G H RAISONI COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Accredited by NAAC with 'A+' Grade

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GHRCE/HoD/Dept./Scheme/UG/PG/02/01/02

Note: Applicable from 2018-19

Vision of the Institute

To achieve excellent standards of quality education by keeping pace with rapidly changing technologies and to create technical manpower of global standards with capabilities of accepting new challenges.

Mission of the Institute

Our efforts are dedicated to impart quality and value based education to raise satisfaction level of all stake-holders. Our strength is directed to create competent professionals. Our endeavor is to provide all possible support to promote research and development activities.

Vision of the Department

To achieve excellent standards of quality education by keeping pace with rapidly changing technologies and to create technical manpower of global standards in electronics & telecommunication engineering with capabilities of accepting new challenges.

Mission of the Department

Mission of the Department is

- To create competent professionals who are trained in the design, implementation of engineering & telecommunication systems
- To contribute towards the advancement of engineering, science and technology
- To impart quality and value based education to raise satisfaction of all stake holders
- To promote research & development activities in the field of electronics & telecommunication engineering and allied areas

Programme Educational Objectives

- **PEO1**: Identify, define and solve problems in the fields of electronics & communication engineering.
- **PEO2:** Employ necessary techniques and tools for advanced engineering applications, engage themselves in research and development, and take up higher education.
- **PEO3:** Use their skills in ethical & professional manner to raise the satisfaction level of the stakeholders.

Programme Outcomes and Programme Specific Outcomes

Graduates of Electronics and Telecommunication Engineering shall be able to

Programme Outcomes

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

2. **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.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **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.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering commCOy 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.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. 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

Graduates of Electronics and Telecommunication Engineering shall be able to

PSO1: Demonstrate industrial practices learned through internship and solve the live problems of the industries

PSO2: Acquire multidisciplinary knowledge through projects and hands on experience to meet industry needs.

PSO3: Demonstrate capability to undertake higher studies and develop leadership qualities to emerge as potential entrepreneur.

B. E. FIRST YEAR SCHEME (ETC/ETRX/CSE/IT/EE)												
Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Teaching mode
							Theory			Practical	Total Marks	
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont.		
SEMESTER-I												
BFYL101	Matrices	1	1	-	2	2	10	15	25	--	50	Classroom Teaching
BFYL102	Differential & Vector Calculus	1	1	-	2	2	10	15	25	--	50	
BEEL101 BEEP101	AC & DC Circuits	1	-	2	3	2	10	15	25	25	75	Classroom & Lab Teaching
BEEL102	AC & DC Machine	2	-	-	2	2	10	15	25	--	50	Classroom & Lab Teaching
BEEL103	Energy Sources & Audit	1		-	1	1	10	15	--	--	25	Classroom & Lab Teaching
BITL101 BITP101	Programming for Problem Solving	1	-	4	5	3	10	15	25	50	100	Lab Teaching
BECL104	Bio-System in Engg.	1	1	-	2	2	10	15	25	--	50	Classroom Teaching
BCSP101	Data Analytics	-	-	2	2	1	--	--	--	25	25	Lab Teaching
BECL101 BECP101	Introduction to Digital System	1	1	2	4	3	10	15	25	25	75	Classroom & Lab Teaching
BHUP103	Foreign Language	-	-	2	2	1	--	--	--	25	25	Classroom Teaching
BHUP104	Liberal/ Creative Arts	-	-	1	1	0.5	--	--	--	25	25	Classroom Teaching
BFYP131	Waste Management	-	-	2	2	1	--	--	--	25	25	Lab Teaching
BFYP132	Environmental Science	-	-	1	1	0.5	--	--	--	25	25	Classroom Teaching
TOTAL		**9**	**4**	**16**	**29**	**21**	**80**	**120**	**175**	**225**	**600**	

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme					Teaching Mode
							Theory			Prac	Total Marks	
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont.		
SEMESTER-II												
BFYL103	Integral & Multiple Calculus	1	1	-	2	2	10	15	25	--	50	Classroom Teaching
BFYL104	Ordinary & Partial Differential Equations	1	-	-	1	1	10	15	25	--	50	Classroom Teaching
BCSP102	Data Structure	-	-	4	4	2	--	--	--	50	50	Lab Teaching
BFYP152	Internet of Things	-	-	2	2	1	--	--	--	25	25	Lab Teaching
BFYL121 BFYP121	Applied Physics	1	1	2	4	3	10	15	25	25	75	Classroom Teaching
BECL102 BECP102	Analog Circuits	1	1	2	4	3	10	15	25	25	75	Classroom Teaching
BECP103	Embedded Programming	-	-	2	2	1	--	--	--	25	25	Lab Teaching
BMEP102	Digital Fabrication	-	-	4	4	2	--	--	--	50	50	Lab Teaching
BFYP151	Mini Model through Innovation & Creativity	-	-	4	4	2	--	--	--	50	50	Project based
BHUL101 BHUP101	Communication Skills	-	2	2	4	3	10	15	25	50	100	Lab Teaching
BHUP102	Ethics & Professional Competencies	-	-	2	2	1	--	--	--	25	25	Classroom Teaching
BMBP101	Entrepreneurship	-	-	2	2	1	--	--	--	25	25	Classroom Teaching
TOTAL		**4**	**5**	**26**	**35**	**22**	**50**	**75**	**125**	**350**	**600**	

B.E. SECOND YEAR SCHEME (ELECTRONICS AND TELECOMMUNICTION ENGINEERING AND ELECTRONICS ENGINEERING)													
Term-III													
Sub. Code	**Name of the Course**	**Teaching Scheme**					**Evaluation Scheme**						**Exam mode**
							Theory			**Practical**		**Total**	
		Th.	**Tu**	**Pr.**	**Total**	**Credit**	**TAE**	**CAE**	**ESE**	**Int.**	**Ext.**		
BFYL112	Maths V: Mathematical Modeling	1	1	-	2	2	10	15	25	-	-	50	Offline
BHUP203	Quant	-	-	1	1	0.5	-	-	-	25	-	25	Online
BHUP202	Reasoning	-	-	1	1	0.5	-	-	-	25	-	25	Online
BAIP202	Skill Development – I (Linear Algebra)	-	-	2	2	1	-	-	-	25	25	50	Online/ Project Based
BHUP205	Business English Certification –I	-	-	4	4	2	-	-	-	50	-	50	Online
BHUP204	Liberal Arts/Creative Arts (Hobby Module)	-	-	1	1	0.5	-	-	-	25	-	25	Offline
BAIP204	Foundation Course in Artificial Neural Network	-	-	2	2	1	-	-	-	25	25	50	Online/ Project Based
BECL215 BECP215	Electronic Devices & Circuits	2	-	2	4	3	10	15	25	25	-	75	Offline
BEEL206	Network Theory	1	1	-	2	2	10	15	25	-	-	50	Offline
BECL216 BECP216	Communication Electronics	2	-	2	4	3	10	15	25	25	-	75	Offline
BECL217	Signal & Systems	1	1	-	2	2	10	15	25	-	-	50	Offline
BECL218 BECP218	Embedded Systems Design	2	-	2	4	3	10	15	25	25	25	100	Online
Total		**9**	**3**	**17**	**29**	**20.5**	**60**	**90**	**150**	**250**	**75**	**625**	

Term-IV													
Sub. Code	Name of the Course	Teaching Scheme					Evaluation Scheme						Exam mode
		Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total	
							TAE	CAE	ESE	Int.	Ext.		
BFYL113	Maths VI: Optimization & Z Transforms	1	1	-	2	2	10	15	25	-	-	50	Offline
BMBP102	Entrepreneurship Development Practice	-	-	2	2	1	-	-	-	25	-	25	Offline
BHUP206	Aptitude I	-	-	1	1	0.5	-	-	-	25	-	25	Online
BAIL203	Machine Learning Algorithms	2	-	-	2	2	10	15	25	-	-	50	Online
BECL220	Sensor & Actuators	1	-	-	1	1	10	15	25	-	-	50	Offline
BECL221	Electromagnetic Field & Waves	1	1	-	2	2	10	15	25	-	-	50	Offline
BECL222 BECP222	Analog Systems & Design	2	-	2	4	3	10	15	25	25	-	75	Offline
XXXX	Open Elective-I	2	-	-	2	2	10	15	25	-	-	50	Offline
BECL223 BECP223	Digital Communication	2	-	2	4	3	10	15	25	25	-	75	Offline
BECL224 BECP224	Introduction to Drones	1	-	2	3	2	10	15	25	25	-	75	Online
BCSL208 BCSP208	Data Base Management System	2	-	2	4	3	10	15	25	10	15	75	Online
Total		**14**	**2**	**11**	**27**	**21.5**	**90**	**135**	**225**	**135**	**15**	**600**	

B.E. THIRD YEAR SCHEME (ELECTRONICS AND TELECOMMUNICTION ENGINEERING AND ELECTRONICS ENGINEERING)													
Term-V													**Exam mode**
Sub. Code	**Name of the Course**	**Teaching Scheme**					**Evaluation Scheme**						
							Theory			**Practical**		**Total**	
		Th.	**Tu**	**Pr.**	**Total**	**Credit**	**TAE**	**CAE**	**ESE**	**Int.**	**Ext.**		
BFYL114	Maths VII: Matrix Differential Equations	1	1	-	2	2	10	15	25	-	-	50	Offline
MBP104	Advanced Communication Skills & Employability	-	-	4	4	2	-	-	-	50	-	50	Online
BECP317	Skill Development - II (VLSI based Project)		-	2	2	1	-	-	-	25	25	50	Online +Practical based
BHUP302	Aptitude II	-	-	1	1	0.5	-	-	-	25	-	25	Online
MBP301	Financial Management for Engineers	-	-	1	1	0.5	-	-	-	25	-	25	Offline
BECL318 BECP318	CMOS VLSI Design	1	-	2	3	2	10	15	25	10	15	75	Online
BECL316 BECP316	Digital Signal Processing	2	-	2	4	3	10	15	25	25	25	100	Offline
BECL319	Transmission Line & Antennas	2	-	-	2	2	10	15	25	-	-	50	Offline
BECL320 BECP320	Hardware Description Language	1	-	2	3	2	10	15	25	10	15	75	Online
BCSP213	Java Programming	-	-	4	4	2	-	-	-	25	25	50	Online
XXXXX	Departmental Elective-I	2	-	-	2	2	10	15	25	-	-	50	Offline
BECP321	Internship (Social +Minor Project & Technical Report Writing)	-	-	2	2	2	-	-	-	50	-	50	Online +offline
Total		**9**	**1**	**20**	**30**	**21**	**60**	**90**	**150**	**245**	**105**	**650**	

Term-VI													
Sub. Code	Name of the Course	Teaching Scheme					Evaluation Scheme						Exam mode
		Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total	
							TAE	CAE	ESE	Int.	Ext.		
BFYL115	Maths VIII : Probability, FFT, complex variables	1	1	-	2	2	10	15	25	-	-	50	Offline
BECP322	Skill Development - III (Machine Learning based Projects)	-	-	2	2	1	-	-	-	25	25	50	Project based
BHUP303	Aptitude III	-	-	1	1	0.5	-	-	-	25	-	25	Online
BHUP207	Soft Employability Skills	-	-	1	1	0.5	-	-	-	25	-	25	Offline
MBPXXX	Project Management	-	-	2	2	1	-	-	-	50	-	50	Offline
BMEP319	Product Development & IPR	-	-	2	2	1	-	-	-	25	-	25	Online
XXXX	Open Elective-II	2	-	-	2	2	10	15	25	-	-	50	Online offline
XXXX	Interdisciplinary Elective-I	2	-	-	2	2	10	15	25	-	-	50	Offline
XXXX	Departmental Elective-II (Modeling)	-	-	4	4	2	-	-	-	25	25	50	Practical based +offline
XXXX	Departmental Elective-III	2	-	-	2	2	10	15	25	-	-	50	Offline
BEEL319 BEEP319	Basic Control System	1	-	2	3	2	10	15	25	25	-	75	Offline
BECL323 BECP323	Digital Image Processing	1	-	2	3	2	10	15	25	25	-	75	Online
MBLXXX	Universal Human Values & Understanding Harmony	2	1	-	3	3	25	25	50	-	-	100	Offline
Total		**11**	**2**	**16**	**29**	**21**	**85**	**115**	**200**	**225**	**50**	**675**	

B.E. FOURTH YEAR SCHEME (ELECTRONICS AND TELECOMMUNICTION ENGINEERING AND ELECTRONICS ENGINEERING)													
Term-VII													**Exam mode**
Sub. Code	**Name of the Course**	**Teaching Scheme**					**Evaluation Scheme**						
		Th.	**Tu**	**Pr.**	**Total**	**Credit**	**Theory**			**Practical**		**Total**	
							TAE	**CAE**	**ESE**	**Int.**	**Ext.**		
XXXXx	Science Elective	2	-	-	2	2	10	15	25	-	-	50	Offline
BHUP304	Career Development Practice	-	-	2	2	1	-	-	-	25		25	Online
XXXX	MOOCS/Open Elective-III	1	-	-	1	1	10	15	-	-	-	25	Online
XXXX	Interdisciplinary Elective-II	2	-	-	2	2	10	15	25	-	-	50	Online
XXXX	Department Elective-IV	2	-	-	2	2	10	15	25	-	-	50	Offline
XXXX	Department Elective-V	2	-	-	2	2	10	15	25	-	-	50	Offline
XXXX	Department Elective-VI	2	-	-	2	2	10	15	25	-	-	50	Offline
BCSL315 BCSP315	Cloud Computing	1	-	2	3	2	10	15	25	10	15	75	Online
BECP412	Project Phase-I	-	-	4	4	4	-	-	-	50		50	Project based
Total		**12**	**0**	**8**	**20**	**18**	**70**	**105**	**150**	**85**	**15**	**425**	

Term-VIII													
Sub. Code	**Name of the Course**	**Teaching Scheme**					**Evaluation Scheme**						**Exam mode**
		Th.	**Tu**	**Pr.**	**Total**	**Credit**	**Theory**			**Practical**		**Total**	
							TAE	**CAE**	**ESE**	**Int.**	**Ext.**		
BECP420	Project Phase-II	-	-	2	2	2	-	-	-	50	50	100	Project based
XXXX	MOOCS/Open Elective-IV	2	-	-	2	1	10	15	-	-	-	25	Online /offline
BECP437	Six Month Industry Internship	-	-	24	24	12	-	-	-	100	100	200	Project based
Total		**2**	**0**	**26**	**28**	**15**	**10**	**15**	**50**	**150**	**150**	**325**	
Total Credit						**160**		**Total Marks**				**4500**	

Board of Studies of Electronics and Electronics and Telecommunication Engineering

Pool of Elective Vs Tracks

Elective / Track	Communication ,Signal Processing & RF	Machine Learning	Embedded & IoT	BioMedical	VLSI & Quantum	Programming
	Track-1	Track-2	Track-3	Track-4	Track-5	Track-6
Departmental Elective1	Television &-Multimedia Processing	Soft Computing	System Programming for Embedded Devices	Biomaterials-Materials in Medicine	Basics Power Electronics	Operating Systems
DepartmentalElective-2	Audio & Speech Signal Processing	Deep Learning Foundations & Applications	IoT System Design	Bio-Informatics: Algorithms and Applications	Analog VLSI Design	Big Data & Hadoop
DepartmentalElective-3	Wireless & Mobile Communication	Pattern Recognition	Mechatronics	Biochemistry & Cell Biology	MEMS & Applications	Data Structure & Algorithms
DepartmentalElective-4	Microwave & millimeter wave circuits	AI: Knowledge Representation and Reasoning	Robotics Manipulation	Brain Machine Interface	Quantum & Optical Electronics	Information Security & Crypto Currency
DepartmentalElective-5	Smart Antennas	Decision Analytics	Automotive Electronics	Physics & Instrumentation of Medical Imaging	Integrated Circuits & Fabrication	Advanced Networks
Departmental Elective-6	Multi-rate and Wavelet Signal Processing	Natural Language Processing	Industrial Automation	Neuromorphic Computing	Photonics & Nanotubes	Blockchain Technology

Open Elective-I Non-Conventional Energy Sources
Open Elective-II Augmented & Virtual Digital Reality
Open Elective-III Pervasive Computing
Open Elective IV Voice over IP
Interdisciplinary Elective-I Electric Drives
Interdisciplinary Elective-II Smart City

SEMSTER-III

BECL215 -Electronic Devices and Circuits

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25	-	75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To gain knowledge of transistor small signal analysis.
2. To study need different types of amplifiers and oscillator.
3. To familiarize the students with the analysis of unipolar devices
4. To use appropriate experimentation techniques to evaluate circuit performance

Course Outcomes:

1. Demonstrate the concept of compensation techniques, Low frequency and High frequency analysis.
2. Interpret the concepts of feedback and apply the concepts for improvement of performance of amplifier and oscillator
3. Analyze and design different types of power amplifiers and use methods for reduction of distortions
4. Compare the operation of the Field Effect Transistor (FET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and design FET circuits
5. Apply concepts of transistors & amplifier Circuits
6. Design simple circuits containing non-linear elements.

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2			2		2	3	2	2	3
CO2	3	3	3	2	3	2			2		2	3	2	2	3
CO3	3	3	3	2	3	2			2		2	3	2	2	3
CO4	3	3	3	3	3	2			3		2	3	3	3	3
CO5	3	3	3	3	3	2			3		2	3	3	3	3
CO6	3	3	3	3	3	2			3		2	3	3	3	3

CO Mapping with PO and PSO:

Contents:

CO-I: (9hrs)

Transistor Biasing & Small Signal Analysis: Review of Transistor, Transistor current equations, Thermal Runaway ,Transistor Biasing & Stability, Compensation Methods, Two-port Devices & the Transistor Hybrid model, analysis of a transistor amplifier circuit using h parameters, comparison of transistor amplifier configuration, Miller's Theorem, the alpha cut-off frequency, the hybrid pi (II) common –emitter transistor model.

CO-II (8hrs)

Feedback Amplifiers & Oscillators: Types of Feedback, Advantages & Disadvantages of Negative Feedback, Topology, Classification of Oscillators, Stability, Barkhausen Criteria, Design of RC, LC and Crystal Oscillators, Numerical

CO-III (7hrs)

Power Amplifier: Classification A, B, AB, C, Efficiency, Push Pull Configuration (A, B, AB) Complementary symmetry, Second Harmonic and Cross over Distortion., Design of Power Amplifiers (Class A and Class AB)

CO-IV (6hrs)

Unipolar Devices: Field Effect Transistor, MOSFET, NMOS, PMOS Principles of operation and characteristics, Biasing arrangement, small signal analysis of CG, CB and CD

Text Books:

1. Electronics Devices and Circuits, S. Saliva Hanan, N Suresh Kumar, Tata McGraw-Hill 2008, Third Edition
2. Integrated Electronics Jacob MillmanTata McGraw-Hill, 2009, Second Edition
3. Electronic Devices & Circuits, Sanjiv Gupta

Reference Books:

1. Electronics devices and Circuits and Theory Robert L. Boylestad, Louis Nashelsky, Pearson India, 2009, Tenth Edition
2. Microelectronics Circuits A. S. Sedra & K. C. Smith, Oxford University Press, 2013, Seventh Edition
3. Electronics Devices and Circuits, Nagrath I J Phi Learning Pvt Ltd, 2009, Third Edition.

BEEL206- Network Theory

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	1	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. The subject aims at basic components

2. To study various sources and circuit analysis method used in electrical system and their behavior.

3. To study various numerical methods

Course Outcomes

Able to understand:

CO1: Analyze circuits with ideal, independent, and controlled voltage and current sources. Using Mesh & Nodal analysis.

CO2: Determine the equivalent circuits of a network that include passive devices, dependent sources, and independent sources in combination using network theorems.

CO3: Interpret and measure the transient and sinusoidal Steady-state Responses of simple RC and RLC circuits

CO4 : Determining two port network parameters and one parameter in terms

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	0	0	0	2	2	2	2	3	2	
CO2	3	3	1	1	1	0	0	0	2	2	2	2	3	2	
CO3	3	2	1	1	1	0	0	0	2	2	2	2	3	2	
CO4	3	2	1	1	1	0	0	0	2	2	2	2	3	2	

Syllabus:

CO I: Nodal and Mesh analysis (8 Hrs)

Nodal and Mesh analysis, basic equilibrium equations, matrix approach for complicated network, containing voltage, current sources, Mutual Inductances, source transformations, Duality.

CO II: Network Theorems (7 Hrs)

Reciprocity, Thevenin's, Norton's, maximum power transfer, compensation, Tellegen's theorem as applied to A.C. Circuits.

CO III: Transfer functions (7Hrs)

Transient behaviors, concept of complex frequency, Driving points and transfer functions, poles, zeros of admittance function, their properties, sinusoidal response from Pole-zero locations, convolution theorem and integral solution.

CO IV: Two port network and filter (8 Hrs)

Two port network parameters and interconnections, three phase unbalanced circuits and power calculations. Introduction of Basic filters (R-C, L-C).Advanced topic on the subject

Text Books:

- Networks & Systems by D Roy Choudhury [partial ebook]
- Engineering Circuit Analysis by W. H. Hayt, J. E. Kemmerly & S. M. Durbin
- Fundamentals of Electric Circuits by C. K. Alexander & M. N. O. Sadiku

Reference Books:

- Network Analysis and Synthesis by Franklin F. Kuo [ebook]
- Network Analysis, M. Van Valkenburg, Pearson Education, 2006
- Introduction to Modern Network Synthesis, M. Van Valkenburg, John Wiley & Sons.

BECL216-Communication Electronics

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25	-	75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To understand the basic concept of communication systems.
2. To understand the concept of analog modulation techniques.
3. To understand theory of analog pulse modulation techniques.
4. To understand working of radio receivers.
5. To understand the classification of multiplexing and multiplexing hierarchy.

Course Outcomes:

1. Demonstrate the fundamentals of communication systems and interpret the presence of noise in communication systems.
2. Interpret and analyze Amplitude Modulation and Frequency modulation.
3. Analyze FDM and TDM systems.
4. Illustrate the fundamentals of analog pulse modulation techniques.
5. Design and conduct experiments, using modern communication tools necessary for various engineering applications.
6. Demonstrate the basics of Television and Satellite systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3					2	3	3	2	2
CO2	2	3	3	2	2	2					2	3	3	3	2
CO3	2	3	3	2	2	3					2	3	3	3	2
CO4	2	3	3	2	2	3					2	3	3	2	2
CO5	2	3	3	3	3	2					2	3	2	3	3
CO6	2	3	3	3	3	2					2	3	2	3	2

Contents:

CO-I: (8hrs)

Introduction to Analog Communication: Review of signals and systems, Frequency domain of signals, Review of probability and random process. Base Band Signals and their bandwidth requirements. Noise in Communication systems, Gaussian and white noise characteristics.

CO-II (8hrs)

Analog Modulation Techniques: Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations, Envelope detector, Angle Modulation and their types, Reactance tube and FET modulators, Armstrong method, FM discriminator, Super heterodyne Receiver, Performance characteristics: Sensitivity, Selectivity, Fidelity, Image Frequency Rejection.

CO-III (7 hrs)

Pulse Modulation Techniques: Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM). Differential pulse code modulation. Delta modulation. Noise considerations in PCM.

CO-IV (7 hrs)

Multiplexers: FDM, TDM, Multiplexing Hierarchy, Digital Multiplexers, Basic concept of Television System, Introduction to satellite systems.Advanced topic on the subject

Text Books:

1. Electronics Communication System, Kennedy, Davis Tata McGraw-Hill, 2010, Fourth Edition
2. Communication Electronics, Roddy &Coolen PHI, 2010, Fourth Edition
3. Communication Electronics Principles and Applications Frenzel, Tata McGraw-Hill, 2011, Third Edition
4. Communication Engineering U. A. Bakshi, A. P. Godse, Technical Publications, 2009, Third Edition

Reference Books:

1. Modern Digital & Analog Communication Systems, B. P. Lathi, Oxford Press Publication, 1998, Third Edition
2. Digital Communication Simon HaykinWiley and sons, 2003, Third Edition
3. Digital Communication John G. Proakis, Tata McGraw-Hill, 2002, Third Edition
4. Digital Communication Shanmugham Wiley student 2009, Fourth Edition

BECL217- Signals and Systems

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	1	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To introduce the fundamentals, characteristics, concept techniques of signals & systems.
2. Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide
3. Development of the mathematical skills like Fourier series, Fourier transforms, Random theory to solve problems involving convolution, filtering, modulation and sampling
4. To define channel capacities and properties using Shannon's Theorem and calculate the information content

Course Outcomes:

Students will be able to

1. Illustrate& classify signals, systems & identify LTI systems
2. Find Fourier series & Fourier transform for different signals
3. Analyze the Continuous Time systems by performing Convolution
4. Demonstrate Discrete time systems and LTI systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3					2	3	3	2	2
CO2	2	3	3	2	2	2					2	3	3	3	2
CO3	2	3	3	2	2	3					2	3	3	3	2
CO4	2	3	3	2	2	3					2	3	3	2	2

Contents:

CO-I: (7hrs)

Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science electrical, mechanical, hydraulic, thermal, biomedical signals and systems as examples. Extracting the common essence and requirements of signal and system analysis from these examples. Formalizing signals: energy and power signals, signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the CO step, the CO impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. Formalizing systems: system properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, Realizability. Examples

CO-II: Continuous Time Fourier Transform:

(7hrs)

Representation of Aperiodic Signal, Fourier Transform for Periodic Signals, Fourier Transform, Properties of CTFT, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. Parseval's Theorem, Sampling Theorem, Effect of Under Sampling, and Sampling of Discrete -Time Signals

CO-III: **(8hrs)**

Continuous time and discrete time Linear shift-invariant (LSI) systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, . The idea of signal space and orthogonal bases of signals. Time de main and Frequency domain aspects of ideal and non-ideal filters.

CO-IV **(8hrs)**

Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT): Properties of DTFT and DFT, convolution property, multiplication property, Duality, Phase and frequency response using DTFT, Systems characterized by Linear Constant Coefficient Difference Equations.

Text Books:

1. Signals and Systems(Alan V Oppenheim, Alan S Willsky, S Hamid Nawab)Prentice Hall India 2009-Second Edition
2. Signals and Systems, S. Haykin and B. van Veen, Wiley1998

Reference Books:

1. Digital Signal Processing, Principles Algorithms, and Applications, John G. Prokis, Dimitris G. Manolakis, PHI, 2007,4
2. Signal Processing, James H. McClellan, Pearson/Prentice Hal,2006,1
3. Signals and System, Third Edition, 2008, P. Ramesh Babu, R. Ananda Natarajan, Scitech,2008,3

BECL218- Embedded Systems Design

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25	25	100

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. To study and understand various microcontrollers and embedded systems.
2. To understand the design parameters of embedded systems applications.
3. To study and impart different tools for embedded system and IoT application design.

Course Outcomes:

1. Demonstrate the principle of embedded systems and Microcontroller
2. Develop programming for applications develop real time applications

3. Design the interfacing of devices and peripherals
4. Make Use of ARM7 Controller for Designing of Embedded Applications
5. Develop Different IoT platform for Embedded applications
6. Design and Develop different embedded system and IoT applications.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3						2	1	3	2	3
CO2	2	2	3	2	3						2	1	3	2	3
CO3	3	2	3	2	3						2	1	3	2	3
CO4	3	2	3	2	3						2	1	3	2	3
CO5	3	2	3	3	3						2	1	3	2	3
CO6	3	2	3	3	3						2	1	3	2	3

Contents:

CO-I: (7hrs)

Embedded Systems: Introduction to embedded Systems, Requirements /Components of Embedded Systems, Design Process in Embedded System

Microcontrollers: Introduction to microcontrollers, 8051 architecture, addressing modes and instruction set, 8051 programming in Assembly language and Embedded C.

CO-II: (7hrs)

Programming: Timer, Interrupts and serial communications, Serial I/O, Programming Tools

Interfacing with 8051: ADC and DAC interfaces for microcontrollers, Real time interfacing with LED, Keypad, LCD display, Sensors interfacing (LDR, IR, PIR ,GSM, GPS, GPRS, Bluetooth.etc.)

CO-III: (8hrs)

Introduction of 32-bit Microcontroller: Advanced devices and peripheral interfacing with ATmega16: ARM7 Processors, ARM Architecture, Register and Memory organization, addressing modes, Arm Thumb and instruction sets, Basic Assembly Programming,

CO-IV: (8hrs)

Embedded IoT Applications: Introduction to Raspberry PI and Intel Galileo & STM32 Board, introduction to Python Programming, OOP's and Modules in Python Programming, Design and perform different embedded system and IoT Applications: Robotic, Industrial Automations& Health care.

Text Books:

1. Muhammad Ali Mazidi, the 8051 Micro-controller & Embedded System using assembly & C, Pearson Education,2008, Second
2. Muhammad Ali Mazidi, ARM Assembly language programming and Architecture, Second
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education India, 2009, Second

Reference Books:

1. Shibu K. V. Introduction to Embedded System, The McGraw Hill, 2011,
2. Ajay V. Deshmukh, Micro-controllers - Theory and Applications, Tata McGraw Hill,
3. Kenneth J. Ayala, The 8051 Micro-controller – Architecture, Programming & Applications, Penram International & Thomson Asia, 1996, Second

BAIP204- Foundation Course in Artificial Neural Network

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks

-	-	2	2	1	-	-	-	25	25	50

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. Be able to formulate machine learning problems corresponding to different applications.
2. Be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes: Upon completion of the course students shall be able to:

1. Interpret the basic concepts and techniques of artificial Intelligence
2. Classify machine learning algorithms to solve real time problems of moderate complexity and Apply experience of independent study and research through case studies.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2					2	3	3	3	2
CO2	3	3	3	1	1	2					2	3	3	3	2

Contents

CO-I: Artificial Neural Networks: (8hrs)

Introduction to Artificial Intelligence, Understanding the Brain, Neural Networks as a Paradigm for Parallel Processing, The Perceptron, Training a Perceptron, Learning Boolean Functions, Multilayer Perceptron, Backpropagation Algorithm, Introduction to Bayesian Function.

CO-II: Applications in Electronics: (7hrs)

This CO provides an intensive introduction to artificial intelligence and its applications to problems of medical diagnosis, therapy selection, and monitoring and learning from databases.

Case Study 1: - Potential use of a causal Bayesian network to support both clinical and pathophysiology tutoring in an intelligent tutoring system for anemias.

Link for problem and solution for case study:
https://ocw.mit.edu/courses/health-sciences-and-technology/hst-947-medical-artificial-intelligence-spring-005/projects/anemias_tutoring.pdf

Text Books:

1. Introduction to machine learning,EthemAlpaydin. — 2nd ed., The MIT Press, Cambridge, Massachusetts, London, England.
2. Introduction to artificial neural systems, J. Zurada, St. Paul: West.
3. R in a Nutshell, 2nd Edition - O'Reilly Media.

Reference Books:

4. Machine Learning, Tom M Mitchell.
5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer

Fourth Term

BECL 220- Sensors and Actuators

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	-	-	1	1	10	15	25	-	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To gain knowledge about the measuring instruments, sensors & actuator.
2. To able to calibrate and testing of different sensors
3. To able to understand different sensors & actuators

Course Outcomes:

1. Analyze and use the functions of various instrumentation systems.

2. Interpret fundamental and some special knowledge in process automation in industries

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	3					2	1	3	2	3
CO2	2	2	3	2	3	3					2	1	3	2	3

Contents:

CO-I: (7hrs)

Static and dynamic characteristics - Active and passive transducers, Sensors and transducers, Pressure, Flow, Level, Temperature, humidity, light sensor, piezo electric transducer

CO-II (8hrs)

Sensors: IC sensor, Digital transducers, Smart sensor, MEMS sensors, Fiber optic transducer, Signal conditioning techniques used in various transducers, Linearization, Shielding techniques, Data Acquisition System, Industry Standard Bus architecture, Actuation Systems: ADC, DAC, Pneumatic & hydraulic control Valves, Solid state switches, Motor Control Techniques, PLC controller.

Text Books:

1. Principles of Industrial Instrumentation, D. Patranabis, Tata Mcgraw-Hill,1999, 2
2. A course in Electrical and Electronic Measurement and Instrumentation, A.K. Sawhney, Dhanpat Raj and Sons, New Delhi, 1999, 3
3. Getting Started with The Internet of Things: Connecting Sensors and Microcontrollers to the Cloud, Cuno Pfister, Oreilly Publication, 2011,

Reference Books:

1. Measurement systems application and design, Ernest O. Doebelin, Tata McGraw Hill Publishing Co. New Delhi, 1999, IV
2. Industrial Instrumentation, Eckman D. P. M, Wiley Eastern Limited, 1990, II
3. Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects, Maneesh Rao, Packet, 2018, I

BECL 221- Electromagnetic Fields & Waves

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
1	1	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To learn the Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields, and apply them to solve physics and engineering problems.
2. To distinguish between static and time-varying fields, and understand the significance and utility of Maxwell's Equations and Boundary Conditions, and gain ability to provide solutions to communication engineering problems.
3. To analyze the characteristics of Uniform Plane Waves (UPW), determine their propagation parameters and estimate the same for dielectric and dissipative media.
4. To conceptually understand the UPW Polarization features and Poynting Theorem, and apply them for practical problems.

Course Outcomes:

1. Distinguish between the static and time-varying fields,
2. Make use of Maxwell equations to solve filed problems
3. Analyze the Wave Equations and evaluate the UPW Characteristics with estimation of Polari

4. Apply the concepts of EM theory to solve the engineering problems.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2			2		2	3	2	2	3
CO2	3	3	3	2	3	2			2		2	3	2	2	3
CO3	3	3	3	2	3	2			2		2	3	2	2	3
CO4	3	3	3	3	3	2			3		2	3	3	3	3

Contents:

CO-I: (8hrs)

Electrostatics: Coordinate Systems – Vector fields, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law, Divergence theorem and applications, Electric Potential, Relations Between E and V, Gradient, Energy Density, Convection and Conduction Currents, Continuity Equation, Isotropic and Homogeneous Dielectrics, Poisson's and Laplace's Equations.

CO-II (7hrs)

Magnetostatics: Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Curl, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields

CO-III (7hrs)

Maxwell's Equations and its applications: Maxwell's Equations for static and time varying fields, Maxwell's Equations in differential and integral Forms and their significance, Conditions at a Boundary Surface, Electric and magnetic boundary conditions: Dielectric-Dielectric and Dielectric-Conductor Interfaces, Practical applications.

CO-IV (8hrs)

EM Waves: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Skin effect, Poynting Vector and Poynting Theorem – Applications,, Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Snell's law, Brewster Angle, Surface Impedance, Polarization.

Text Books:

1. Engineering Electromagnetics. William H. Hayt Jr. and John A. Buck, Mc Graw Hill Education,2006,7
2. Principles of Electromagnetics, Matthew N.O. Sadiku and S.V. Kulkarni, Oxford University Press,2015,6
3. Electromagnetic Waves and Radiating Systems., E. C. Jordan and K.G. Balmain, PHI, 2000, 2

Reference Books:

4. Engineering Electromagnetics, Nathan Ida, Springer (India) Pvt. Ltd., New Delhi, 2005, 2
5. Networks, Lines and Fields. John D. Ryder, PHI,1999,2

BECL 222, BECP 222- Analog System Design

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
2	-	2	4	3	10	15	25	25	-	75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To understand analog circuits and systems.
2. To know linear and nonlinear applications of operational amplifier ICs.

3. To study frequency response of different circuits based on operational amplifier applications.
4. To study and use different ICs such as timers for applications.

Course Outcomes:

1. Apply knowledge of differential amplifier to design operational amplifier.
2. Design op-amp based circuits required in embedded system design, communications systems
3. Design real time applications using filters & oscillators.
4. Design analog applications using different ICs.
5. Analyze and estimate the low and high frequency behavior of linear circuits, including noise.
6. Apply op-amps fundamentals and computer tools in project design, evaluation, and analysis

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2	1				2	3	3	3	2
CO2	3	3	3	1	1	2	2				2	3	3	3	2
CO3	3	3	3	1	1	2	2				2	3	3	3	3
CO4	3	3	3	1	1	2	2				2	3	3	3	3
CO5	3	3	3	1	1	2	1				2	3	3	3	2
CO6	3	3	3	1	1	2	2				2	3	3	3	3

Contents:

CO-I: (6hrs)

Differential Amplifier, Cascaded Differential Amplifier Stages and Level Translator, AC and DC Analysis of Cascade Amplifier, Current Mirror, Design of two stage direct-coupled amplifier.

CO-II (8hrs)

OPAMP, inverting, non-inverting, differential amplifier configurations, negative feedback, voltage gain, input & output impedance, Bandwidth. Input offset voltage, input bias and offset current, Thermal drift, CMRR, PSRR, Frequency response. Linear applications, DC, ac amplifiers, summing differential amplifier, instrumentation amplifier, V to I and I to V converters, Integrator, Differentiator.

CO-III (8hrs)

Classification of Filters, Active Filters, First to Sixth –Order Butterworth filter, IGMF configuration, All Pass Filter, Cascade Design of Filters, Classification of Oscillators, Design of Op-amp based Phase Shift and Wein Bridge Oscillators, Square, Triangular and Saw Tooth Wave Generators, Schmitt Trigger, Voltage Comparator, Voltage Limiters and Window Detector, Clippers and Clampers, Peak Detector, Precision Rectifiers, sample & Hold, ADC, DAC

CO-IV (8hrs)

The 555 Timer, Phase Locked Loops IC565, ICL8038 & XR2206 Function Generator, Voltage Controlled Oscillator Basic Operation, IC based Voltage Regulator Circuits, Dual Track Voltage Regulator, Three - Terminal Regulator (Fixed Regulator) Voltage Adjustment and Current Boosting of Fixed Regulator, Merits and Drawbacks of Linear Regulators.

Text Books:

1. Operational amplifiers, Design and applications, Tobey, Graeme, Huelsman, McGraw Hill,1990,2
2. Operational Amplifiers and Linear Integrated Circuits, Gaikwad R. A, PHI, 2

Reference Books:

1. Design with OPAMPS and Analog ICS Francis S McGraw Hills
2. OPAMPS and Linear ICs Fiore J.M Delmer-Thomson, USA 2001, 2

BECL223, BECP 223- Digital Communication

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25	-	75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To understand the basic knowledge of digital communication system & Source coding techniques.
2. To study different modulation schemes, multiple accesses, error probability for digital communication.
3. To impart the knowledge of design, analysis & comparison of digital communication systems.

Course Outcomes:

1. Interpret baseband systems, sampling, quantization and source coding
2. Elaborate different techniques of modern digital communication
3. Evaluate performance of various modulation & demodulation techniques
4. Design digital systems using appropriate mathematical techniques
5. Solve various source/channel coding and error-control coding techniques
6. Evaluate and apply spread spectrum Techniques and its performance parameters

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3
CO2	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3
CO6	3	3	3	3	3	2	1	1	1	1	2	3	3	3	3

Contents:

CO-I: (8hrs)

Digital Base Band Modulation Techniques: Bandwidth of digital Data, Base band system, formatting textual Data, Messages, characters, and symbols, Formatting Analog Information, Sources of Corruption, Inter symbol Interference. Uniform and non-uniform quantization, Base band Modulation, Correlative Coding, Line coding, Huffman Coding.

CO-II (7hrs)

Baseband Modulation and Demodulation Techniques:

Digital Modulation techniques ASK, FSK, PSK, DPSK, Coherent & Non coherent detection, Complex envelop, Error performance for Binary system, M-Ary signaling and performance, Symbol error performance for M-ary Systems, Bit error Rate calculations.

CO-III (7hrs)

Linear block codes, generator matrix and parity check matrix, some specific linear block codes, syndrome decoding, cyclic codes, convolutional channel codes, optimum decoding of convolutional codes- Viterbi algorithm.

CO-IV (8hrs)

Advanced Modulation Method & Spread Spectrum techniques: Gram – Schmitt procedure, Spread Spectrum techniques: Spread Spectrum Overview, Pseudo noise Sequences, Direct-Sequence Spread Spectrum systems, Frequency hopping systems, Synchronization, Jamming consideration, Advanced topics on Digital Communication.

Text Books:

1. Digital Communications (Fundamentals and applications), Bernard Sklar, Pearson Education,2005,2nd
2. Digital Communication, Simon Haykin, Wiley Eastern,2001,4th

3. Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University press,1999,3rd

Reference Books:

1. Digital Communication, John G. Prokis, Tata Mc –Graw HILLS,2007,5
2. Communication Electronics, Roddy & Colin, PHI, Prentice-Hall PTR,1981,2
3. Communication Electronics, Kennedy, Tata Mc –Graw HILLS,,2012,5

BECL224- Introduction to Drones

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
-	-	4	4	2	10	15	25	25	-	75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To familiarize with various drone components and understand their properties.
2. To understand basic fundamentals of Drone.
3. To prepare for various engineering applications based on Drones.

Course Outcomes:

1. Examine various drones and its devices.
2. Apply knowledge of drone for related application.
3. Demonstrate the knowledge of Drone and its application
4. Develop the skill to build, and troubleshoot Drone circuits

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	1	3	1	3	3	2	2
CO2	2	2	3	2	2	2	2	2	1	3	2	3	3	3	3
CO3	2	2	3	2	2	2	2	2	1	3	3	3	3	2	2
CO4	2	2	3	2	2	2	2	2	1	3	1	3	3	3	3

Contents:

CO-I: (6hrs)

Basics: Introduction to the Drones and various Applications of Drone, Working Principle and design. Inertial Measurement CO, Sensors and calibration, ID Implementation and Tuning

CO-II (6hrs)

Drone Technology & Networking: Intra-inter Drone Communication, Network Topology & protocol, Cluster-networking

CO-III (6hrs)

Drone Hardware Fabrication: Selection electronics components such sensors, controller, BLDC motor, Battery, Flight controller, Remote Controller and other Assembly accessories.

CO-IV (12hrs)

Drone Designing: Design structure. Designing techniques and optimization, Battery Management, Payload management, Testing and analysis, aero-dynamics & calibration.Hands on project: Precautions while Assembling, Exercises based on Flight controller **&**boards like Ardupilot APM 2.x,3.x,hobby kin kk5.0, CC3D,Pixhawk

Reference Books:

1. Theory, Design and Applications of Unmanned Aerial Vehicles- by A. R. Jha ,2016
2. Handbook of Unmanned Aerial Vehicles- Valavanis, K. Vachtsevanos, Geore J,2014

BCSL208, BCSP208-Database Management System

Pre-requisite: Programming for Problem SolvingTeaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	10	15	75

***Mode of Exam: Practical Application Based Online**

Course Objective:

1. This course introduces general idea of database management system.
2. It is aimed at developing skills to design databases using data modeling and design techniques.
3. It is also aimed to developing skills to implement real life applications which involve database handling.
4. This course also provide carrier opportCOies in subject areas of designing, storage techniques and data handling and managing techniques

Course Outcome: Upon successful completion of the course, students shall be able to-

1. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms and design appropriate data model for it.
2. Demonstrate an understanding of various normalization forms and apply knowledge of normalization for creation of database.
3. Demonstrate SQL queries to perform CRUD (Create, Retrieve, Update, Delete) operations on database and perform inferential analysis of data model
4. Demonstrate query processing and able to design optimized query execution plan.
5. Develop basic transaction processing and management and ensure database security, integrity and concurrency control
6. Demonstrate the management of structured and unstructured data management with recent tools and technologies.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	1	3	1	3	3	2	2
CO2	2	2	3	2	2	2	2	2	1	3	2	3	3	3	3
CO3	2	2	3	2	2	2	2	2	1	3	3	3	3	2	2
CO4	2	2	3	2	2	2	2	2	1	3	1	3	3	3	3
CO5	2	2	3	2	2	2	2	2	1	3	2	3	3	2	2
CO6	2	2	3	2	2	2	2	2	1	3	3	3	3	2	2

Contents:

CO-I: (5hrs)

Introduction to DBMS, DBMS Architecture, Data Models, UML

CO-II: (7hrs)

Relational Database design: Functional Dependency (FD) – Basic concepts, closure of set of FD, closure of attribute set, Decomposition, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF.

CO-III: (9hrs)

SQL Concepts: Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point. Cursors, Stored Procedures, Stored Function, Database Triggers

CO-IV: (9hrs)

Query Processing & Query Optimization: Overview, measures of query cost, selection operation, sorting, join, evaluation of expressions, transformation of relational expressions, estimating statistics of expression results, evaluation plans and materialized views

Text Books:

1 Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
2 Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.

Reference Books:

1 G. K. Gupta ”Database Management Systems”, McGraw – Hill.
2 Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017.
3 Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
4 RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.

BCSP217- MACHINE LEARNING

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
-	-	2	2	1	-	-	-	25	25	50

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. Be able to formulate machine learning problems corresponding to different applications.
2. Be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes:

Upon completion of the course students shall be able to:

1. Develop skills of using recent machine learning software for solving practical problems.
2. Summarize and compare a range of machine learning algorithms along with their strengths and weaknesses

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2					2	3	3	3	2
CO2	3	3	3	1	1	2					2	3	3	3	2

Contents:

CO-I (6 hrs)

Understanding Machine Learning: Introduction, What Is Machine Learning? Examples of Machine Learning Applications, Learning Associations, Supervised & Unsupervised Learning, Reinforcement Learning, Classification, Regression

CO-II: Applying R-Programming: (7 Hrs)

R - Basic Syntax, Data Types, Variables, Operators, Decision Making, Loops, Functions, Strings, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Packages-chart & graphs

CO-III (4hrs)

Clustering & Application of ML: Introduction to clustering, k-Means Clustering, Hierarchical clustering, Introduction to Chat Bot, creation of Chat Bot

Text Books:

1. Introduction to machine learning, Ethem Alpaydin. 2nd ed., The MIT Press, Cambridge, Massachusetts, London, England.
2. Introduction to artificial neural systems, J. Zurada, St. Paul: West.
3. R in a Nutshell, 2nd Edition - O'Reilly Media.

Reference Books:

1. Machine Learning, Tom M Mitchell.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer

FIFTH Term

BECL318- CMOS VLSI Design

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	-	2	3	2	10	15	25	10	15	75

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. Learn MOS transistor theory.
2. Expose to MOS circuit design & Layout processes.
3. Expose to CMOS logic structures.
4. Learn scaling of MOS circuits.

Course Outcomes:

1. Identify fundamental principles of VLSI (Very Large Scale Integrated) circuit design and layout.
2. Interpret CMOS fabrication technologies.
3. Determine physical VLSI design issues (bottom-up design) and basic CMOS logic gates,
4. Design building blocks of large-scale CMOS digital integrated circuits

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes													Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	1	3	1	3		3	2	2
CO2	2	2	3	2	2	2	2	2	1	3	2	3		3	3	3
CO3	2	2	3	2	2	2	2	2	1	3	3	3		3	2	2
CO4	2	2	3	2	2	2	2	2	1	3	1	3		3	3	3

Contents:

CO-I: (6hrs)

Basic MOS Technology: MOS Structure, Threshold Equation, Ion Implantation, MOSFET Current-Voltage Characteristics, Channel Length Modulation, Substrate Bias Effect, MOSFET Scaling, Channel Effects, MOSFET Capacitance, Numerical, Introduction to SOC, MPSOC, RFSOC

CO-II (8hrs)

MOS Inverter: Noise Imm COy, Noise Margin, Inverter with different Loads, CMOS DC Characteristics, Design of CMOS Inverter, Static Load MOS Inverters, Numerical

CO-III (10hrs)

Switching Characteristics: Rise and Fall Time Derivation, Numerical, Inverter Design with delay constraint, MOSFET Capacitance, Estimation of Interconnect Parasitics, Interconnect Delay, Switching Power Dissipation, Power Delay Product

CO-IV (6hrs)

Circuit Design Processes: Combinational MOS Circuits, Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams, Transmission Gates, nMOS fabrication. CMOS fabrication.

Text Books:

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi., McGraw-Hill, Inc., New York, NY, USA.,2000,
2. CMOS Circuit design, Layout and Simulation, R. J. Baker, H W Li, D. E. Boyce, PHI EEE,
3. Principles of CMOS VLSI Design, Neil H. E. Weste, Kamran Eshraghian, Addison Wesley,

Reference Books:

1. CMOS Logic Circuit Design,,John P. Uyemura,,Illustrated, Springer Science & Business Media,,1999,

2. CMOS Digital Integrated Circuits Analysis & Design,,Sung-Mo Kang & Yusuf Leblebici,,Tata McGraw -Hill,2003,
3. Digital integrated circuits: a design perspective, Second Edition,,Jan M. Rabaey, Anantha P. Chandrakasan, Borivoje Nikolic,Illustrated, Pearson Education,2003,
4. Design of Analog CMOS Integrated Circuits,Razavi,McGraw-Hill,2001,

BECL316, BECP 316- Digital Signal Processing

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25		75

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. Analyze the signals in time and frequency domain
2. Be familiar with transformation tools on signals & systems and analyze
3. Learn to design various digital filters and analyze their frequency response
4. Develop DSP technique for various applications

Course Outcomes:

1. Make use of linear time invariant systems.
2. Elaborate discrete parameter signals.
3. Apply knowledge of how to use linear transforms.
4. Apply linear system analysis to engineering problems.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	1	3	1	3	3	2	2
CO2	2	2	3	2	2	2	2	2	1	3	2	3	3	3	3
CO3	2	2	3	2	2	2	2	2	1	3	3	3	3	2	2
CO4	2	2	3	2	2	2	2	2	1	3	1	3	3	3	3
CO5	2	2	3	2	2	2	2	2	1	3	2	3	3	2	2
CO6	2	2	3	2	2	2	2	2	1	3	3	3	3	2	2

Contents:

CO-I: (6hrs)

Introduction: Representations of discrete signals, Discrete time systems & properties, Basic operators and Convolution, Correlation, Z-Transforms & properties, Inverse Z-Transforms Methods.

CO-II (8hrs)

Fourier Analytical Techniques: Frequency analysis of discrete time signals, Discrete Time Fourier Transform and Discrete Fourier Transform, Properties, Inverse Discrete Fourier Transform, Circular Convolution, Efficient Computation of DFT using FFT algorithms, Linear Filtering approach to computation of DFT.

CO-III (10hrs)

Digital Filters: Structures for FIR Systems and IIR Systems and representation of Structures using Block diagram & Signal Flow Graph, Design of IIR filters from analog filters using Impulse Invariant Method, Bilinear Transformation, Matched Z Transformation, Butterworth Approximation, FIR filters design Methods-Fourier Series, Windowing, DFT, Frequency Sampling.

CO-IV (6hrs)

DSP Processor & Applications: Desirable Features of DSP Processors, Types of Architectures of DSP processor, Application areas: Dual-Tone Multi Frequency Signal Detection,

Spectral Analysis Using DFT, Short Term DFT, Musical Sound Processing, Application to Image processing & Radar, Oversampling A/D Converter, Oversampling D/A Converter.

Text Books:

1. Theory and Applications of Digital Signal Processing. R. Rabiner, and B., Gold, Prentice Hall,2000,3rd

Reference Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications, J. G. Proakis and D. G. Manolakis, Prentice Hall, ,2006,4th
2. Digital Filters: Analysis Design and Application A. Antonion, Prentice Hall,1999,
3. Digital Signal Processing, A. V. Oppenheim and R. W. Schafer, Prentice Hall,1998,1998,
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Tata McGraw Hill Pvt. Ltd.,2011,3rd

BECL319- Transmission Line and Antennas

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objectives:

1. To understand transmission line fundamentals and propagation of signals through lines.
2. Design various impedance matching devices such as stub tuners and multi-stage quarter wave transformers.
3. To solve the electric field and magnetic fields for a given wire antenna.
4. Determination of the fields radiated from antennas; wire antennas; array antennas; parabolic reflectors, antenna radiation pattern & antenna directivity.

Course Outcomes:

1. Demonstrate the fundamentals of transmission line theory and impedance matching in high frequency lines.
2. Interpret& utilization of antenna as required in different communication systems.
3. Determine directions of maximum signal radiations and the nulls in the radiation patterns.
4. Design array antenna systems from specifications.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	2	2	1	1	2	2	1	1	3
CO2	3	3	3	3	2	3	2	2	1	1	2	2	1	1	3
CO3	3	3	3	3	3	3	2	2	1	1	2	2	1	1	3
CO4	3	3	3	3	3	3	2	2	1	1	2	2	1	1	3

Contents:

CO-I: (8hrs)

Introduction: Line parameters, Types of transmission line, skin effect, General solution, physical significance of the equations; the infinite line, Voltages and currents on the Distortion less line & , wavelength, velocity of propagation, the distortion less line, Reflection on a line not terminated in Z0, Reflection coefficient, Standing waves Open and Short circuited lines, Reflection loss, Impedance matching, Quarter wave line; Single-Stub, Smith Chart, Application of the Smith chart for calculating impedance and admittance.

CO-II (7hrs)

Antenna Fundamentals: Introduction, Isotropic Radiator, Radiation Mechanism. Antenna Terminology: Radiation pattern, radiation power

density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area. Reciprocity Theorem. Radiation Integrals: Retarded Vector potentials A, J.

CO-III (9hrs)

Types of Antenna: Wire Antenna: Infinitesimal Dipole, Its Radiation Field, Radiation Resistance, Radiation Sphere, Near Field, Far Field Small Dipole, Finite Length Dipole, Half Wave Length Dipole, Folded Dipole, Linear Elements Near Or On Infinite Perfect Conductors, Ground Effects And Their Application, Loop Antenna: Small Loop, Comparisons Of Small Loop With Magnetic Dipole, Radiation Pattern, Its Parameters And Their Application, Microstrip Antenna , Broadband and Reflector antennas.

CO-IV (6hrs)

Antenna Array: Antenna Arrays: Two element array, Pattern multiplication, Broad side and End-fire array, N-element array: Uniform spacing, non uniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi-Uda Antenna Array.

Text Books:

1. Antenna and Wave Propagation. D. Prasad, Satya Prakashan,2003,3
2. Antenna Theory and Design, Balanis, C. A, Ed., John Wiley &,2005,3

Reference Books:

1. Electromagnetics with, Kraus, J.D. and Fleisch, D. A, McGraw -,

BECL320, BECP 320- Hardware Description Language

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
1	-	2	3	2	10	15	25	10	15	75

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. Apply Boolean algebra and other techniques to express and simplify logic expressions.
2. Analyze and design combinational and sequential digital systems.
3. Use different techniques among them a hardware description language and a programming language, to design digital systems.

Course Outcomes:

1. Summarize digital systems and the use of Boolean algebra in logic analysis and design
2. Interpret RTL design and verification techniques and methodologies
3. Experiment the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.
4. Illustrate basic tools of logic design and provide hands-on experience designing digital circuits

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO2	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO3	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO4	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3

Contents:

CO-I: (7hrs)

Introduction to Hardware Description Languages: Combinational Logic, Structural

Modeling, Sequential Logic, More Combinational Logic, Parameterized Modules, Test benches

CO-II (7hrs)

Sequential circuit Sequential circuit: Latches and flip-flops, counters, shift register, Finite state machine; representation and synthesis.

CO-III (8hrs)

FPGA architecture and synthesis Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation

CO-IV (8hrs)

Semiconductor memories, PALs, PLAs and FPGAs; Pipelining and timing issues, PROMs (DRAMs, Flash memory etc.), SOC

Text Books:

1. HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog, Douglas Smith, Doone publications,1998,1st
2. Verilog HDL, A guide to Digital Design and Synthesis, Samir Palnitkar, Prentice Hall,1st

Reference Books:

1. FPGA based Prototyping Methodology Manual, Doug Amos, Austin Lesea, Rene Richter, Synopsis Press,
2. Introduction to Reconfigurable Computing, Architectures, Algorithms, Christophe Bobda, Springer Netherlands.
3. Writing Testbenches: Functional Verification of HDL Model,J anick Bergeron, Springer, 2003, 2nd

BCSP213- Java Programming

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
-	-	4	4	2	-	-	-	25	25	50

***Mode of Exam: Practical Application Based Online**

Course Objective:

1. This course introduces fundamentals of object- oriented programming in Java, including Defining classes, invoking methods, using class libraries.
2. It is aimed at building software development skills using java programming for creating real world applications.
3. Use a development environment to design, code, test, and debug simple programs, including multi-file source projects, in an object-oriented programming language

Course Outcomes:

- **CO 1:** Explain the basic data types and control flow constructs using J2SE.
- **CO 2:** Make use of Integrated Development Environments (IDEs) such as Eclipse, NetBeans, and JDeveloper for program development.
- **CO3:** Design object oriented class structures with parameters, constructors, and utility.

CO4: Implement a final project selected from an approved project chosen by the studentCO Mapping with PO and PSO

Contents:

CO I: Introduction to JAVA, Class and Object
Introduction to data types, operators and control statements, Classes: fundamentals of classes, declaring objects, Assigning objects, reference variables, methods, constructor, variable handling. Methods and classes: Overloading methods, understanding static and final.

CO II: Array, Packages, Interface Introduction to Array, Vectors, Wrapper class & Inheritance, Packages and interface: Packages, access protection, importing packages, interfaces.

CO III: Exception Handling &Multithreaded Programming
Exception handling: Fundamentals exception types, uncaught exception, try-catch, displaying description of an exception, multiple catch clauses, nested try statements, throw, finally, built in exceptions, creating own exception subclasses, JAVA thread model, creating thread, creating multiple thread.

CO IV: Applet, Graphics Programming and Database Connectivity

Introduction to applet, The Five Stages of an Applet's Life Cycle, Methods for Adding UI Components, Methods for Drawing and Event Handling.

Database Connectivity: JDBC (Java Data Base Connection), Introduction to JDBC, Databases and Drivers, Types of Driver, Loading a driver class file, establishing the Connection to Database with different Driver. Executing SQL queries by result Set using Statements

Text Books:

1. The Complete Reference by Herbert Schild, TMH Publication
2. Programming with Java- A Primer by E. Balagurusamy, 3rd Edition, TMH Publication

Reference Books:

1. The Complete Reference- JAVA 2- 3rd Edition By Patrick Naughton, TMH Publication.
2. Java 6 Programming Black Book by Kogent Solution Inc., Dreamtech Press Publication.
3. Java 2 Black Book by Steve Holzner, Paraglyph Press, 2nd Ed.
4.

BEEL319,BEEP319- Basic Control System

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	-	2	3	2	10	15	25	25	-	50

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objective

1. The students should be able to learn the different types systems and governing differential equations and mathematical representation in terms of output and input correlation.
2. The students should able to learn time response analysis and demonstrate their knowledge to frequency response.
3. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.
4. To get insight of modern control theory based on matrix approach and state variables.

Course Outcome

The students should be able to

CO1 : To build classical mathematical foundation for control philosophy and time response of systems.

CO2 : To determine performance of system and its stability issues.

CO3 : To evaluate performance of system for broad range of frequency.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO2	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO3	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3

Contents:

CO I Introduction to need for automation and automatic control ,use of feedback, broad spectrum of system application, Mathematical modeling,(Electrical & Electromechanical) diff. Equations., transfer functions, block diagram, signal flow graphs, application to elementary systems, simplifications, effect of feedback on parameter variations, disturbance signal. Time response of system, first order and second order system, standard inputs, concept of gain and time constants, Steady state error, type of control system, approximate methods for higher order system.

CO II Stability of control systems, conditions of stability, characteristics equations, RouthHurwitz criterion, special cases for determining relative stability, Root location and its effect on time response, elementary idea of root locus, effect of addition of pole and zero on proximity of imaginary axis.

CO III Frequency response method of analyzing linear system, Nyquist and Bode Plots, Stability and accuracy analysis from frequency response, open loop and close loop frequency response, Nyquist Criterion, Effect of variation of gain and addition of pole and zero on response plot, stability margin in frequency response. Design by state variable feedback: Review of state variable

representations. Solution of State equations. Controllability & Observablity.

Text Books:

1. B. C. Kuo, Automatic Control Systems, 3rd Edition, Prentice Hall India, 1975

2. Nagrath, Gopal, Control System Analysis. 5th Edition, New Age International, 2010

Reference Books:

1. M.Gopal, Control Systems, Principles & Design, 3rd Edition, TMH Publishers, 2010

2. Norman S. Nise, Control Systems Engineering, 5th Edition, John Wiley & Sons, 2008

BECL323,BECP323: Digital Image Processing

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	2	4	3	10	15	25	25	-	75

***Mode of Exam: Practical Application Based Online**

Course Objectives:

1. Learn digital image fundamentals.
2. Be exposed to image processing techniques.
3. Be familiar with segmentation techniques and image compression.
4. Understand applying image processing algorithms to real problems

Course Outcomes:

1. Interpret the need for image transforms and their properties.
2. Apply image enhancement and restoration techniques.
3. Develop algorithm for image segmentation, image compression & coding.
4. Make use of techniques, skills, and modern engineering tools necessary for engineering application to real problems.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	1	1	2	2	2	3	1	2
CO2	3	3	3	3	2	3	3	1	1	2	2	2	3	1	2
CO3	3	3	3	3	2	3	3	1	1	2	2	2	3	1	2
CO4	3	3	2	3	2	3	3	1	1	2	2	2	3	1	2

Contents:

CO-I: (6hrs)

DIGITAL IMAGE FUNDAMENTALS: Light and Electromagnetic spectrum, Components of Image processing system, Image formation and digitization concepts, Neighbours of pixel adjacency connectivity, Distance measures, Color fundamentals, Color models.

CO-II (10hrs)

IMAGE PROCESSING TECHNIQUE: Image **Enhancements:**
In spatial domain: Basic gray level transformations, Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters.

In Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters, Sharpening frequency domain filters.

Image Restoration:

Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering.

CO-III (8hrs)

IMAGE SEGMENTATION: Detection of Discontinuities, Edge linking and boundary

Description: Local processing, Global processing, Hough transform, Thresholding& Region based segmentation, Segmentation by Morphological watersheds, Object representation, description and recognition

CO-IV **(6hrs)**

IMAGE COMPRESSION: Image compression model, Fundamental coding theorem, Lossless compression, Lossy compression.

Text Books:

- R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
- A. K. Jain. Fundamentals of Digital Image *Processing*. Prentice-Hall, 1989.

Reference Books:

- R. M. Haralick, L. G. Shapiro. *Computer and Robot Vision.* Addison-Wesley, 1993.
- A. Rosenfeld, A. C. Kak. *Digital Picture Processing.* Addison-Wesley, 1983
- D. A. Forsyth, J. Ponce. *Computer Vision: A Modern Approach.* Prentice-Hall, 2003.
- C. R. Giardina, E. R. Dougherty. *Morphological Methods in Image and Signal Processing.* Prentice-Hall, Englewood Cliffs, New Jersey, 1988.
- R. J. Schalkoff. *Digital Image Processing and Computer Vision.* John Wiley & Sons, Singapore, 1989.

SEVENTH TERM

BCSL315/BCSP315-Cloud Computing

Pre-requisite: NA

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
1	-	2	3	2	10	15	25	10	15	75

***Mode of Exam: Practical Application Based Online**

Course Objective:

1. Understand the new technologies for resources sharing
2. Explain classification of Cloud deployment
3. Discuss capacity planning for cloud configuration
4. Understand Cloud service model
5. Cloud Security and privacy issue
6. Cloud business model for cost effectiveness

Course Outcome: Upon successful completion of the course, students shall be able to-

CO1: State the basics of distributed computing and cloud computing.

CO2: Summarize the technical capabilities and business benefits cloud technology.

CO3: Develop cloud-based application demonstrating its implications

CO4: Develop cost effective solution using cloud technology

CO5 : Develop solution for Society with minimized resources

CO Mapping with PO and PSO:

Course Outcomes	Program Outcomes					Program Specific Outcomes
	P01	PO2	PO3	P04	PO5	PSO1
CO1	1	3	3	3	3	-
CO2	-	3	3	3	3	2
CO3	2	3	3	3	3	3
CO4	1	3	2	3	3	3
CO5	1	2	3	2	3	3
CO6	1	3	2	3	3	3

Contents:

CO- I: Introduction to Cloud Computing (8 Hrs)

Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm,Evolution of cloud computing, Defining cloud computing, Components of a computing cloud,Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)

CO – II: Cloud Computing Architectural Framework (7 Hrs)

Cloud architectural principles, Role of Web services, Benefitsand challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to managecloud services deployment.

CO – III: Cloud Application Development (8 Hrs)

Role of business analyst, Technical architecture considerations, Service creation environments to

develop cloud based applications, Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages, Cloud Economics,

CO – IV: Cloud Security and Risk Management (7 Hrs)

Cloud Security: Understanding cloud based security issues and threats, Data security and Storage,Identity& Access Management, Risk Management in cloud, Governance and Enterprise RiskManagement.

Text Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
2. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
3. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
4. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos,Lee Gillam, Springer, 2012

Reference Books:

1 Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

2 Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN:978-0521137355]

3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]

4. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010

5. Tim Mather, SubraKumaraswamy, and ShahedLatif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2019

Track 1:-

DEPARTMENT ELECTIVE 1: TELEVISION & MULTIMEDIA PROCESSING

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

***Mode of Exam: Pen and paper**

Course Objective:

1. To introduce the study and analyse transmission & reception for audio and video systems in digital television.
2. To study the principle of HDTV, 3D TV, IPTV.
3. To understand ATSC & DVB Modulation.
4. To understand multimedia system architecture & compression techniques.

Course Outcomes:

1. Outline importance of various sections of television receiver & analyse colour difference signals & its components.
2. Demonstrate transmission & reception of digital television & Compare digital television systems used worldwide.
3. Interpret working principles of ATSC & DVB techniques.
4. To provide the student with an understanding of multimedia system design.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	3	1	1	2	2	1	2	2	2	2
CO2	3	3	3	2	2	3	2	1	2	2	3	3	3	3	3
CO3	2	2	3	2	2	2	2	1	2	2	2	3	2	2	2
CO4	3	3	2	3	2	2	1	1	2	2	3	3	3	3	2

Contents:

CO-I: (Mapped CO1) (8 hrs)

Introduction to Television & Color Television Receiver: Picture transmission, TV transmitter, Colour mixing, video signals for colour, Luminance signal (Y), Compatibility, Colour-difference signals, encoding, Formation of chrominance signals. RF Tuner, IF Subsystem, Video amplifier, Sound section, Sync separation, Deflection circuits, Scanning currents in the yoke, Chroma decoder, Separation of U and V colour phasors, Synchronous demodulators, Sub carrier generation and control, Matrixing for drive circuits

CO-II: (Mapped CO2) (6 hrs)

Digital Satellite Television, Direct-to-Home Satellite Television, Digital TV Receiver, Basic principles of Digital TV broadcasting, Digitization of video signals, Digitization formats. Digital television systems – ATSC, DVB-T, ISDB, DTMB.

CO-III: (Mapped CO3) (8 hrs)

ATSC 8-VSB Modulation, ATSC Data Framing, ATSC Concatenated Channel Coder, ATSC Channel Capacity, DVB Modulation, DVB Channel Coding, DVB Channel Capacity, DVB teletext, DVB subtitling system, Global View of transmission and reception process, Composition of Integrated Decoder, Flat panel display TV receiver, Stereo sound in TV, 3D TV Evolution of the set top box, High-Definition Television (HDTV), Digital TV over IP, Digital terrestrial television for mobiles.

CO-IV: (Mapped CO4) (8 hrs)

Multimedia Elements, Multimedia Applications, Multimedia System, Architecture, Evolving Technologies For Multimedia Systems, Multimedia, Databases, Types Of Compression, Binary Image Compression Schemes, Color, Gray Scale, Still-Video Image Compression, Discrete Cosine Transform, Video Image Compression, MPEG Coding Methodology, Audio Compression, Data and File Format Standards- RTF, TIFF, RIFF, MIDI, JPEG, AVI, JPEG, Twain Architecture. Storage and Retrieval Technologies, Multimedia Application Design

Text Books:

1. R.R. Gulati, "Monochrome & Color TV", PHI Learning, 2014
2. A. M. Dhake, "TV and Video Engineering", Tata McGraw-Hill Education, 2001.
3. Andleigh PK and Thakrar K, "Multimedia Systems", Addison Wesley Longman, 1999.

Reference Books:

1. R. G. Gupta, "Television Engineering and Video Systems", Tata McGraw-Hill Education, 2011
2. Jerry Whitaker, Blair Benson "Standard Handbook of Video and Television Engineering", Tata McGraw-Hill Education
3. Ralf Steinmetz, KlaraNahrstedt, "Multimedia, computing, communications and applications", Prentice Hall, 1995.

DEPARTMENT ELECTIVE 2: MICROWAVE & MILLIMETER WAVE CIRCUITS

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
1	-	2	3	2	-	-	-	10	15	25

***Mode of Exam: Paper Pen with 30% Gate Pattern Questions**

Course Objective:

1. To understand transmission line fundamentals and apply them to the basic problem
2. To understand the fundamentals of electromagnetic theory and transmission lines
3. To analyze and understand the Uniform plane wave propagation in various media
4. To solve the electric field and magnetic fields for a given wire antenna

Course Outcomes:

1.Interpret and Analyze various parameters and characteristics ofthe various waveguide components
2. Relate and analyze various passive and active devices.
3. Examine the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves.
4. Acquire knowledge about the measurements to be done at microwaves.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5					PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1	1	1	1
CO3	2	3	3	-	-	-	-	-	-	-	-	1	1	1	1
CO4	3	2	3	-	2	-	-	-	-	-	-	3	2	2	2

Contents:

CO-I: (Mapped CO1) (8 hrs)

Introduction, wave equations, Rectangular waveguide, TE, TM, TEM, Wave Velocity, Guide wavelength, wave impedance, Attenuation in wave guide, introduction to circular waveguide, Dominant mode, Degenerative modes. Introduction to Planar Transmission Lines

CO-II: (Mapped CO2) (8hrs)

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Scattering parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, Relation of Z,Y,ABCD parameter with S parameter problems on S parameter,RF behavior of Resistors, Capacitors and Inductors. Coaxial Line Components, Coupling mechanisms – Probe, Loop, Aperture types, Wave-guide and MIC component : Directional Couplers, Hybrids , Tee Junction, Magic Tee, Attenuators, Ferrite Devices, Isolators, Circulators, Cavity Resonators, microstrip resonator Re-entrant Cavities, S Matrix Calculations for – 2 port Junction, E plane and H plane Tees, Magic Tee, Directional Coupler, Circulator and Isolator. Related Problems.

CO-III: (MappedCO3) (6hrs)

Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, , parametric amplifier, microwave bipolar junction transistor ,Power frequency limitation, Microwave FET, HEMT

CO-IV: (Mapped CO4) (8hrs)

Review of conventional vacuum Triodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator. VSWR, Frequency, impedance, power and Q factor measurements. Electromagnetic interference (EMI), electromagnetic compatibility(EMC),Electromagnetic radiation hazards

Textbooks:

1. Principles of Electromagnetics, Matthew N.O. sadiku and S.V. Kulkarni, Oxford University Press, 2015
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, PHI, 2000

Reference Books:

1. Engineering Electromagnetics, Nathan Ida, Springer (India) Pvt. Ltd., New Delhi, 2005
2. Networks, Lines and Fields, John D. Ryder, PHI, 2005
3. Engineering Electromagnetics, William H. Hayt Jr. and John A. Buck, McGraw Hill Education, 2006

DEPARTMENT ELECTIVE 3:

WIRELESS AND MOBILE COMMUNICATION

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	-	-	25	-	-	25

***Mode of Exam: Pen and paper**

Course Objective:

1. To Study 2G and 2.5G Fundamentals
2. To study 3G CDMA technology
3. To study Different wireless LAN technologies.
4. To study MIMO and OFDM for wireless communication

Course Outcomes:

1. Apply the concept of GSM/GPRS/EDGE technologies in real time application
2. Interpret the concept of CDMA & leading technologies.
3. Interpret the IEEE 802.11 Wireless LAN technologies
4. Infer the concept of MIMO and OFDM concept

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO2	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO3	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3
CO4	3	3	2	3	3	1	1	1	1	2	1	2	2	3	3

Contents:

CO-I: (Mapped COs) (7 hrs)

GSM: services, features, architecture, radio link, channel types, Diversity ,Path loss Models , frames, call handling, EDGE, GPRS.

CO-II: (Mapped COs) (8 hrs)

The 3G systems: Introduction, evolution of 3G networks, ITU IMT 2000, CDMA 2000: bandwidth, chip rate, channels, spreading and modulation, power control, soft handoff, EV-DO,EV-DV UMTS: radio access network, spreading and modulation, channels, core network.

CO-III: (Mapped COs) (7 hrs)

Wireless LANs IEEE 802.11 system and protocol architecture, physical layer and MAC, options like 802.11b, a g etc. and their purpose.

CO-IV: (Mapped COs) (8 hrs)

Introduction to MIMO, MIMO Channel Capacity,

SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, MIMO Beam forming – MRT, MIMO - OFDM

Text Books:

1. Fundamentals of Wireless Communication, 2005, David Tse and PramodViswanath, Cambridge University Press
2. Wireless Communications, Andrea Goldsmith

Reference Books:

1. Wireless and Cellular Telecommunications, William C. Y. Lee, 3rd edition
2. Wireless Telecommunications Systems and Networks, Gary J.Mullett 3rd edition

Departmental Elective 4:

AUDIO & SPEECH SIGNAL PROCESSING

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper and Pen**

Course Objectives:

1. To introduce process of speech production
2. To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients in the analysis of speech
3. To understand analysis of Linear predictive coding for speech
4. To be able to develop speech recognition system.

Course Outcomes:

1. Demonstrate advanced knowledge in

- Digital model representation of speech signal
- LPC analysis
- Homomorphic models.

2. Examine complex engineering problems critically for conducting research in speech signal processing.

3. Solve engineering problems using efficient algorithms for feasible and optimal solutions in Speech signal processing field.

4. Utilize speech and speaker verification techniques to complex engineering activities in the field of speech processing.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	1	1	2	1	1	3	1	2
CO2	3	3	3	3	2	3	3	1	1	2	1	1	3	1	2
CO3	3	3	3	3	2	3	3	1	1	2	1	1	3	1	2
CO4	3	3	2	3	2	3	3	1	1	2	1	1	3	1	2

Contents:

CO-I : (7 hrs)

The process of speech production - the mechanism of speech production, acoustic phonetics. The Acoustic theory of speech production- sound propagation, uniform lossless tubes, Effect of losses in the vocal tract, Effect of radiation at the lips, Vocal tract transfer functions for vowels, the effect of nasal coupling, Excitation of sound in the vocal tract. Digital model for speech signals.

CO-II (8 hrs)

Introduction, Window considerations, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function. properties of the complex Cepstrum, computational considerations. The complex Cepstrum of speech, pitch detection, formant estimation

CO-III (8 hrs)

Basic principles of linear predictive analysis – Auto correlation method, The covariance method. Computation of the gain for the model, solution of LPC Equations – Cholesky Decomposition solution for the covariance method. Durbin's Recursive solution for the autocorrelation equations. Comparison between methods of solutions of LPC analysis equations. Applications

of LPC parameters – Pitch detection using LPC parameters, Formant analysis using LPC parameters.

CO-IV (7 hrs)

Speaker recognition system-speaker verification system, speaker identification systems. Speech recognition system- isolated digit recognition system, continuous digit recognition system, LPC distance measure.

Text Books:

1. L R Rabiner and SW Schafer, " Digital processing of speech signals", pearson education, 2006.
2. LR Rabiner ,BHJuang, B Yegnanarayana, " Fundamentals of Speech Recognition", pearson Education, 1993.

Reference Books:

1. Thomas F Quateri, "Discrete time speech signal processing", pearson edition, 2006.

2. Ben Gold & Nelson Morgan, "Speech & audio signal processing", wiley, 2006.

3. Douglas o shaughnessy , " Speech Communications", 2nd Edition , Oxford university press, 2000.

DEPARTMENTAL ELECTIVE 5: SMART ANTENNA

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

***Mode of Exam: Paper and Pen**

Course Objectives:

1. To introduce the students with the concepts of smart antennas.
2. To introduce different algorithms for DOA and beam forming.
3. To introduce architecture and working of smart antenna systems.
4. To have a good knowledge about all the modern smart antenna wireless systems.

Course Outcomes:

1. Outline the fundamental parameters of smart antennas and their applications.
2. Infer the DOA, beam forming methods and their algorithms. Also, they understand basic architecture, features and benefits of smart antennas.
3. Relate how to integrate smart antenna technology with overall communication system design and learn principles, performance.
4. Summarize the complete use of smart antennas in the modern wireless communication systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	1	1	2	1	1	3	2	2
CO2	3	3	3	3	2	3	3	1	1	2	1	1	3	2	2
CO3	3	3	3	3	2	3	3	1	1	2	1	1	3	2	2
CO4	3	3	2	3	2	3	3	1	1	2	1	1	3	2	2

Contents:

CO-I : (6 hrs)

Introduction: Need for Smart Antennas, Overview, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

CO-II: (8 hrs)

DOA Estimation Fundamentals: Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Auto-covariance, Conventional DOA Estimation Methods, Conventional Beam forming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, MUSIC Algorithm,

ESPRIT Algorithm, Uniqueness of DOA Estimates.

CO-III: (8 hrs)

Beam Forming Fundamentals: Classical Beam former, Statistically Optimum Beam forming Weight Vectors, Maximum SNR Beam former, Multiple Side-lobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained MinimumVariance (LCMV), Adaptive Algorithms for Beam forming.

CO-IV: (8 hrs)

Smart Antennas for Wireless Communications: Spatial Processing for Wireless Systems, Key Benefits of Smart Antenna Technology, The Vector Channel Impulse Response and the Spatial Signature, Spatial Processing Receivers, Fixed Beam forming Networks, Switched Beam Systems, Adaptive Antenna Systems, Wideband Smart Antennas, Diversity Techniques, Multiple Input-Multiple Output (MIMO) Communications Systems, MIMO for frequency selective scenarios. Integration and simulation of smart antennas.

Text Books:

1. Introduction to Smart Antennas, C. A. Balanis, Morgan and Claypool, 2007.
2. Smart Antennas, L. C. Godra, CRC Press, 2004.
3. Smart Antenna for Wireless Communication, T. S. Rappaport and J. C. Liberti, Prentice Hall, 1999.

Reference Books:

1. Frank Gross, Smart Antennas for Wireless Communications-McGraw Hill.
2. Ahmed El-Zooghby, Smart Antenna Engineering, Artech House Publishers.

Departmental Elective 6:

MULTI-RATE AND WAVELET SIGNAL PROCESSING

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
2	-	-	2	2	10	15	25	-	-	50

***Mode of Exam:**

COURSE OBJECTIVES:

1. To acquire the basics of Multirate Signal processing and Multirate Sampling.
2. To comprehend Linear Prediction and Optimum Linear Filters
3. To analyse the Power Spectrum Estimation
4. To comprehend the basics of Continuous and Discrete Wavelet Transform

COURSE OUTCOMES:

1. Design Interpolator, Decimator and I/D Sampling Rate Converter
2. Design Optimum Linear filters and Linear Prediction filters.
3. Interpret the Parametric and Non-Parametric methods for Power Spectrum Estimation.
4. Infer the theory and construction of wavelets

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	1	1	2	1	1	3	1	2
CO2	3	3	3	3	2	3	3	1	1	2	1	1	3	1	2
CO3	3	3	3	3	2	3	3	1	1	2	1	1	3	1	2
CO4	3	3	2	3	2	3	3	1	1	2	1	1	3	1	2

Contents:

CO-I: (8 hrs)

Multirate Digital Signal Processing:
Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for Sampling Rate Conversion, Multistage Implementation of Sampling Rate Conversion, Sampling Rate Conversion of Band-pass Signals, Sampling Rate Conversion by an Arbitrary Factor, Applications of Multirate signal Processing

CO-II (7hrs)

Linear Prediction and Optimum Linear Filters:
Representation of a Stationary Random Process, Forward and Backward Linear Prediction, Solution of Normal Equations, Properties of the Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

CO-III (7hrs)

Power Spectrum Estimation:
Estimation of Spectra from Finite-Duration Observations of Signals, Non-parametric Methods for Power Spectrum Estimation, Parametric methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithm for Spectral Estimation

CO-IV (8hrs)

Wavelet Transform:
Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelet Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain. Discrete Wavelet Transform and Filter banks Orthogonal and bi- orthogonal two-channel filter banks, Design of two-channel filter banks.

Text Books:

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications , Third Edition, Prentice-Hall International, INC
2. Alan V. Oppenheim, Ronald W. Schafer, Discrete Time Signal Processing, Prentice-Hall International, INC
3. S. Mallat, A Wavelet Tour of Signal Processing, 2nd edition, Academic Press, 1999.
4. M. Vetterli and J. Kovacevic, Wavelets and Sub band Coding, Prentice Hall, 1995.
5. RaghuveerRao and AjitS.Bopardikar, Wavelet transforms: Introduction, Theory andApplications, Pearson Education Asia, 2000.

Reference Books:

1. J.C.Goswami and A.K. Chan, Fundamentals of Wavelets: Theory, Algorithms, and Applications, 2nd ed., Wiley, 2011.
2. Michel Misiti, Yves Misiti, Georges Oppenheim, Jean- Michel Poggi, Wavelets and their Applications, John Wiley & Sons, 2010.
3. J S Walker, A premier on Wavelets and their scientific applications, , CRC press, 2002.
4. Gerald keiser, A friendly guide to Wavelets, Springer, 2011.
5. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education, 2004.
6. K P Soman and KL Ramachandran, Insight into wavelets from theory to practice, PHI, 2008.

Soft Computing

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
2	0	-	2	2	10	15	25	-	-	50

Mode of exam: offline

Course objectives

1. Develop the skills to gain a basic understanding of neural network theory and support vector machine.
2. Introduce students to radial basis function and associated memory networks, Hopfield networks, and Kohonen networks.

Course outcome

1. Demonstrate the basics concept of artificial neural network.
2. Make use of associated memory networks, Hopfield networks, and Kohonen networks for problem solving.
3. Make use of radial basis function and support vector machine for the classification of different classes of data.
4. Demonstrate the use of fuzzy neural network in the real world problems.

Contents:

CO 1 (9 Hrs)

Introduction: Artificial neural networks: feed-forward, recurrent and multi-layer architectures; Supervised and unsupervised learning; Characteristics: adaptability, fault tolerance, generalization; limitations of neuro-computing. **Perceptron:** Linear classifiers; Simple perceptron; Perceptron learning algorithms; ADALINE; MADALINE; Limitation of perceptron dichotomizer. **Multi-Layer Perceptron:** Gradient decent scheme for error minimization; Generalized delta learning rule; Back-propagation learning for multi-layer networks; Multi-layer perceptrons for multidimensional functional mappings.

CO 2 (9 Hrs)

Associated Memory Networks: Auto-association; Heteroassociation; Linear associative networks: Hebbian learning, perfect recall, cross-talk; Bidirectional associative memory; Brain-State-in aBox network. **Hopfield Networks:** Binary Hopfield network: basic structure, asynchronous updating, convergence, associative memory; Continuous-valued Hopfield network. Advantages and limitations.
Kohonen Networks: Self-organizing networks; Similarity measures;Kohonen‟s winner-take-all network; Geometrical interpretation of Kohonen‟s learning; Functional specificity of human brain, Kohonen‟sself-organizing feature map algorithm; Conscience algorithm.

CO 3 (6 Hrs)

Radial Basis Function Networks: Radial Basis Function Networks: radial basis vs. linear basis, Gaussian basis functions, K-means learning, LMS algorithm, comparison with Multi-Layer Perceptron networks.
Support Vector Machines (SVM): Optimal hyperplane for linear separability, quadratic optimization, SVM for pattern recognition, different kernels for hidden-layer, optimal design of SVM.

CO 4 (6 Hrs)

Fuzzy Neural Networks

Fuzzy sets: Basic Definition; Fuzzy-set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning, Fuzzy If-Then Rules Fuzzy-neural networks; Neuro-fuzzy systems; Genetic algorithms: selection schemes, operations.

Suggested Books:

1. J.S.R.J ang, C.T. Sun and E. Mizutani, "**Neuro-Fuzzy and Soft Computing"**, Prentice Hall of India and Pearson Education, 2004.
2. S. Rajasekaran and G.A.V. Pai**, "Neural Networks, Fuzzy Logic and Genetic Algorithms"**, Prentice Hall of India, 2003.
3. R. Eberhart, P. Simpson and R. Dobbins, **"Computational Intelligence - PC Tools"**, AP Professional, Boston,

Pattern Recognition

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
2	0	-	2	2	10	15	25	-	-	50

Mode of exam: offline

Course objectives

1. To cover the basic concepts for analyzing patterns and their pre-processing techniques.
2. To give exposure to various learning algorithms and their applications to various real life applications.

Course outcome

1. Demonstrate the basics concept of pattern recognition.
2. Illustrate the various parametric and non-parametric techniques in pattern recognition.
3. Demonstrate the various dimension reduction techniques.

4. Make use of their learning for the analysis of the real world problems.

Contents:

CO 1 (8 Hrs)

Definitions, data sets for pattern recognition, representations of patterns and classes, metric and non-metric proximity measures, feature extraction, statistical and syntactic pattern recognition

CO 2 (8 Hrs)

Bayesian decision theory: Classifiers, discriminant functions, decision surfaces, normal density and discriminant functions, discrete features

Parameter estimation methods: Maximum-likelihood estimation, expectation-maximization method, Bayesian estimation, Gaussian mixture models

Non-parametric techniques: Density estimation using Parzen-window method, K-nearest neighbor method, nearest neighbor classifier

CO 3 (8 Hrs)

Dimension reduction methods: Linear discriminant analysis (LDA), principal component analysis (PCA)

Linear discriminant function based classifiers

Non-metric methods for pattern classification: Non-numeric data or nominal data decision trees

Unsupervised learning and clustering: Criterion functions for clustering, algorithms for clustering: K-means, Hierarchical and other methods, Cluster validation

CO 4 (6 Hrs)

Applications: Biometrics recognition, handwriting recognition, document recognition, multimedia data retrieval, speech recognition, data mining, web searching, network traffic analysis etc.

Suggested Books

1. R. O. Duda, P. E. Hart and D. G. Stork, **Pattern Classification**, John Wiley, 2001

2. S. Theodoridis and K. Koutroumbas, **Pattern Recognition**, 4th Ed., Academic Press, 2009

3. C. M. Bishop, **Pattern Recognition and Machine Learning**, Springer,

Artificial Intelligence: knowledge representation and reasoning

Teaching Scheme				Credits	Evaluation Scheme				
					Theory			Practical	Total Marks
Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont. Evaluation	
3	-	-	3	3	20	30	50	--	100

Mode of Examination: Offline (Paper pen)

Course Objectives:

1. To introduce concepts on about random variables and random process
2. To build capability to statistically characterize and model physical systems
3. To build capability to solve problems related to random variables and random processes

Course Outcome:

1. Students will have understanding about random variables and random process.
2. Students will be able to statistically characterize and mode physical systems.
3. Students will be able to solve problems related to random variables and random processes.

CO Mapping with PO and PSO:

CO	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3								3		
CO2		3											3		
CO3					3										
CO4			3		3								3		

Content:

CO 1: Introduction to probability: Sample space, outcomes and events. Axioms and properties of probability. Random variables: Conditions for function to be random variable. Discrete and continuous random

variable. Distribution function. Density function. Binomial, Poisson, Uniform.

CO 2:

Exponential, Gaussian, Rayleigh density functions. Conditional distribution and density functions. The central limit theorem. Reliability. Operations on random variables: Expectation. Week and strong law of large numbers. Conditional expectation. Expectation of function of random variable. Moments about origin and central moments. Variance, skew and kurtosis.

CO 3:

Chebychev's and Markov inequalities. Characteristic function. Moment generating function. Chernoff's inequality and bounds.Transformation of discrete and continuous random variables. Multiple Random Variables: Vector of random variables. Joint distribution. Marginal distribution. Conditional distribution and density: Point and interval conditioning. Statistical independence. Distribution and density of sum and product of random variables. Gaussian Random variables: Bivariate, Multivariate Gaussian. Joint characteristic, density function. Linear transformation of Gaussian random variables. Complex Gaussian random variables.

CO 4:

Random Processes: Definition and characteristic of random processes. Strict-sense and wide-sense random processes. WSS through LTI systems. Power spectral density of WSS processes. Characterization of correlation function. Matched filter. Wiener filter. Wiener-Khinchin theorem. Ergodic process. Introduction to Poisson process, Renewal and Wiener and Markov process. theorem. Ergodic process. Introduction to Poisson process, Renewal and Wiener and Markov process.

Books:

1. Peyton Z Peebles Jr., Probability, Random Variables, and Random Signal principles, McGraw Hill , 4th Edition 2002

2. Athanasios Papoulis, Probability, Random Variables and Stochastic Processes, McGraw Hill , 4th Edition 2002

DECISION ANALYTICS

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	0	-	2	2	10	15	25	-	-	50

Mode offline

COURSE OBJECTIVE:

1. Introduces the basic principles and techniques of applied mathematical modeling for managerial decision-making.
2. To use some important analytic methods (spreadsheet modeling, optimization, Monte Carlo simulation), to recognize their assumptions and limitations, and to employ them in decision-making.

COURSE OUTCOME:

1. Develop mathematical models that can be used to improve decision making within an organization
2. Ability to structure problems and to perform logical analyses.
3. Translating descriptions of decision problems into formal models, and investigate those models in an organized fashion
4. Identify settings in which models can be used effectively and apply modeling concepts in practical situations.

CO 1 (9 Hrs)

Deterministic Models:

Linear Programming- formulating optimization problems, spreadsheet modeling, using Solver and Solver Table, sensitivity analysis, multi-period modeling. Integer Programming – Integer and binary variables, logical relationships, project selection, facility location, crew scheduling

CO 2 (8 Hrs)

Deterministic Models:

Network Optimization –Assignment problem, transportation problem, minimum-cost flow, funds-flow model, project management, currency exchange. Non-linear Optimization –Portfolio optimization, demand estimation, pricing.

CO 3 (7 Hrs)

Probabilistic Models:

Stochastic Optimization – Newsvendor model. Simulation –Basic concepts, Crystal Ball software, option pricing.

CO4 **(6 Hrs)**

Probabilistic Models:

Simulation and Optimization – project management, revenue management, liquidity optimization.

TEXT BOOK

1. Practical Management Science (5th edition), by Winston and Albright.

Natural Language Processing

Mode of exam: offline

Course Objective:

1. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.
2. Understand the concepts of morphology, Shallow Parsing and pragmatics of the language

Course Outcome:

1.Understand approaches to syntax and semantics in NLP**.**

2. Understand current methods for statistical approaches to machine translation.

3.Understand machine learning techniques used in NLP

CO I **(8 Hrs)**

Sound : Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

Words and Word Forms : Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

CO 2 **(8 Hrs)**

Structures : Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution

CO 3 **(8 Hrs)**

Meaning : Lexical Knowledge Networks, Wordnet Theory; Indian Language, Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

CO 4 **(6 Hrs)**

Web 2.0 Applications: Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting;
Cross Lingual Information Retrieval (CLIR).

References:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Deep Learning Foundations & Applications

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	0	-	2	2	10	15	25	-	-	50

Mode of exam: offline

Course Objective:

1.To provide students with foundational concepts required for deep learning across various applications ranging across speech and natural language processing to machine vision to medical imaging.

2.To introduce the fundamental principles of deep neural networks and the important paradigms of deep learning.

3. To build analytics solutions to problems in signal, image and text paradigm using deep neural networks.

4. To understand the concepts of deep neural networks and will be able to develop solutions using deep neural networks

Course Outcome:

1. Introduce the fundamental principles of deep neural networks and the important paradigms of deep learning.

2. To build analytics solutions to problems in signal, image and text paradigm using deep neural networks.
3. To understand the concepts of deep neural networks
4. To develop solutions using deep neural networks.

CO 1 (8 Hrs)

Foundation Concepts:

Linear Algebra for Deep Learning: Scalars, vectors, matrices, tensors. Multiplication on matrices and tensors, trace operator and determinant.

Deep Neural Network Design and Learning:Simple exercises with Deep Neural Network Libraries viz. PyTorch/TensorFlow. Acceleration with CUDA on GPUs and MKL/Open MPI on CPUs.

Optimization for Training a Deep Neural Network Gradient descent, Stochastic gradient descent, Adaptive momentum.

CO 2 (8 Hrs)

Deep Learning for Speech and Natural Language Processing:

Sequence Modeling with Recurrent Networks:Long Short-term Memory (LSTM) and Gated Recurrent COs (GRU), Backpropagation through time (BPTT)

Machine Translation and Text Summarization:Word Vectors, RNN Language Model, attention mechanism for sequence generation with applications to machine translation and text summarization.

CO 3 (7 Hrs)

Deep Learning for Machine Vision:

Vector Convolutional Networks:Vector Convolution for rotation and scale invariance/equivariance, Learnable Deconvolution.

Digit, Handwriting and Hieroglyph Classification:LeNet-5 for MNIST, Fashion MNIST, NIST SD-19, Egyptian Heiroglyph, Rotation equivariant and scale invariant LeNet-5.

Object Recognition and Classification: AlexNet, VGG, ResNet, DenseNet on CIFAR-10.

Object Localization: Single shot multi-box detection and classification. Regional Proposal CNN (rCNN), Fast rCNN and Faster rCNN, YOLO-9000

CO 4 (7 Hrs)

Deep Learning for Healthcare and Medical Imaging:

ECG Signal Classification:ECG signal filtering, segmentation and classification using 1D CNN

Digital Pathology: Blood pathology classification on ALL-IDB using transfer learning of Image Net pre-trained models, Multiple Instance Learning of CNN for Histopathology Whole Slide Classification

Digital Radiology: Chest X-ray Classification, Brain Lesion Classification and Segmentation in MRI.

Text Books:

1."Deep Learning", I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
2."Neural Networks and Learning Machines", S. Haykin, 3rd Edition, Pearson, 2008.

Reference Books:

1."Neural Networks for Pattern Recognition", C. M. Bishop, Oxford University Press, 1995.
2."Pattern Classification", R. O. Duda, P. E. Hart, D. G. Stork, 2nd Edition, Wiley, 2001.
3."A Sampler of Useful Computational Tools for Applied Geometry, Computer Graphics and Image Processing", D. Cohen-Or, C. Greif, T. Ju, N. J. Mitra, A. Shamir, O. Sorkine-Hornung, H. Zhang, CRC Press, 2015.
4."Machine Learning", T. M. Mitchell, Mc. Graw Hill Education, 1997.
5."Pattern Recognition and Machine Learning", C.M. Bishop, 2nd Edition, Springer, 2011

Track 3

System Programming for Embedded Devices (Elective Track)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
4	-	-	4	3	20	20	60	-	-	100

Course Objectives:

1. To gain knowledge about the Embedded system & its architecture
2. To able to use-Interface hardware, software tools.
3. To able to understand concept Programming & Tools.

4. To able to understand Perform programming & application design.

Course Outcomes:

1. Analyze different embedded system & its architecture.
2. Interpret functioning of microcontroller & Processor using new architecture.
3. Design the system programming using embedded tool.
4. Interpret embedded advance programming & simulation.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	3	1	1	1	1	1	1	1	1	1	2
CO2	2	1	1	1	3	1	1	1	1	1	1	1	1	1	2
CO3	2	1	1	1	3	1	1	1	1	1	1	1	1	1	2
CO4	2	1	1	1	3	1	1	1	1	1	1	1	1	1	2

Contents:

CO-I: (CO1) Introduction of Microcontroller and architecture: (8Hrs)

Microcontrollers : Microprocessors and Micro-controllers, Types of Micro-controllers, External memory, Processor Architecture – Harvard v/s Van Neumann; CISC v/s RISC, Micro-controller, Memory types, Software development tools like assembler, cross- compiler, emulator, and simulator, 8051 controller, Block Diagram &Architecture.

CO-II (CO2) Embedded system and languages (6hrs)

8051 Instruction Set, Addressing modes & programming. 8051 Timers, Serial I/O, Embedded C programming, AVR addressing modes, RISC, CISC Programming set of instruction.

CO-III (CO3) Embedded internal programming (8hrs)

Simulator vs Emulator, Memory Addressing Program Memory, ROM, Data Memory, RAM, Internal RAM, Registers, Bit addressable memory, Special Function Register, Classic and Extended 8051 Devices, ARM7 and ARM9 based Microcontrollers, Cortex-Mx based Microcontrollers, Code Comparison, Software Development Cycle, µVision IDE, µVision Device Database, µVision Debugger, Assembler, C/C++ Compiler, Object-HEX Converter.

CO-IV (CO4) Embedded software Tools & Advance application (8hrs)

Programming & debugging, Hex code creation, Logic analyzer, Serial I/O interface, UART interface, Programming Flash Devices, Configuring External Tools, ISIS AND PCB DESIGN, ISIS AND SIMULATION, Bitmap Generation Interfacing in Proteus, Classic and Extended 8051 Devices, ARM7 and ARM9 based Microcontrollers, Cortex-Mx based Microcontrollers, Code Comparison, Software Development Cycle, µVision IDE, µVision Device Database, µVision Debugger, Assembler, C/C++ Compiler, Object-HEX Converter.

Text Books:

1. Muhammad Ali Mazidi, The 8051 Micro-controller & Embedded System using assembly & C Pearson Education second edition 2008
2. Kenneth J. Ayala,The 8051 Micro-controller – Architecture, Programming & Applications, Penram International & Thomson Asia, Second edition 1996
3. Maneesh Rao, Internet of Things with Raspberry Pi 3, Packt Publisher, Second edition 2018

Reference Books:

1. Ajay V. Deshmukh Micro-controllers - Theory and Applications, Tata McGraw Hill
2. The Arduini Project Book, Designed, printed and bound in Torino, Italy, September 2012

Mechatronics (Elective Track)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
4	-	-	4	3	20	20	60	-	-	100

Course Objectives:

1. To gain knowledge about the electromechanical system & its automation
2. To able to use-Interface hardware, software tools.
3. To able to understand concept Programming & Tools.
4. To able to understand Perform programming & application design.

Course Outcomes:

1. Analyze different embedded system & its architecture.
2. Interpret functioning of microcontroller & sensor interfacing
3. Illustrate the system design for stepper motor & transfer function mechanisms.
4. Illustrate & develop embedded application using Hydraulic systems.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO2	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO3	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO4	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2

Content:

CO-I (CO1) Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.

CO-II (CO2): Review of fundamentals of electronics. Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

CO-III (CO3) Module III: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

CO-IV (CO4): Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description, Description of PID controllers. CNC machines and part programming. Industrial Robotics.

Text Book:

1. Kenneth J. Ayala,The 8051 Micro-controller – Architecture, Programming & Applications, Penram International & Thomson Asia, Second edition 1996
2. Groover, M. P., Automation, Production System & Computer Integrated Manufacturing, Pearson Education Asia (2009).
3. Nakra, B. C., Theory and Applications of Automatic Controls, Revised 2nd Edition, New Age International Publishers (2014).

Reference Books:

1. Muhammad Ali Mazidi, The 8051 Micro-controller & Embedded System using assembly & C Pearson Education second edition 2008
2. Morriss, S. B., Automated Manufacturing Systems, McGraw Hill (2006).
3. Auslander, D. M. and Kempf, C. J., Mechatronics: Mechanical System Interfacing, Prentice Hall., New Jersey (1996). John W. Webb & Ronald A. Reis,
4. Programmable Logic Controllers – Principles and Applications, Fifth Edition, Pearson Education (2008).
5. John R. Hackworth & Frederick D. Hackworth Jr, Programmable Logic Controllers – Programming Methods and Applications, Pearson (2011).

Automotive Electronics (Elective Track)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
4	-	-	4	3	20	20	60	-	-	100

Course Objectives:

1. To understand the concepts of Automotive Electronics and its evolution and trends & Automotive systems & subsystems overview.
2. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
3. To understand, design and model various automotive control systems using Model based development technique. & Microcontrollers in ECU design and choice of appropriate Hardware and Software.
4. To describe various communication systems, wired and wireless protocols used in vehicle networking & Safety standards, advances in towards autonomous vehicles.

Course Outcomes:

1. Obtain an overview of automotive components, subsystems, design cycles, communication protocols.
2. Interface automotive sensors and actuators with microcontrollers.
3. Develop, simulate and integrate control algorithms for ECUs with hardware.
4. Safety systems employed in today's automotive industry.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO2	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO3	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO4	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2

Content

CO-I: Overview of Automotive Industry: (7 Hours)
Leading players, Automotive supply chain, Global challenges, Role of technology in Automotive Electronics and interdisciplinary design, Tools and processes, Lead acid and alkaline batteries, battery rating, and battery charging characteristics, battery testing and maintenance, gel battery.

CO-II: Systems Approach to Control and Instrumentation: (8 Hours)
Concept of a system, Analog and digital systems, Basic measurement systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling, Smart Nodes, Ignition system, magneto coil ignition system, spark plug types, electronic ignition system-transistor ignition system, and capacitor discharge ignition system, distributor less ignition system and solid state ignition system.

CO-III: STARTING AND CHARGING SYSTEM: (7 Hours)
Principle and construction of starter motor, working of different starter drive COs. DC and AC Generators – principle, construction and working, regulation, automotive transmissions: Transmission fundamentals, Types MT, AT, CVT and DCT. Vehicle Braking Fundamentals: Vehicle dynamics during braking, Hydraulic brake system components, Introduction to antilock braking systems.

CO-IV: SENSORS AND ACTUATORS: (8 Hours)
Classification of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay.ELECTRONIC ENGINE CONTROLS: Concept of an electronic engine control system, electronic fuel injection - throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, engine mapping, and on-board diagnostics – engine control module and power train control module. Communication protocols: Overview of automotive communication protocols, CAN, LIN , Flex Ray, MOST , Ethernet, D2B and DSI, Communication interface with ECUs

Text Books:

1. Williams. B. Ribbens: “Understanding Automotive Electronics”, 6th Edition, Elsevier Science, Newnes Publication, 2003.

2. Robert Bosch: “Automotive Electronics Handbook”, John Wiley and Sons, 2004.

Reference books:

1. Ronald K Jurgen: “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 1999.

2. James D. Halderman: “Automotive Electricity and Electronics", PHI Publication.

3. Terence Rybak & Mark Stefika: “Automotive Electromagnetic Compatibility (EMC)”, Springer, 2004.

4. Allan Bonnick: “Automotive Computer Controlled Systems, Diagnostic Tools and Techniques”, Elsevier Science, 2001.

5. Uwe Kieneke and Lars Nielsen: “Automotive Control Systems: Engine, Driveline and Vehicle”, 2nd Edition, Springer Verlag, 2005.

6. David Alciatore & Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)”, TMH, 2007.

7. Iqbal Husain: "Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

8. Tom Denton: "Advanced Automotive Diagnosis”, 2nd Edition, Elsevier, 2006.

9. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications”, Springer, 2009.

10. Tracy Martin: “How to Diagnose and Repair Automotive Electrical Systems" Motor Books / MBl Publishing Company, 2005.

11. Mehrdad Ebsani, Ali Emadi & Yimin Gao: “Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, 2009.

12. Marc E. Herniter and Zac Chambers: “Introduction to Model Based System Design”, Rose-Hulman Institute of Technology.

Industrial Automation (Elective Track)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
4	-	-	4	3	20	20	60	-	-	100

Course Objectives:

1. To gain knowledge about the Industrial system & its automation
2. To able to use-Interface hardware, software tools.
3. To able to understand concept Programming & Tools.
4. To able to understand Perform programming & application design.

Course Outcomes:

1. Analyze different embedded system & its architecture.
2. Interpret functioning of microcontroller & Processor using new architecture.
3. Illustrate the system programming using embedded tool.
4. Illustrate & develop embedded application using advanced IDE tools for simulation.

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO2	2	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO3	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2
CO4	1	1	2	1	3	1	1	1	2	1	1	1	1	1	2

Content:

CO-I: COMPUTER BASED CONTRO:

(7 Hours)

Implementing control system using computer or microprocessor; computer based controller: hardware configuration and software requirements. DISTRIBUTED CONTROL SYSTEM-Meaning and necessity of distributed control; hardware components of DCS; DCS software.

CO-II: INTRODUCTION PROGRAMMABLE LOGIC CONTROLLER (PLC):

(7 Hours)

What is PLC? PLC versus microprocessor/microcontroller/computer, advantages and disadvantages of PLC, architecture and physical forms of PLC, BASIC PLC FUNCTIONS-Registers: holding, input and output registers; Timers and timer functions; counters and counter functions

CO-III: INTERMEDIATE PLC FUNCTIONS: (9 Hours)

Arithmetic functions: addition, subtraction, multiplication, division and other arithmetic functions; Number comparison and conversion, DATA HANDLING FUNCTIONS OF PLC: Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions, BIT FUNCTIONS OF PLC: Digital bit functions and applications; sequencer functions and applications, ADVANCED FUNCTIONS OF PLC: Analog input and output functions, analog input and output modules, analog signal processing in PLC; PID control function, network communication function, PLC PROGRAMMING: PLC programming languages, ladder programming, mnemonic programming and high level language programming.

CO-IV: SCADA: (7 Hours)

Supervisory control versus distributed control; Layout and parts of SCADA system, detailed block schematic of SCADA system; Functions of SCADA system: data acquisition, monitoring, control, data collection and storage, data processing and calculation, report generation; MTU: functions, single and dual computer configurations of MTU; RTU: functions, architecture / layout; MTU-RTU communication and RTU-field device communication.

Text Books:

1. Johnson CD, Process Control Instrumentation Technology, Prentice Hall
2. Webb JW and Reis RA, Programmable Logic Controllers, Prentice Hall
3. Hackworth JR and Hackworth FD, "Programmable Logic Controllers," Pearson Edition
4. Boyer SA, Supervisory Control and Data Acquisition (SCADA), International Society of Automation

IoT System Design

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
4	-	-	4	3	20	20	60	-	-	100

Course Objectives:

1. To gain knowledge about the Embedded system & its architecture
2. To able to use-Interface hardware, software tools.
3. To able to understand concept of IOT & its system architecture
4. To able to understand sensory system analysis on Cloud using IoT platform

Course Outcomes:

1. Analyze different embedded system & its architecture.
2. Interpret functioning of microcontroller & Processor using new architecture.
3. Design the embedded system software & Hardware interfacing.
4. Analyze IOT concept & architecture.
5. Interpret IOT DATA LINK LAYER & IOT Hardware.
6. Design & develop IoT based application using advanced technology

CO Mapping with PO and PSO:

Course Outcomes ↓	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	3	1	1	1	1	1	1	2	1	1	3
CO2	2	2	1	1	3	1	1	1	1	1	1	2	1	1	3
CO3	2	2	1	1	3	1	1	1	1	1	1	2	1	1	3
CO4	2	2	1	1	3	1	1	1	1	1	1	2	1	1	3

Contents:

CO-I: INTRODUCTION TO EMBEDDED CONCEPTS (6hrs)

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview

of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software

CO-II: Embedded system architecture

(8hrs)

Classifications of embedded systems, challenges and design issues in embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, fundamentals of Vonneuman/Harvard architectures, and types of microcontrollers, MP vs MC 8051, MC-8051 & 89s52 architecture–pin diagram, Simulator vs Emulator, Memory Addressing Program Memory, ROM, Data Memory, RAM, Internal RAM, Registers, Bit addressable memory, Special Function Register, Motor driver – Manual robot Interfacing.

CO-III: IOT Architecture

(8hrs)

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management CO

CO-IV: IOT DATA LINK LAYER & IOT Hardware

(8hrs)

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP, Arduino, Raspberry Pi, Sensors Interfacing, and Wi-Fi ESP8266 interfacing ,WSN node, Power supply, Antenna concept, Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, Think speak, carrot, Amazon Web Services for IoT, Skynet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation, Alexa services.

Text Books:

1. Muhammad Ali Mazidi, The 8051 Micro-controller &Embedded System using assembly & C Pearson Education second edition 2008
2. Kenneth J. Ayala,The 8051 Micro-controller – Architecture, Programming & Applications, Penram International & Thomson Asia, Second edition 1996
3. Maneesh Rao, Internet of Things with Raspberry Pi 3, Packt Publisher, Second edition 2018
4. Peter Waher, Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3, Packt Publisher, First edition 2018
5. Internet of Things A to Z: Technologies and Applications June 2018 with 6,388 Reads Publisher: 978-1-119-45674-2, Publisher: Wiley-IEEE Press.

Reference Books:

1. John C. Shovic, Raspberry Pi IoT Projects: Prototyping Experiments for Makers, Apress Publisher, First edition 2018
2. Ajay V. DeshmukhMicro-controllers - Theory and Applications, Tata McGraw Hill
3. Building Blocks for IoT Analytics Internet-of-Things Analytics, River Publishers Series in Signal, Image and Speech Processing John Soldatos Athens Information Technology Greece, River Publishers Alsbjergvej 10 9260 Gistrup Denmark.

TRACK 4:

Department Elective –I:

Biomaterials- Materials in Medicine

(Total Hours 30)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

Course objectives:

1. Description of classes of biomaterials used in medicine and specific requirements.
2. Understanding of the concept of biocompatibility and the methods for biomaterials testing.
3. Learn how to design, synthesize, evaluate and analyze biomaterials.

Course outcomes:

1. Demonstrate the fundamental of biomaterials.
2. Interpret the bioinformatics.
3. Design, synthesize, evaluate, and analyze biomaterials.
4. Make use of their learning for clinical trials, and manufacturing.

Contents:

CO-I: (7 Hours)

Fundamentals of biomaterial science, concept of biocompatibility, classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance, disinfection and sterilization of biomaterials.

CO-II: (8 Hours)

Physico-chemical properties of biomaterials: mechanical (elasticity, yield stress, ductility, toughness, strength, fatigue, hardness, wear resistance), tribological (friction, wear, lubricity), morphology and texture, physical (electrical, optical, magnetic, thermical), chemical and biological properties.

CO-III: (7 Hours)

Elements in contact with the surface of a biomaterial: blood composition, plasma proteins, cells, tissues. Phenomena at the bio-interfaces. molecular and cellular processes with living environment, blood-materials interaction, short and long term reactions to the body.

CO-IV: (8 Hours)

FDA requirements, standards on the biological evaluation of medical devices (ISO-10993) and implications to applications in human. Practical aspects of biomedical devices: manufacturing, storage quality, regulatory and ethical issues, price of implants and allocation of resources.

Text Books:

1. H.Boenig, Fundamentals of Plasma Chemistry and Tehnology, Technomic Publishing Co.Inc. Lancaster Basel, 1990.

2. Practical Surface Analysis, 2- edition, Edited by D.Briggs, M.P.Seah, J.Wiley & Sons Ltd, 1990.
3. Biomaterials Science, An Intoduction to Materials in medicine, Eds. B. D. Ratner and A. S. Hoffman, Academic Press, New York, 1996.

4. Plasma-surface modification of biomaterials, P.K.Chua, J.Y.Chena, L.P.Wanga, N.Huang, Elsevier Science B.V, 2002.

5. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons. Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2004, USA.

Department Elective -2:

Biochemistry & Cell Biology

(Total Hours 30)

Teaching Scheme					Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credit	TAE	CAE	ESE	Int.	Ext.	Total Marks
2	-	-	2	2	10	15	25	-	-	50

Course objectives:

The course should give awareness about the basic molecular mechanisms in a living cell and its main components.

Course outcomes:

1. Interpret the general structures of the macromolecules of the cell (protein, nucleic acid, carbohydrate and lipid).
2. Describe the different parts of the eukaryotic cell, their cellular functions and the basic energy metabolism.
3. Demonstrate the renewal of glucose, fatty acids, amino acids and nucleotides.
4. Explain the flow of genetic information in the cell; including replication, transcription and translation and their regulation.

Contents:

CO-I: (8 Hours)

Biochemistry Protein structure, enzymology, cellular renewal of glucose, fatty acids, amino acids and nucleotides, basic cell energy metabolism, biological membranes, reactive oxygen forms, methods for isolation and analysis of proteins (lectures). The structure and function of haemoglobin (seminar).

CO-II: (7 Hours)

The structure of nucleic acids, function and synthesis. The cell biology central dogma about the information flow in the cell. The structure of the genome. The gene concept and gene structure.

CO -III: (7 Hours)

DNA replication and DNA repair. Genetic recombination. Transcription and its regulation. Translation and its regulation. Basic recombinant DNA techniques.

CO -IV: (8 Hours)

The structure and ultrastructure of the cell. Organelles and membrane systems and their structure and function. Cell division: mitosis and meiosis. Intracellular protein sorting and secretion and endocytosis. Cell skeletons and cell motility.

Text Books:

1. Champe, Pamela C.; Harvey, Richard A.; Ferrier, Densise R, Biochemistry 4. Ed.: Baltimore, MD: Lippincott Williams & Wilkins, cop. 2008
2. Lodish, Harvey F., Molecular cell biology, 7th ed., International ed.: New York: W.H. Freeman, 2012

Department Elective -3:

Bioinformatics: Algorithms and Applications

(Total Hours: 30)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

Course objectives:

To give students an introduction to the basic practical techniques of bioinformatics.

Course outcomes:

1. Illustrate the basic concepts of bioinformatics
2. Analyse protein structures and protein sequence
3. Explain Finite Volume Method
4. Develop algorithms by using machine learning techniques and programming.

Contents:

CO –I: (7 Hours)

Introduction, DNA sequence analysis, DNA Databases, Protein structure and function, protein sequence databases, sequence alignment, PAM matrix, Global and local alignment, BLAST: features and scores.

CO –II: (8 Hours)

Multiple sequence alignment, Conservation score, phylogenetic trees. Protein sequence analysis, hydrophobicity profiles, non-redundant datasets. Protein secondary structures, Ramachandran plot, propensity, secondary structure prediction.

CO –III: (7 Hours)

Protein tertiary structure, Protein Data Bank, visualization tools, structural classification, contact maps. Protein structural analysis, protein structure prediction, Finite Volume Method (FVM) – I

CO-IV: (8 Hours)

Protein stability, energetic contributions, database, stabilizing residues, stability upon mutations, Computer aided drug design, docking, screening, QSAR, Development ofalgorithms, AWK programming, machine learning techniques, applications using WEKA.

Text Books:

1. M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, Academic Press, 2010

2. D.E. Krane and M.L. Raymer, Fundamental concepts of bioinformatics, Pearson Education Inc. 2006

Department Elective -4:

Brain Machine Interface

(Total Hours 30)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

Course objectives:

1. To introduce the basic concepts of brain computer interface.
2. To study the various signal acquisition methods.
3. To study the signal processing methods used in BCI.

Course outcomes:

1. Demonstrate the basics concept in the field of brain sensing for human-computer interaction research.
2. Make use of the various tools used in brain sensing.
3. Illustrate the steps required to use real-time brain sensing data as input to an interactive system.
4. Make use of the required features and classify the signal for applications.

Contents:

CO I: Introduction to Brain Machine Interface
(8 Hours)

Fundamentals, structure and classification of brain machine interface system, Non-invasive and Partially Invasive Brain signal acquisition, Signal Pre-processing, artefacts removal.

CO –II: Electrophysiological Sources

(8 Hours)

Sensorimotor, Neuronal activity in motor cortex and related areas, Electric and magnetic fields produced by the brain, signals reflecting brain metabolic activity, Mu rhythm, Movement Related Potentials, Slow Cortical Potentials, P300 Event related potential, Visual Evoked Potential, Activity of Neural Cells, Multiple Neuro-mechanisms

CO –III: Feature Extraction Methods

(7 Hours)

Time/Space Methods – Fourier Transform, Wavelets, Auto-regressive, Moving average, AR-MA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features

CO –IV: Feature Translation Methods

(7 Hours)

Linear Discriminant Analysis – Nearest neighbours, Support Vector Machines, Regression, Learning Vector Quantization, Gaussian Mixture Modeling, Hidden Markov Modeling, Neural Networks.

Text Books:

1. Jonathan Wolpaw, Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012.
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.

Department Elective -5:

Physics and instrumentation in medical imaging

(Total Hours 30)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

Course Objectives:

1. To understand the physics behind different instruments in medical imaging
2. To learn how to design a simple review paper

Course Outcomes:

1. Demonstrate the basics concept and physics behind of X-ray technique
2. Illustrate the importance of nuclear magnetic resonance in MRI
3. Explain the concept of generation of ultrasound
4. Design a term paper on one of the given topics

Contents:

CO -I: Planar X-rays (8 Hours)

Electromagnetic radiation, generation and characteristics of x-rays, x-ray tubes, interaction of x-rays with tissues.

CO -II: Magnetic Resonance Imaging (MRI) (9 Hours)

Concept of spin and nuclear magnetic resonance, spin decay through interaction with tissues, use of different magnets in MRI systems, one or two simple imaging sequences.

CO –III: Ultrasound (9 Hours)

Characteristics of sound waves, piezoelectricity and generation of ultrasound, interaction of ultrasound with tissues, Doppler effect and its uses.

CO –IV: Term Paper (4 Hours)

Write a term paper on one of the given topics.

Text Books:

1. William R. Hendee and E. Russell Ritenour, Medical Imaging Physics, Wiley-Liss, 4th edition, 2002
2. Nadine Barrie Smith and Andrew Webb, Introduction to Medical Imaging: Physics, Engineering and Clinical Applications, Cambridge University Press, 1st edition, 2011

Department Elective -6:

Neuromorphic Computing

(Total Hours: 30)

Teaching Scheme					Evaluation Scheme					
Th.	Tu	Pr.	Total Hours	Credit	Theory			Practical		Total Marks
					TAE	CAE	ESE	Int.	Ext.	
2	-	-	2	2	10	15	25	-	-	50

Course objectives:

To introduce a number of mathematical and computational concepts and techniques that can be used for the mathematical modelling of the real world problem.

Course outcomes:

1. Demonstrate the basics concept in the field neuromorphic computing.

2. Illustrate the organization of nervous system and neuroanatomy.

3. Demonstrate the biophysical models of single neuron and simplified neural models.

4. Make use of the various models based on the neural networks to solve the real world problems.

Contents:

CO -1: (6 Hours)

Linear algebra – eigenvalues and eigenvectors for symmetric matrices. Quadratic forms, solving a system of linear equations, Dynamical systems - types of fixed pts, bifurcation map in terms of trace and determinant. Dynamical systems - types of fixed pts, bifurcation map in terms of trace and determinant.

CO -2: (8 Hours)

Neuron - axons, dendrites etc, the four components of Neural Signalling. Neurotransmission: neurotransmitter, receptor, ion channel, channel gating. Electrophysiology - Nernst potential, resting potential, Goldman-Hodgkin-Katz voltage equation, outline of the Hodgkin-Huxley model. Modeling ion channel kinetics, activation and inactivation gates. Complete formulation of Hodgkin-Huxley model. Relation between output firing and constant input current. Discussion of regimes.

CO -3: (8 Hours)

Derivation of the cable equation - defining axial, radial resistance and membrane capacitance, defining quantities in terms of per CO length. Steady state Solution for Infinite cable and semi-infinite cable. Solution for Finite cable: sealed end, killed end and arbitrary boundary conditions. Time-dependent solution for impulse input. Propagation delay, pseudo-velocity. Relation between cable diameter and conduction velocity. Branched cables and Rall's condition. Modeling synaptic transmission.

CO -4: (7 Hours)

Fitzhugh-Nagumo neuron model - phase-plane analysis, showing excitability, bistability and oscillations. Integrate and fire neuron, resonate and fire neuron, Izhikevich models. Classical conditioning and instrumental condition. Sensitization, habituation and priming, Cellular correlates of learning. Hebbian learning, Long-term Potentiation (LTP) and Long-term Depression (LTD).

Text Books:

1. Peter Dayan & LF Abbot, Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems, MIT Press. ISBN 0-262-04199-5.
2. Patricia Churcland & Terence Sejnowski, Computational Brain, MIT Press.
3. Christof Koch, Biophysics of computation: information processing in single neurons, Oxford University Press, 2005
4. Eric Kandel, James Thomas Schwartz, Jessel, Principles of Neural Science,4th ed. McGraw-Hill, New York.
5. Computational neuroscience: a comprehensive approach, Edited by J. Feng, Chapman & Hall/CRC, 2004.
6. Randall C. O'Reilly, Yuko Munakata, Computational explorations in cognitive neuroscience: understanding the mind, MIT Press, 2000.

DEPARTMENTAL ELECTIVE 1: OPERATING SYSTEMS:

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Mode of exam: Paper and pen-Offline

Course Objective:

1. Introduces general idea, structure and functions of operating system
2. Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.

Course Outcome:

1.Identify basic structure and purpose of operating system.
2. Interpret the concepts of process and illustrate various CPU scheduling algorithms.
3. Interpret the concepts of inter process communication.
4. Schematize Deadlock & security mechanisms in operating systems.
5. Analyze different memory management techniques with advantages and disadvantages.

CO Mapping with PO and PSO:

Course Outcomes	Program Outcomes				Program Specific Outcomes	
	P02	P03	P04	P05	PSO1	PSO2
CO1	2	-	1	3	-	1
CO2	2	-	3	-	2	2
CO3	3	3	-	-	2	3
CO4	3	-	2	-	2	2

Contents

CO-I (8 hrs)

Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.

CO-II (8 hrs)

Process & Its Scheduling : Process concept, process control block, Types of scheduler, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms,

CO-III (7 hrs)

Process management and synchronization: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems

CO-IV (7 hrs)

Deadlock definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation

TEXT BOOKS :

1. Operating System concepts – Silberchatz& Galvin, Addison Wesley, 6 thEdn.
2. Modern Operating Systems – Tanenbaum, Pearson Edn. 2 ndedn.

REFERENCE BOOKS :

1. Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
2. Operating System –Milan Milenkovik, McGraw-Hill, 1987
3. Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.

DEPARTMENTAL ELECTIVE 2: BIG DATA & HADOOP:

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
1	-	2	3	2	10	15	25	10	15	75

Mode of exam: Paper and pen-Offline

Course Objective:

1. Understand the various parts of Hadoop condition, for instance, Hadoop 2.7, Impala, Yarn, MapReduce, Pig, Hive, HBase, Sqoop, Flume, and Apache Spark
2. Learn Hadoop Distributed File System (HDFS) and YARN building, and make sense of how to function with them for limit and resource organization
3. Understand MapReduce and its qualities and retain advanced MapReduce thoughts.

Course Outcome:

1. Interpret basic concepts and techniques of Hadoop ecosystem and Big data.
2. Design different component of Hadoop ecosystem.
3. Interpret the domain of data science and analysis of big data
4. Gain experience of doing independent study and research through case studies.

CO Mapping with PO and PSO:

Course Outcomes	Program Outcomes				Program Specific Outcomes	
	P02	P03	P04	P05	PSO1	PSO2
CO1	1	1	1	1	1	1
CO2	1	1	2	1	1	2
CO3	2	1	2	2	1	1
CO4	1	1	1	1	1	1

Contents

CO-I: (Mapped CO1) (8 hrs)

Introduction to Hadoop and Big Data, Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, RDBMS vs Hadoop When to use and when not to use Hadoop.

CO-II: (Mapped CO2) (8 hrs)

Hadoop Distributed File System, Significance of HDFS in Hadoop,Features of HDFS,Data Storage in HDFS :Introduction about Blocks, Data replication. Accessing HDFS:CLI (Command Line Interface) and admin commands, Java Based Approach, Fault tolerance. Download Hoodoo, Installation and set-up of Hadoop,Start-up & Shut down process.

CO-III: (Mapped CO3) **(7 hrs)**

Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Different phases of Map Reduce Algorithm, Different Data types in Map Reduce

CO-IV: (Mapped CO4) **(7 hrs)**

PIG: Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands,

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
2. Big Data (Black Book), Wiley
3. V. Prajapati, "Big Data Analytics with R and Hadoop", PacktPub.

Reference Books:

1. V. Ankam, Big Data Analytics, Packt Pub Ltd.

2. N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.

DEPARTMENTAL ELECTIVE 3: DATA STRUCTURE & ALGORITHMS:

Teaching Scheme				Credits	Continuous Evaluation Scheme						
					Theory				Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Exam Mode	Int	Ext	
2	-	2	4	3	10	15	25	Online	10	15	75

Mode of exam:Paper and pen-Offline

Course Objective:

1. This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.

2. It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.

3. The course also provides career opportCOies in design of data, implementation of data, technique to sort and searching the data.

Course Outcome:

1. Describe data structures and understand when it is appropriate to use.
2. Infer algorithms for data searching and sorting.
3. Make use of linear and nonlinear data structures to solve various real world computing problems.
4. Inspecting to Relate use of Abstract data types & ways in which they can be stored, accessed and manipulated.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes			Programme Specific Outcomes	
	PO2	PO3	PO4	PSO1	PSO2
CO1	3	2	3	1	-
CO2	2	3	3	2	-
CO3	3	3	3	2	1
CO4	3	3	3	3	2

Contents:

CO-I: **(8 hrs)**

Arrays & Pointers

Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Inserting and deleting, Multidimensional Arrays, Pointers; Pointer Arrays, Dynamic Memory Management.

CO-II: **(8 hrs)**

Sorting and Searching

Introduction: Sorting; Bubble Sort, Insertion Sort, Selection Sort, Merging, Searching; Linear Search, Binary Search.

CO-III: **(7 hrs)**

Linked List

Introduction, Linked Lists, Representation of Linked Lists in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation and Garbage Collection, Insertion into a Linked List, Deletion from a Linked List, Circularly Linked Lists, Doubly Linked Lists.

CO-IV: **(7 hrs)**

Stacks, Queue and Recursion Introduction, Stacks, Array Representation of Stacks, Linked Representation of Stacks, Stack as ADT, Application of Stacks, Recursion, Linked Representation of Queues, Queues as ADT, Circular Queues, Deques and Applications of Queues.

Text Books:

1.AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison- Wesley, 1983.
2.THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.

Reference Books:

1. Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
2. MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)

DEPARTMENTAL ELECTIVE 4: INFORMATION SECURITY & CRYPTO CURRENCY:

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Mode of exam:Paper and pen-Offline

Course Objectives:

1. This course covers the fundamentals of computer systems security.
2. It introduces many different areas of security such as encryption, malicious code, authentication and access control, trusted computer systems, operating system and network security.
3. The objective of this course is to provide students with a comprehensive overview of the threats to computer security, technologies for security assurance, and engineering approaches to security solutions.
4. Create an ability to understand and use various open source security tools to improve personal information security & network security.

Course Outcomes:

1. Use the fundamentals of Cryptography and standard algorithms to provide confidentiality, integrity and authenticity.
2. Use symmetric and asymmetric key encryption systems
3. Analyze various message authentication codes and hash functions.
4. Analyze detection and prevention of various attacks

CO Mapping with PO and PSO

Course Outcomes	Programme Outcomes			Programme Specific Outcomes	
	PO2	PO3	PO4	PSO1	PSO2
CO1	1	2	1	1	-
CO2	2	1	2	2	-
CO3	1	2	1	-	1
CO4	1	2	2	-	2

Contents:

CO-I: **(8 hrs)**

Introduction: Introduction to information and network security, Attacks, services, mechanisms, security attacks, security services, a model for internet work security, encryption model, steganography, classical encryption techniques, modern techniques - simplified DES, block cipher principles, data encryption standard, strength of DES, block cipher design principles, block cipher modes of operation.

(CO2) **(7 hrs)**

Confidentiality and Key Management: Confidentiality using conventional encryption: placement of encryption function, random number generation. Public key cryptography: principles, RSA algorithm, key management, diffie-heliman key exchange, elliptic curve cryptography, Chinese remainder theorem, Euclidean algorithm, extended

Euclidean algorithm, discrete logarithms, primality testing, Chinese remainder theorem, finite fields.

CO-III: (8 hrs)

Authentication requirements, functions, codes**,** security of hash function &MACs.Hash& Mac algorithms.Messages digest, Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions. Digital signatures & authentication protocols, Elgamal digital signature algorithm, digital signature standard.

CO-III: (7 hrs)

Network Security: Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPSec. Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication.

Books:

1. Cryptography and networks security principles & practice by William Stalings (Pearson Education prentice Hall).
2. Networks security Essentials Applications & standards by William Stalings (Pearson Education, LPF).
3. Cryptography in C and C++ by Michael Welschenbach (A press IDG Books India).
4. Introduction to Data Compression by Khalid Sayood (Morgan kaufmann/Harcourt India).

Reference Books

1. Information Security: The Complete Reference, Second Edition2nd Edition by Mark Rhodes-OusleyISBN-13:978-0071784351 ,ISBN-10:0071784357
2. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
3.Cryptography and Network Security : ForouzanMukhopadhyay, McGraw Hill, 3rd Edition

DEPARTMENTAL ELECTIVE 5: ADVANCED NETWORKS

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
1	-	4	5	3	10	15		10	15	50

Mode of exam: Paper and pen: Offline

CO mapping with PO and PSO

Course Outcomes	Programme Outcomes			Programme Specific Outcomes	
	PO2	PO3	PO4	PSO1	PSO2
CO1	2	2	1	1	-
CO2	2	1	2	2	-
CO3	1	3	1	2	1
CO4	1	2	2	1	2

Course Objectives:

1. To learn about Software Defined Networking.
2. To understand an emerging Internet architectural framework, including the main concepts, architectures, algorithms, protocols and applications.
3. To be able to implement Network virtualization framework.

Course Outcomes:

1. Design a network with appropriate protocols selected according to requirement.
2. Analyze different routing protocols and traffic engineering methods deployed in networking.
3. Interpret the concept of SDN (i.e. abstracting and centralizing the control plane).
4. Analyze the implications of shifting from traditional network architectures to software defined networks.
5. Apply and analyze network functions virtualization.
6. Implement a network service using the

knowledge acquired throughout the lectures.

Contents:

CO-I: (Mapped CO1) (8 hrs)

Routing in Packet Networks: Circuit Switching and Packet Switching, Types of Routing Protocols: Interior and Exterior Gateway protocols, Adaptive and Non-adaptive Routing Algorithms, Traffic Management at packet level, Traffic management at flow level.

CO-II: (Mapped CO2) (8 hrs)

Introduction to Software Defined Networking (SDN) Evolution of Switches and Control Planes, Centralized and Distributed Control and Data Planes Concepts, Advantages and Disadvantages, Open Flow protocol. SDN Controller: General Concepts, Layer 3 Centric, Plexxi ,CiscoOnePK ,Network Programmability

CO-III: (Mapped CO3) (6 hrs)

Data Center Concepts and Constructs

Technologies for the Data Center, The Multitenant Data Center ,The Virtualized Multitenant Data Center ,SDN Solutions for the Data Center Network ,VLANs, EVPN ,VxLan,NVGRENetwork Topology and Topological Information Abstraction: Introduction,Network Topology ,Traditional Methods ,LLDP ,BGP-TE/LS ,ALTO ,I2RS Topology

CO-IV: (Mapped CO3) (8 hrs)

Building an SDN Framework: Introduction The Juniper SDN Framework IETF SDN Framework(s) Open Daylight Controller/Framework Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions, Firewalls as a Service ,Network Access Control Replacement ,Extending the Use Case with a Virtual Firewall ,Feedback and Optimization ,Intrusion Detection/Threat Mitigation

Textbooks

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10: 1-4493-4230-2.
2. Software Defined Networks: A Comprehensive Approach, by PaulGoransson and Chuck Black, Morgan Kaufmann, June 2014, Print BookISBN: 9780124166752, eBook ISBN : 9780124166844

References Books:

1. SDN and OpenFlow for Beginners by VivekTiwari, Sold by: Amazon Digital Services, Inc., ASIN: , 2013.
2. Network Innovation through Open Flow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.
4. Open Flow standards, http://www.openflow.org, 2015.
5. Online Reading Lists, including: http://www.nec-labs.com/~lume/sdn-reading-list.html, 2015.

DEPARTMENTAL ELECTIVE 6: BLOCKCHAIN TECHNOLOGY

(Total hours – 30)

Teaching Scheme				Credits	Theory				Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Exam Mode	Int	Ext	
2	-	2	4	3	10	15	25	Online	10	15	75

Mode of exam: Offline

Course Objective:

1. To understand the concept of blockchain.
2. To be able to implement blockchain in security and other applications

Course Outcomes:

1. Demonstrate Basic Cryptographic primitives used in Blockchain
2. Illustrate hyperledger fabric in blockchain
3. Experiment with different applications of blockchain

4. Apply blockchain for research in AI, Big Data

Course Outcomes	Programme Outcomes			Programme Specific Outcomes	
	PO2	PO3	PO4	PSO1	PSO2
CO1	2	2	1	1	1
CO2	2	2	3	1	1
CO3	1	1	1	2	1
CO4	1	1	2	3	2

Contents

CO –I: (8 Hours)

Introduction to Blockchain, Crypto Primitives and Bitcoin, Consensus algorithms and their scalability problems, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

CO –II: (8 Hours)

Permissioned Blockchain, Hyperledger Fabric, Fabric Demo, Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

CO –III: (7 Hours)

Blockchain Use Cases – Finance, Blockchain Use Cases – Industry, Blockchain in Government and Blockchain Security

CO –IV: (7 Hours)

Security and Research Aspects, Research Aspects in Blockchain, AI and Blockchain and Big Data

Text Books:

1. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.