Edition reprint), 2009.
- R2. Joseph Vithayathil, "Power Electronics: Principles and Applications", tata McGraw-Hill, New Delhi, 2010.
- R3. M.D.Singh and K.B.Khanchandani, "Power Electronics", Tata McGraw Hills Publishing Company Limited, 2nd Edition, 2006.
- R4. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 1st Edition,

Web References:

1. <http://nptel.ac.in/courses/117106093/>
2. <http://www.vlsi-expert.com/p/vlsi-basic.html>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Course Code: 19EEEC1001		Course Title:Industrial Automation (Common to EC & EE)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites:

- 19ECCN1302 - Digital Principles and System Design
- 19ECCN1502 - Control Systems

Course Objectives

The course is intended to:

1. Justify the need for automation in industry
2. Describe the architecture and types of PLC used in industry automation
3. Develop the PLC based control logic program according to their application
4. Explain industry networking Protocols and SCADA programming
5. Explain the applications of DCS in various power plants

9 Hours

Unit I Introduction to Factory Automation

History and developments in industrial automation- Vertical integration of industrial automation- Building blocks in Automation: Processing systems, Multi microprocessor systems, LAN, analog and digital I/O modules, remote terminal unit

Unit II Programmable Logic Controllers

9 Hours

PLC an Overview- Parts and Architecture of PLC- Principles of Operation - I /O Specifications - Memory types-Programming devices- PLC vs Computers, PLC size and Applications, Advantages of PLC, selection of PLC

Unit III Programming of PLC

9 Hours

Program scan - PLC Programming Languages-Simple process control programs using Relay Ladder Logic - Programming Timers : On delay timer, OFF delay timer- Programming counters: Up and Down counter – PLC arithmetic functions –Program Control Instructions- Math Instructions-data transfer operations-Data comparison instructions

Unit IV Industry Networking and SCADA

9 Hours

PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus

and Ethernet .SCADA-Channel scanning-conversion to engineering units- data processing – Distributed SCADA systems- HMI introduction

Unit V Distributed Control System and Applications

9 Hours

DCS: Evolution – Different architectures – local control unit – Operator interface – Displays – Engineering interface. **Applications:** Thermal power plant-cement plant-water treatment plant-Solar, windmill substation automation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Justify the need for automation in industry	Understand
CO2. Describe the architecture and types of PLC used in industry automation	Understand
CO3. Develop the PLC based control logic program according to their application	Apply
CO4. Explain industry networking Protocols and SCADA programming	Understand
CO5. Explain the applications of DCS in various power plants	Understand

Text Book(s):

T1. Frank D Petruzella “Programmable Logic Controllers”, McGraw Hill Education India

T2. Bolton.W, “Mechatronics”, Pearson Education, 4th Edition,2014.

Reference Book(s):

R1.John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 5th edition, 2006

R2.Dobrivojje Popovic, Vijay P. Bhatkar, “Distributed Computer Control for Industrial Automation”, MarcelDekkar Inc., New York, 1st edition, 2011.

R3. Krishna Kant, ‘Computer based Industrial Control’, Prentice Hall of India, 2nd edition, 2010 .

R4. Rajesh Mehra and Vikrant Vij, “PLCs& SCADA- Theory and Practice”,Laxmi Publications, 1st edition, 2016.

Web References:

1. <http://www.fieldbus.org>
2. www.nptel.ac.in/downloads/108105063/
3. <http://nptel.ac.in/courses/108105062/18>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	1	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	1	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Course Code: 19EEEC1002		Course Title: Automotive Electronics (Common to EC & EE)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0		Credits:3	Total Contact Hours:45
			Max Marks:100

Prerequisites:

- Electron devices
- Microprocessor and Microcontroller

Course Objectives

The course is intended to:

1. Inculcate knowledge of mechanical system in automotive systems.
2. Understand the electronic system in automobiles.
3. Know the X-by-wire concepts in automobiles.
4. Understand the embedded system applications in automobiles.
5. Disseminate the knowledge of communication protocols used in automobiles.

Unit I Automotive Mechanical Systems 9 Hours

Vehicle Systems: Power Train System (Air System, Fuel System (Carburettor & Diesel Fuel Injection, Ignition System, Exhaust System and other Auxiliary Systems (Cooling, Lubrications & Electrical Systems)), Transmission System (Front, Rear & 4 wheel Drive, Manual, Automatic Transmission, Differential). Braking System (Drum, Disc, Hydraulic, Pneumatic), Steering System (Rack and Pinion, Power Steering).

Unit II Electronics in Automotive Systems 9 Hours

Performance (Speed, Power, and Torque), Control (Emission, Fuel Economy, Drivability, and Safety) & Legislation (Environmental legislation for pollution & Safety Norms). Overview of Chassis subsystem (ABS, TCS, & ESP) – Comfort and safety subsystems (Night Vision, Airbags, Seatbelt Tensioners, Cruise Control-Lane-departure-warning, Parking).

Unit III Drive by Wire 9 Hours

Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-by wire, gas-by-wire, power-by-wire, shift by wire- Future of Automotive Electronics

Unit IV Embedded System in Automotive Applications 9 Hours

Gasoline / Diesel systems Sensors – Nox sensor, Knock Sensor, MAP Sensor, Oxygen sensor, Throttle Position Sensor- Actuators - Idle speed control valves, Exhaust gas

recirculation valves Thermal actuators - Body electronics – Body electronics domain- Central locking and electric windows, Climatic Control - On-Board Diagnostics (OBD). Introduction to electric vehicles- Types of electric vehicles.

Unit V

Vehicle Communication Protocols

9 Hours

SPI, I2C, USB communication protocols - Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000. Introduction to AUTOSAR

Course Outcomes	
At the end of the course students will be able to:	Cognitive Level
CO1. Explain the mechanical systems of automobiles	Understand
CO2. Describe the electronic system in automobiles	Understand
CO3. Summarize the X-by-wire concepts in automobile	Understand
CO4. Outline the embedded system applications in automobiles	Understand
CO5. Explain the different communication protocols in embedded system for automobile	Understand

Text Books

T1. Robert Bosch GmbH, "Bosch Automotive Handbook", 10th Edition, Wiley Publishers, 2019

T2. William B. Ribbens, "Understanding Automotive Electronics", 7th Edition, SAMS/Elsevier Publishing, 2012

Reference Books

R1. Robert Bosch GmbH, Automotive Electrics and Automotive Electronics, Systems and Components, Networking and Hybrid drive, 5th edition, Springer Vieweg, Wiesbaden 2014

R2. Knowles.D, Automotive Electronic and Computer Controlled Ignition Systems, Reston Pub Co,1990

Web References

1. www.austincc.edu/autotech
2. www.austincc.edu
3. <https://aconline.austincc.edu/webapps/portal/frameset.jsp>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1

Unit V Labview Applications**9 Hours**

LabVIEW RT, Process control applications, Physical applications, Speed control, Data visualization, Imaging and Sound. Level, flow, temperature process, biomedical application - Pulse rate

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Discuss the importance of virtual instrumentation using Lab view	Understand
CO2.Develop virtual instruments using LabVIEW graphical programming tools	Understand
CO3. Apply the concept of Arrays, Strings and File I/O tasks in Data Acquisition	Apply
CO4. Select suitable Data acquisition system interfaces based on the Requirement	Apply
CO5.Examine DAQ hardware's and LabVIEW in various real time Environments	Apply

Text Book(s):

- T1. Jovitha Jerome, 'Virtual Instrumentation using LabVIEW' PHI Learning Private Limited, New Delhi, 2nd Printing, 2011
- T2. Gary W Johnson, Richard Jennings, 'LabVIEW Graphical Programming' 4th Edition, McGraw Hill, 2006

Reference Book(s):

- R1. R Sanjay Gupta, Joseph John, 'Virtual Instrumentation using LabVIEW' Tata McGraw Hill, 5th Reprint, 2010
- R2. Robert H Bishop. 'Learning with LabVIEW 2009' Pearson Education, 2010

Web References:

- 1. <http://www.av.it.pt/conftele2009/Papers/125.pdf>
- 2. https://www.researchgate.net/publication/3420671_What_is_virtual_
- 3. <http://www.ni.com/pdf/manuals/374629c.pdf>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Unit V Safety Regulations**9 Hours**

Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety – case studies

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Understand safety engineering fundamentals and safety management practices	Understand
CO2. Understand the basic concepts of chemical hazards	Understand
CO3. Summarize industrial health hazards and environmental control for protection	Apply
CO4. Identify and prevent hazards through analysis	Apply
CO5. Apply proper safety techniques on safety engineering and management	Understand

Text Book(s)

- T1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003
- T2. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 1986

Reference Book(s)

- R1. Safety Manual, "EDEL Engineering Consultancy", 2000.
- R2. Indian Electricity Act and Rules, Government of India.
- R3. Power Engineers – Handbook of TNEB, Chennai, 1989.
- R4. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

Web References

- 1.<https://nptel.ac.in/courses/110/105/110105094/>
- 2.<http://ccc.chem.pitt.edu/wipf/Web/HCH.pdf>
- 3.<https://www.preventionweb.net/publications/view/61941>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	-	1	1
CO2	2	1	-	-	-	-	-	1	-	1	-	-	1	1
CO3	3	2	1	1	-	-	-	1	-	1	-	-	1	1
CO4	3	2	1	1	-	-	-	1	-	1	-	-	1	1
CO5	2	1	-	-	-	-	-	1	-	1	-	3	1	1

High-3; Medium-2;Low-1

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 IV Replacement and Maintenance Analysis

9 Hours

Replacement and Maintenance analysis – 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 and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V Depreciation

9 Hours

Depreciation- 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- Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case study

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1. Categorize different cost and calculate the breakeven point for a given business situation	Understand
CO2. Apply different interest formulae and their application in decision making process.	Understand
CO3. Evaluate present value, future value and annual worth analysis on one or more economic alternatives.	Understand
CO4. Determine the economic value of an asset and develop a better replacement policy for given equipment.	Understand
CO5. Evaluate the depreciation of equipment per period.	Understand

Text Book(s):

T1.Panneerselvam R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2014

T2.Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2016.

Reference(s):

R1. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.

R2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2010.

Web References:

1. https://en.wikipedia.org/wiki/Engineering_economics
2. https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	2	3	1	-	-
CO2	2	1	-	-	-	-	-	1	-	2	3	1	-	-
CO3	2	1	-	-	-	-	-	1	-	2	3	1	-	-
CO4	2	1	-	-	-	-	-	1	-	2	3	1	-	-
CO5	2	1	-	-	-	-	-	1	-	2	3	1	-	-

High-3; Medium-2; Low-1

UNIT IV Directing**9 Hours**

Creativity and Innovation – Motivation and Satisfaction – Motivation Theories
Leadership – Leadership theories – Communication – Hurdles to effective
communication – Organization Culture – Elements and types of culture – Managing
cultural diversity

UNIT V Controlling**9 Hours**

Process of controlling – Types of control – Budgetary and non-budgetary control
techniques – Managing Productivity – Cost Control – Purchase Control –
Maintenance Control – Quality Control – Planning operations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1.Describe the role of managers with reference to an organization context and business.	Understand
CO2.Explain the significance of planning, decision making and strategies for international business to accomplish the organizational goal.	Understand
CO3.Explain the significance of organizing the tasks to accomplish the organizational goal.	Understand
CO4.Explain the motivational theories to increase the productivity and retention rate of employees.	Understand
CO5.Explain the control techniques such as budgetary, maintenance, quality to accomplish the organizational goal.	Understand

Text Book(s):

- T1.Stephen P. Robbins, Rolf Bergman and Mary Coulter, "Management",
Prentice Hall of India, 8th edition, 2017.
- T2.Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw
Hill Education, 2008.

Reference(s):

- R1.Hellriegel, Slocum & Jackson, "Management – A Competency Based
Approach", Thomson South Western, 10th edition, 2007.
- R2.Harold Koontz, Heinz Weihrich and mark V Cannice, "Management – A

global & Entrepreneurial Perspective”, Tata McGraw Hill, 12th edition, 2007.

R3. Andrew J. Dubrin, “Essentials of Management”, Thomson Southwestern, 7th edition, 2007.

Web References:

1. <http://www.managementstudyguide.com/all-subjects.htm>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO1	PSO 2
CO1	2	1	-	-	-	-	-	1	-	1	2	1	2	2
CO2	2	1	-	-	-	-	-	1	-	1	2	1	2	2
CO3	2	1	-	-	-	-	-	1	-	1	2	1	2	2
CO4	2	1	-	-	-	-	-	1	-	1	2	1	2	2
CO5	2	1	-	-	-	-	-	1	-	1	2	1	2	2

High-3; Medium-2; Low-1

Course Code: 19EEEC1045		Course Title: Disaster Management (Common to EC,EE & EI)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

- 19ENHG2101- Communication Skills–I
- 19ENHG2201- Communication Skills–II

Course Objectives

The course is intended to:

1. Distinguish the natural and manmade disasters.
2. Explain the environment hazards and level of toxicology.
3. Analyze the causes and effects of Earthquake and Tsunami formation.
4. Analyze the causes and effects of Cyclone formation.
5. Describe about modern technological tools in disaster management.

Unit I Introduction

9 Hours

Disaster- Disaster management- Disaster prevention and preparedness measures-Types of Disaster – Causal factor of Disaster – Natural, Manmade, creeping disaster-Disaster in the Indian context various measures – Disaster related policy goals – United Nations Development Program (UNDP) – United Nations Disaster Relief Organization (UNDRO) – Govt. of India.

Unit II Environmental Disaster

9 Hours

Environmental hazards – Typology – Assessment and response – the strategies– the scale of disaster – Vulnerability – Disaster trends – Paradigms towards a balanced view – Chemical hazards and Toxicology – Biological hazards –Hazard caused by world climate change – Risk analysis – other technological disasters.

Unit III Earthquake and Tsunami

9 Hours

Earthquake – Causes of earthquake – Earthquake scales – Measures of earth –quake – Magnitude and Intensity – Earthquake Recurrence hazard assessment –Seismic zoning – Earthquake disaster mitigation – Component research focus –Forecasting techniques and Risk analysis – Tsunami – Causes of Tsunami –Effects of Tsunami – Tsunami warning

system – Tsunami warning system in India – International status of Tsunami warning and communication system –Tsunami warning centers – Pacific Tsunami Warning Center (PTWC) – Pacific Tsunami Warning System (PTWS) components – Institutional arrangements and design criteria for Tsunami mitigation.

Unit IV Cyclone

9 Hours

Tropical cyclone - Warning system – Protection of buildings from cyclones - Precaution before and during cyclones – Tropical cyclone warning strategy in India – Cyclone related problems – aerial survey – Management strategy – risk reduction by public awareness and education.

Unit V Application of Technology In Disaster Management

9Hours

Hazard map – Multi hazard mapping – Application of satellites in Disaster Management – Application of remote sensing in forecasting and disaster relief –Use of digital image processing in disaster management – GIS in disaster management – Spatial data – GIS data base design – Convention mapping concepts and Coordinate system – Methods of spatial Interpolation in GIS.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Distinguish the natural and manmade disasters	Understand
CO2:Explain the environment hazards and level of toxicology	Understand
CO3:Analyze the causes and effects of Earthquake and Tsunami formation	Apply
CO4:Analyze the causes and effects of Cyclone formation	Apply
CO5:Describe about modern technological tools in disaster management	Understand

Text Book(s):

- T1. PardeepSahni, Madhavimalalgoda and Ariyabandu, “Disaster risk reduction in south Asia”, PHI
- T2. AmitaSinhal, “Understanding earthquake disasters” TMH, 2010.

Reference Book(s):

- R1. PardeepSahni, AlkaDhameja and Uma medury, “Disaster mitigation: Experiences and reflections”, PHI
- R2.Jeff Groman, “The atlas of Natural Disasters”, Friedman/Fairfax publishing, 2002

R3.Jaikrishna and Chandrasekar, Elements of Earthquake Engineering.

Web References:

1. www.nptel.ac.in

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	-	-	1	-	1	-	-
CO2	2	1	-	-	-	2	2	-	-	1	-	1	-	-
CO3	3	2	1	1	-	2	2	-	-	1	-	1	-	-
CO4	3	2	1	1	-	2	2	-	-	1	-	1	-	-
CO5	2	1	-	-	-	2	2	-	-	1	-	1	-	-

High-3; Medium-2;Low-1

Course Code: 19CSEC6701		Course Title: Professional Readiness for Innovation, Employability and Entrepreneurship (common to CSE, IT & ECE)	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week):0:0:6	Credits:3	Total Contact Hours: 96	Max Marks:100

Objectives

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students

This course is a four months immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type, “Experiential Project Based Learning”.**

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approaches and methodologies.
- Collaborate in teams with other students working on the same topic

- Have a dedicated mentor to guide

OUTCOMES:

On completion of the course, the students will be able to:

- Up skill in emerging technologies and apply to real industry-level use cases.
- Understand agile development process.
- Develop career readiness competencies, Team Skills / Leadership qualities.
- Develop Time management, Project management skills and Communication Skills.
- Use Critical Thinking for Innovative Problem Solving.
- Develop entrepreneurship skills to independently work on products.

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
TOTAL		16 WEEKS

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

**TABLE 2: EVALUATION
SCHEMA**

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP			
Technical Skills		Soft Skills	
Criteria	Weightage	Criteria	Weightage
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools, Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	70	Total	30
Total Weightage			100
Passing Requirement			50
Continuous Assessment Only			

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO2	1	1	1	1	1	3	3	3	3	3	3	3	3	3
CO3	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO4	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO5	2	2	2	2	2	3	3	3	3	3	3	3	3	3

High-3; Medium-2; Low-1

Course Code: 19ITEC1001	Course Title: Intellectual Property Rights		
Course Category: Professional Elective	Course Level : Introductory		
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Describe the basic concepts of Intellectual Property Law.
2. Explain the classification of Patents and its Rights and Limitations.
3. Explain the Patent Searching Process and Application Filling Process.
4. Describe the concepts and principles of Trademark.
5. Explain the principles of copyright and its sources.

Unit I Intellectual Property: An Introduction 9 Hours

Intellectual Property Law: Patent Law-Copyright Law-Trademark Law- Trade secret Law-Right of Publicity-Paralegal tasks in Intellectual Property Law-Ethical obligations of the paralegal in Intellectual Property Law-Trade secrets: Protectible as a trade secret-Maintaining trade secrets-Protecting an Idea

Unit II Patents: Rights and Limitations 9 Hours

Sources of patent law-Subject matter of Patents: Utility Patents-Plant Patents-Design Patents-Design Patents and copyright-Design Patents and trademarks-Computer Software, Business methods and Patent Protection-Rights under Patent Law-Patent Requirements-Limitations on Patent Rights-Patent Ownership

Unit III Patents: Research, Applications, Disputes, and International Considerations 9 Hours

Patent Search Process-Patent Application Process-Patent Infringement-Patent Litigation, International Patent laws

Unit IV Principles of Trademark**9 Hours**

Trademarks and Unfair Competition-Acquiring Trademark Rights-Types of Marks, Strong Marks Versus Weak Marks-Selecting and Evaluating a Trademark-International Trademark Laws

Unit V Principles of Copyrights**9 Hours**

Sources of Copyright Law- The Eight Categories of Works of Authorship-Derivative Works and Compilations- Rights and Limitations :Grant of Exclusive Rights–Copyrights Ownership- International Copyright Laws

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the basics of Intellectual Property Law	Apply
CO2: Identify the Rights and Limitations of various patents	Apply
CO3: Apply the process of patent search and application filling process	Apply
CO4: Explain the concept of trademark and its types	Apply
CO5: Classify the concepts of copyrights and its limitations	Apply

Text Book(s):

- T1. Richard Stim, "Intellectual Property: Copyrights, Trademark and Patents", Cengage learning, 2nd edition 2012.

Reference Book(s):

- R1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2013.
- R2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2017.

Web References:

<https://ipindia.gov.in/writereaddata/Portal/ev/sections-index.html>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	-	-	-	2	-	-
CO2	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO5	-	-	-	-	2	-	2	-	-	-	-	2	-	-

High-3; Medium-2; Low-1

Course Code: 19MEEEC1026		Course Title: Design Thinking and Innovation	
Course Category: Professional Elective		Course Level: Introductory	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Disseminate the fundamental concepts and principles of design thinking
2. Explain the design thinking methods in each stage of the problem
3. Conceptualize innovative ideas using prototypes
4. Explain the significance of Evaluating and Testing Ideas
5. Describe the design thinking approach to real world problems

Unit I INTRODUCTION TO DESIGN THINKING

9 Hours

Design thinking overview - Impact of Design Thinking - Design Process – Principles of Design Thinking – Creating Ideal Conditions – Case Study: Identify problem in AI

Unit II UNDERSTAND THE PROBLEM

9 Hours

Information Gathering – Analysis – Storytelling tool- Innovation- Ideation Finding and Evaluating Ideas –Mind Mapping Tool. Case Study: Analysis of the Identified Problem.

Unit III DEFINING PROTOTYPES

8 Hours

Tasks in Prototyping – Understanding Different Prototypes - Developing different prototypes – Demonstration – Prototyping Tools. Case Study: Prototype the solution.

Unit IV EVALUATING AND TESTING IDEAS

10 Hours

Finding Ideas – Developing Ideas Intuitively and Creatively - Selecting Evaluation method – Evaluating Ideas with checklist –Testing Ideas and Assumptions – Tasks in the Test Phase – Testing with Interviews – Testing with Online Studies – Case Study: Evaluate the solution.

Unit V APPLICATIONS

9 Hours

Politics and Society – Business – Strategic technology Plan – Creativity – Visioning, Listening and Diagramming - HealthCare and Science – Approach to treat Cancer – Law – Problem Definition – Alternatives.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the key concepts of design thinking	Apply
CO2: Relate design thinking in all stages of problem solving	Apply
CO3: Identify the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices	Analyze
CO4: Determine the significance of testing and evaluating the solution	Analyze
CO5: Apply design thinking skills to solve real time user experience problems	Apply

Text Book(s):

1. Muller-Roterberg "Design thinking for dummies" John Wiley & Sons, 2020. (Unit-I, III & IV)
2. Andrew Pressman "Design Thinking A Guide to Creative Problem Solving for Everyone", Routledge Publication, 2019. (Unit-II & V)

Reference Book(s):

1. Robert Curedale, "Design Thinking Process & Methods" Design Community College, 5th Edition, 2019.
2. Alyssa Gallagher and Kami Thordarson, "Design Thinking in Play: An Action Guide for Educators", ASCD Book, 2020
3. Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins, 2009.

Web References:

1. <https://www.open.edu/openlearn/science-maths-technology/design-innovation/design-thinking/content-section-6>
2. <https://www.interaction-design.org/literature/topics/design-thinking>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	2	-	-	-	3	3	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	3	-	-	3	-	-	3	-	-	-
CO5	-	-	2	-	-	-	-	-	2	-	-	-	-	-

High-3; Medium-2; Low-1

Course Code: 19MEEC1025	Course Title: Fundamentals of Entrepreneurship		
Course Category: Professional Elective		Course Level : Introductory	
L: T: P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Describe the types, characteristics of entrepreneurship and its role in economic development.
2. Define the types of entrepreneurship.
3. Explain the appropriate form of business ownership in setting up an enterprise.
4. Disseminate the support and management to entrepreneurs in the growth strategies in enterprise.
5. Explain the techniques involved in development of industries

Unit I Entrepreneurship

9 Hours

Entrepreneur – Characteristics – Entrepreneurial Decision Process-Types of Entrepreneurs – Difference between Entrepreneur and a manager-Intrapreneur-Social Entrepreneur –Entrepreneurial Growth- Role of Entrepreneurship in Economic Development.

Unit II Types of Entrepreneurship

9 Hours

Women Entrepreneurship-Rural Entrepreneurship-Tourism Enterprise, Entrepreneurship-Policy Measure of Tourism Entrepreneurship-Eco-Tourism/Nature Tourism/Rural Tourism-Need, Opportunities, Challenges for Developing Agri-preneurship-Social Entrepreneurship.

Unit III Start-Up

9 Hours

Small Enterprises-Micro and Macro Units-Essentials, Features and Characteristics-Relationship between Micro and Macro Enterprises-Scope of Micro and Small Enterprises-

Enterprise and Society-Package for Promotion of Micro and Small-Scale Enterprises-Problems of Micro and Small Enterprises- Identification of Business Opportunity-Steps in Setting Up of a Small Business Enterprise – Content of Business Plan- Significance of Business Plan, Formulation of Business Plan – Guidelines for Formulating Project Report– Project Appraisal.

Unit IV Support and Management

9 Hours

Institutional Finance-Types of Lease Agreements-Lease Financing-Concept and Procedure for Hire-Purchase-Institutional Support to Small Entrepreneurs-Tax Benefits- Depreciation, Rehabilitation Allowance- Investment Allowance-Expenditure to Scientific Research-Tax Concession in Rural and Backward Areas-Difference between Management and Administration-Management of Working Capital-Methods of Inventory Management- Production Design-Market Segmentation-Marketing Mix

Unit V Development

9 Hours

Accounting for Small Enterprise-Types of Growth Strategies-Signal and Symptoms, Causes and Consequences of Industrial Sickness-Forms of Export Business-Types of Documents-E-Commerce Suitability for Small Enterprises-Types of Franchising-Evaluation of Franchise Arrangement-Corporate Citizenship.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the types, characteristics of entrepreneurship and its role in economic development.	Apply
CO2:Classify various types of entrepreneurship and highlight the opportunities to improve the economy of India.	Apply
CO3:Select the appropriate form of business ownership in setting up an enterprise.	Apply
CO4:Determine the financial planning to become an entrepreneur and manage tax benefits that can be provided to the small Entrepreneurs	Analyze
CO5:Identify the techniques involved in the development of the small enterprise for the growth of industries.	Apply

Text Book(s):

T1.S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi,2020.

Reference Book(s):

- R1. Charantimath, P. M., "Entrepreneurship Development and Small Business Enterprises", Pearson, 2006.
- R2. Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis" Dream tech, 2nd edition 2006.
- R3. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 2003.
- R4. Singh, A. K., "Entrepreneurship Development and Management", University Science Press, 2009.

Web References:

1. <https://nptel.ac.in/courses/127105007>
2. <https://ncert.nic.in/ncerts/l/lebs213.pdf>

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2		2				3	3					
CO3				2						2		
CO4					3			3			3	
CO5			2						2			

High-3; Medium-2; Low-1

Course Code: 19SCEC2001	Course Title: Cyber Security (Common to all)		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Discuss the various concepts in Cyber security and infrastructures involved.
2. Describe the cyber-crimes, reporting procedures and legal remedies.
3. Explain various social media related security issues and reporting flaws.
4. Explain various settings related to E-Commerce and digital payments.
5. Demonstrate the security aspects related to digital devices and technology.

Unit I Introduction to Cyber Security

6 Hours

Defining Cyberspace and Overview of Computer and Web-technology - Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

Unit II Cyber crime and Cyber law

6 Hours

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India,

Case studies

Unit III Social Media Overview and Security

6 Hours

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

Unit IV E-Commerce and Digital Payments

6 Hours

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act, 2007.

Unit V Digital Devices Security, Tools and Technologies for Cyber Security

6 Hours

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions

List of Exercises

30 Hours

1. Prepare checklist for following scenarios :
 - a) Reporting cybercrime at Cybercrime Police Station.
 - b) Reporting cybercrime online.
 - c) Using popular social media platforms.
 - d) Secure net banking.
2. Demonstrate the following:
 - a) Reporting phishing emails, email phishing attack and preventive

measures.

- b) Reporting and redressal mechanism for violations and misuse of Social media platforms.
- 3. Manage the following activities:
 - a) Privacy and security settings for popular Social media platforms, Mobile Wallets and UPIs.
 - b) Application permissions in mobile phone.
- 4. Perform the following activities:
 - a) Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User).
 - b) Setting and configuring two factor authentication in the Mobile phone.
- 5. Demonstrate the following:
 - a) Security patch management and updates in computer and mobiles.
 - b) Wi-Fi security management in computer and mobile.
- 6. Install and configure computer Anti-virus & Computer Host Firewall.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the concept of Cyber Security and infrastructure involved.	Understand
CO2: Develop procedures for reporting various cyber-crimes through available platforms.	Apply
CO3: Demonstrate various social media related security issues and reporting flaws.	Apply
CO4: Illustrate various settings in e-commerce and digital payment applications.	Apply
CO5: Demonstrate the digital devices security, tools and Technologies for cyber security.	Apply

Text Book(s):

T1.T1.Cyber Crime Impact in the New Millennium, R. C Mishra. Auther Press.T2, 2010

T2.Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, 1st Edition, Wiley India Pvt. Ltd, 2011.

T3.Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform, PearsonEducation, 2001.

Reference Book(s):

R1. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition,Wiley India Pvt. Ltd, 2001

R2. Security Fundamentals of Network by E. Maiwald, McGraw Hill ,2014

R3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers, 2011.

Web Reference(s):

1. <https://unacademy.com/content/upsc/study-material/science-and-technology/initiatives-taken-by-indian-government-for-cyber-security/>
2. <https://cybercrime.gov.in/>
3. <https://www.meity.gov.in/cyber-security-division>
4. <https://intellipaat.com/blog/what-is-cyber-security/>

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	3	-	1	-	-	-	-
CO2	-	-	-	2	-	3	3	3	3	2	-	-	-	-
CO3	-	-	-	2	-	3	3	3	3	2	-	-	-	-
CO4	1	-	1	3	2	3	2	3	3	2	-	2	-	-
CO5	1	-	1	3	2	3	2	3	-	1	-	3	-	-

High-3; Medium-2;Low-1

OPEN ELECTIVES (OE)

Course Code: 19ECOC1001	Course Title: In Vehicle Networking		
Course Category: Open Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Explain the fundamental concepts and architecture of in-vehicle networking
2. Develop the in-vehicle networking using Controlled Area Network
3. Demonstrate the Flexray protocol for in-vehicle networking
4. Model the Local Interconnect Network (LIN) for vehicular networking
5. Design the model of Media Oriented System Transport in-vehicle networking

Unit I Introduction To In-Vehicle Networking

9 Hours

Introduction to Computer Networks - Network Topologies - Types of Networks: Local Area Networks, Wide Area Networks - Vehicle network Architecture - Vehicle network.

Unit II Control Area Network

9 Hours

Layered Architecture - ISO 11898 Architecture - CAN Physical Layer- CAN transceiver – CAN working example.

Unit III Flex Ray

9 Hours

Flex ray Architecture - topologies: Multi-drop Bus, star and hybrid – node operation – frames and signals – Applications.

Unit IV Local Interconnect Network

9 Hours

Introduction: Transmit & receive data through LIN network- The power management in LIN network - LIN Versus CAN.

Unit V - Media Oriented System Transport**9 Hours**

MOST in ISO-OSI reference model – Types – Topology – MOST physical layer – Frames and signals – Functioning and synchronization.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the fundamental concepts and architecture of in-vehicle networking.	Understand
CO2: Develop the in-vehicle networking using Controlled Area Network.	Understand
CO3: Demonstrate the Flexray protocol for in-vehicle networking.	Understand
CO4: Model the Local Interconnect Network (LIN) for vehicular networking.	Understand
CO5: Design the model of Media Oriented System Transport in-vehicle networking.	Understand

Text Book(s):

- T1. Kirsten Matheus, Thomas Königseder., Automotive Ethernet, Cambridge University Press, UK, 1st Edition 2015.
- T2. Dominique Paret .Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe-by-Wire, John Wiley & Sons Ltd. 1st Edition 2007.
- T3. Christoph Sommer, Falko Dressler., Vehicular Networking, Cambridge University Press, UK, 1st Edition 2015.

Reference Book(s):

- R1. Marc Emmelmann, ,Bernd Bochow,.Christopher KellumVehicular Networking: Automotive Applications and Beyond, John Wiley & Sons Ltd, 1st Edition 2010.
- R2. Hannes Hartenstein, -Kenneth Laberteaux.,VANET: Vehicular Applications and Inter Networking Technologies, John Wiley & Sons Ltd, 1st Edition 2010.
- R3. Stephan Olariu, Michele C. Weigle, Vehicular Networks: From Theory to Practice, CRC Press, USA, 1st Edition 2009.

Web References:

1. <https://www.elprocus.com/controller-area-network-can/>
2. <https://www.embitel.com/product-engineering-2/automotive/in-vehicle-networking>
3. <https://www.globaledgesoft.com/blog-posts/in-vehicle-networking-at-a-glance/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2;Low-1

Unit V Safety & Liability issues**9 Hours**

Product Compliance: Product safety and liability issues; standards related to electrical safety and fire hazards, EMI/EMC requirements, design techniques for ESD, RF interference and immunity, Line current harmonics and mains voltage surge.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO6. Explain the concept of Basic electronic devices.	Understand
CO7. Explain the construction and working of audio & video system.	Understand
CO8. Illustrate the working functions of home appliances.	Understand
CO9. Summarize the communication devices used for information exchange.	Understand
CO10. Identify different product safety, compliance standards and techniques associated with electronic products.	Understand

Text Book(s)

- T1. Thomas L Floyed "Electronic Devices" 10th Edition Pearson Education Asia 2018.
- T2. Philp Hoff "Consumer Electronics for Engineers" – Cambridge University Press, 1998.

Reference Book(s):

- R1. Bali S P, Consumer Electronics. Pearson, 2007, Peter Waher, 'Learning internet of Things'. Packt Publishing, 2015.
- R2. Jordan Frith, "Smartphones as Locative Media", Wiley, 2014
- R3. Douglas Kinney, A Beginners Guide to Consumer Electronics Repair, Hand Book and Tutorial, iUniverse, 2006
- R4. Sridhar Canumalla, Puligandla Viswanadham, Portable Consumer Electronics Packaging, Materials, and Reliability, PennWell, 2010. Making Sensors: End- to- End Algorithms and Infrastructure Design By Omesh Tickoo, Ravi Iyer 2016.

Web References:

- 1. <https://blog.epicvila.com/home-appliance-working-conditions/>
- 2. <https://www.mediacollege.com>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19ECOC1003		Course Title: Internet of Everything	
Course Category: Open Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. To impart knowledge on Internet of Things (IoT), which relates to the study of sensors, actuators, and controllers, among other Things
2. To understand IoT value chain structure (device, data cloud), application areas and technologies involved
3. To understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
4. To learn how to use software programs to perform varying and complex tasks
5. To Expand upon the knowledge learned and apply it to solve real world problems

Unit I Introduction 9 Hours

Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT–IoT Map Device

Unit II Seven Generations of IOT Sensors 9 Hours

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics

Unit III Technological Analysis 9 Hours

Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

Unit IV The World of the Future – Internet of Everything 9 Hours

Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Free-roaming AR: Wearable Computing, Wireless, Sensing, and Meta sensing with light bulbs.

Unit V - Future and Perspectives

9 Hours

Internet of Everything – The Future and perspectives – Challenges- Examples for sensor, actuator, control circuits with applications.

Course Outcomes

Cognitive Level

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

CO1: Explain the basic concepts on Internet of Things (IoT)	Understand
CO2: State IoT value chain structure	Understand
CO3: Describe about IoT sensors and technology challenges in it	Understand
CO4: Illustrate software techniques for performing varying and complex tasks	Understand
CO5: Explain the knowledge for solving real world problems	Understand

Text Book(s):

- T1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Développement Copyrights ,2014
- T2. Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014

Reference Book(s):

- R1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
- R2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.
- R3. Woodrow Barfield, Fundamentals of Wearable Computers and Augmented Reality, Second Edition – 2015.
- R4.OmeshTickoo, Ravi Iyer Making, Sense of Sensors: End-to-End Algorithms and Infrastructure Design – 2016.
- R5. “Practical Electronics for Inventors, Third Edition,” by Paul ScherzandSimon Monk. 2016

Web References:

1. <https://www.open.edu/openlearn/science-maths-technology/internet-everything>
2. https://onlinecourses.nptel.ac.in/noc21_cs17

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO2	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO3	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO4	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO5	2	1	-	-	-	-	-	1	1	1	-	-	-	-

High-3; Medium-2;Low-1

Course Code: 19ECOC1004	Course Title : Data Science Using Hadoop With R		
Course Category: Open Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Describe the significance of Big Data.
2. Solve the basic Analysis problem.
3. Explain the YARN architecture, configuration and containers.
4. Use suitable data types for basic operations.
5. Choose an appropriate plot for visualizing the data.

UNIT I Introduction To Big Data

9 Hours

Data science process – roles, stages in data science project, What is Big Data-types of data-elements of big data-big data analytics. Exploring the big data stack-big data applications.

UNIT II Hadoop Eco System

9 Hours

Hadoop ecosystem-Hadoop Distributed File System-Map Reduce framework techniques to optimize MapReduce jobs-uses of Map Reduce.

UNIT III Hadoop Yarn Architecture

9 Hours

YARN Architecture-working of YARN-YARN schedulers-backward compatibility with YARN-YARN configurations-YARN commands-YARN containers.

UNIT IV Introduction to R

9 Hours

Basic features of R-data types in R-reading data sets-reading and combining numeric, text-reading multiple data values from large values-reading data from R Studio-exporting data from R.

UNIT V Manipulating and Processing Data In R**9 Hours**

Creating data subset-merging datasets in R-sorting data-melting-casting-matrices-data frames-functions-arguments in functions-built-in functions in R-plots-RHadoop-integration of R and Hadooptext mining in RHadoop.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the significance of Big Data	Understand
CO2: Solve the basic Analysis problem using Map and reduce	Apply
CO3: Explain the YARN architecture, configuration and containers	Understand
CO4: Identify suitable data types for basic operations on data	Apply
CO5: Choose an appropriate plot for visualizing the data.	Apply

Text Books:

T1. Black Book, "BIG DATA", DT Editorial Services, Dream tech press, Edition:2016.

T2. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, USA, 2011

Reference Books

R1. Jimmy Lin and Chris Dyer, "Data Intensive Text Processing using Map Reduce", Morgan and Claypool Publishers, USA, 2010.

R2. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.

R3. ArvindSathi, "Big Data Analytics: Disruptive Technologies for changing the game(paperback)", Mc Press, 2012.

R4. Dirk deRoos, "HadoopFor Dummies", John Wiley & Sons, 2014.

Web References:

1. <https://www.datascience.com/resources#.learn-data-science>

2. <http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction>

3. <http://lintool.github.io/MapReduceAlgorithms/ed1n.html>

4. https://www.tutorialspoint.com/r/r_overview.htm

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	-	1	-	1	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2;Low-1

Unit IV Knowledge Acquisition and Machine Learning**9 Hours**

Knowledge Acquisition process – Meta knowledge - Components of planning system – Understanding – Learning – Rote learning – Explanation based Learning – Inductive Learning - Natural language processing.

Unit V Expert Systems**9 Hours**

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells. AI for robotics.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify a suitable Artificial Intelligence methods for solving the given problems	Understand
CO2: Explain the knowledge representation using various logics and rule based systems	Understand
CO3: Explain the knowledge using various reasoning techniques	Understand
CO4: Interpret the concepts of planning and machine learning	Understand
CO5: Explain the concepts of typical expert systems and its architectures	Understand

Text Book(s):

- T1. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill- 2008.
- T2. R.B.Mishra, “Artificial Intelligence” PHI learning private ltd, 2011.

Reference Book(s):

- R1. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.
- R2. Stuart Russel and Peter Norvig “AI – A Modern Approach”, 2nd Edition, Pearson Education 2007.
- R3. Deepak Khemani “Artificial Intelligence”, Tata McGraw Hill Education 2013.
- R4. N.P.Padhy, “Artificial Intelligence and Intelligent systems” Oxford University press, 4th Edition, 2008

Web References:

- 1.<http://nptel.ac.in/courses/106105077/>

2.<https://in.udacity.com/course/intro-to-artificial-intelligence--cs271>

3.https://www.tutorialspoint.com/artificial_intelligence/index.htm

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO2	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO3	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO4	2	1	-	-	-	-	-	1	1	1	-	-	-	-
CO5	2	1	-	-	-	-	-	1	1	1	-	-	-	-

High-3; Medium-2;Low-1

Course Code: 19ECOC1006		Course Title: Machine Vision System	
Course Category: Open Elective		Course Level: Mastery	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Pre-requisites

➤ Nil

Course Objectives

The course is intended to:

1. Describe the fundamental concepts in machine vision systems
2. Explain the concepts of image acquisition
3. Practice the algorithms for machine vision
4. Illustrate the pattern recognition algorithms
5. Apply the machine vision algorithms for real time applications

Unit Introduction to Machine Vision 9 Hours

The nature of vision - tasks for a vision system – The image: representations and properties - mathematical and physical background - Data structures for image analysis - Basic Image Filtering Operations

Unit II Image Acquisition and Conversion 9 Hours

Illumination - Electromagnetic Radiation - Types of Light Sources - Interaction of Light and Matter - Lenses - Pinhole Cameras - Gaussian Optics – Depth of Field – Tele centric Lenses - Lens Aberrations - Cameras : CCD Sensors CMOS Sensors - Color Cameras - Sensor Sizes - Camera-Computer Interfaces - Image Acquisition Modes - Camera Calibration - Camera Models for Area Scan Cameras - Camera Model for Line Scan Cameras - Calibration Process - Accuracy of the Camera Parameters.

Unit III Machine Vision Algorithms 9 Hours

Image Enhancement - Gray Value Transformations - Image Smoothing - Thresholding - Extraction of Connected Components - Feature Extraction - Morphology - Edge Extraction – Image Segmentation - Segmentation and Fitting of Geometric Primitives

Unit IV Pattern Recognition**9 Hours**

Template Matching Gray-Value-Based Template Matching - Template Matching with Rotations and Scalings - Optical Character Recognition- Classifiers: parametric classifiers – non parametric classifiers - nearest neighbor- neural networks

Unit V Machine Vision Applications**9 Hours**

Reading of Serial Numbers - Inspection of Saw Blades - Inspection of Ball Grid Arrays (BGA) - Surface Inspection - Inspection of Punched Sheets - Pose Verification of Resistors.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the fundamental concepts in machine vision systems by studying the fundamental concepts of image representation and its properties	Understand
CO2: Explain the concepts of image acquisition using various cameras and its interfacing techniques	Understand
CO3: Practice the algorithms for machine vision using image segmentation, Edge extraction and morphological operations	Understand
CO4: Illustrate the pattern recognition algorithms like template matching and classifiers	Understand
CO5: Apply the machine vision algorithms for real time applications for inspection, reading and measuring applications	Apply

Text Book(s):

- T1. Carsten Steger, Markus Ulrich, and Christian Wiedemann "Machine Vision Algorithms and Applications" Wiley-VCH; 1st Edition, 2007.
- T2. E.R.Davies, "Machine Vision: Theory, Algorithms, Practicalities" Elsevier, Technology & Engineering , 2004.
- T3. Alexander Hornberg, "Handbook of Machine Vision" John Wiley & Sons, (2007).

Reference Book(s):

- R1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis Publisher, 1973
- R2. Rafael C. Gonzales, Richard E. Woods, Digital Image processing publisher, 1992.
- R3. Nellazuech, 'Understanding & applying machine vision Marceldekker Inc.2000.
- R4. E. R. DAVIES, Computer and Machine Vision: Theory, Algorithms, Practicalities, Academic Press(2012).
- R5. Harley R. Myler, "Fundamentals of Machine Vision", SPIE Press, (1999).

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. <https://nptel.ac.in/courses/122101003/2>
3. <https://nptel.ac.in/syllabus/111104092/>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	1	2	-

High-3; Medium-2;Low-1

Vector quantization – Counter Propagation networks. Introduction to hybrid systems – Architecture of Adaptive Neuro Fuzzy Inference System (ANFIS) – Hybrid learning algorithm

UNIT V Optimization

9 Hours

Introduction to optimization – principles of optimization – Duality principle – Classification of optimization problems – Traditional optimization methods and its drawbacks – Evolutionary concepts in optimization: Genetic Algorithm (GA) – Simple GA – Binary coded GA – Limitations of Binary coded GA

Course Outcomes	Cognitive Level
At the end of the course students will be able to:	
CO1: Explain the basics of soft computing and Fuzzy theory	Understand
CO2: Apply the fuzzy theory for problem solving	Apply
CO3: Explain the supervised learning of neural networks	Understand
CO4: Summarize the concepts of fuzzy and neural networks	Understand
CO5: Apply Genetic algorithms for optimizing a problem	Apply

Text Books:

- T1. Sivanandam.S.N, Deepa.S.N, “Principles of soft computing”, 2nd Edition, Wiley India Pvt Limited, 2011.
- T2. Jyh - Shing Roger Jang, Cheun Tsai Sun, Eiji - Mizutani, “Neuro fuzzy and Soft computing”, Prentice Hall, 1997.

Reference Books:

- R1. Dilip Kumar Prathiar, “Soft Computing” Narosa Publishing House Pvt Ltd, 2008
- R2. Anupam - shukla, Ritu Tiwari, Rahul Kala, “Real life applications of Soft computing”, CRC press, 2010.
- R3. Aliev, R.A, Aliev, R.R, “Soft Computing and its Application”, World Scientific Publishing Co. Pvt. Ltd., 2001.
- R4. Mehrotra.K, Mohan.C.K, Ranka.S, “Elements of Artificial Neural Networks”, The MIT Press, 2nd Edition, 2000.
- R5. Ronald R. Yager, Lofti - Zadeh, “An Introduction to fuzzy logic applications in

intelligent Systems”, Kluwer Academic, 1992.

Web References:

1. http://www.myreaders.info/html/soft_computing.html
2. https://www.tutorialspoint.com/artificial_intelligence/
3. <http://www.soft-computing.de/def.html>
4. <http://nptel.ac.in/courses/106106046/41>

Course Articulation matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO4	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2;Low-1