Program Structure for Third Year UG Technology (EX)

Semester-VI- Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		Course Category
		TH – P – TUT	Total (Hrs.)	TH – P – TUT	Credits	
EXC601	Electromagnetics and Antenna	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC602	Machine Learning	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC603	Image Processing and Machine Vision	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC604	Computer Communication Networks	3 – 0 – 0	03	3 – 0 – 0	03	PC
EXDLC605	Department Level Elective Course– II	3 – 0 – 0	03	3 – 0 – 0	03	DLE
EXL601	Electromagnetic and Antenna Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL602	Machine Learning Networks Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL603	Image Processing and Machine Vision Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXDLL605	Department Level Elective Course – II Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	DLE
EXPR64	Project Based Learning – Minor Project Lab - II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
EXXS69	Skill Based Learning –IX	0 – 2* – 0	02	0 – 1 – 0	01	SAT
EXXT610	Technology Based Learning - X	0 – 2* – 0	02	0 – 1 – 0	01	SAT
Total		**15– 14– 0**	**29**	**15 - 07 - 0**	**22**	

Minor Project Lab - II:

- Students can form groups with minimum 2 (Two) and not more than 4 (Four)
- Faculty Load: 1 hour per week per four groups

	Course Code	Course Title and Group^
Department Level Elective Course - II	EXDLC6051	Group A: Speech and Audio Processing
	EXDLC6052	Group B: IoT and Industry 4.0
	EXDLC6053	Group C: Mixed Signal VLSI Design
	EXDLC6054	Group D: Database Management System

^ Student have freedom to select any course from Group A / B / C / D from Semester V to VIII

Program Structure for Third Year UG Technology (EX)

Semester-VI- Credit Scheme

Course Code	Course Name	Teaching Scheme	Credits Assigned	Course

		(Hrs.)				Category
		TH – P – TUT	Total (Hrs.)	TH – P – TUT	Credits	
EXC601	Electromagnetics and Antenna	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC602	Machine Learning	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC603	Image Processing and Machine Vision	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC604	Computer Communication Networks	3 – 0 – 0	03	3 – 0 – 0	03	PC
EXDLC605	Department Level Elective Course– II	3 – 0 – 0	03	3 – 0 – 0	03	DLE
EXL601	Electromagnetic and Antenna Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL602	Machine Learning Networks Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL603	Image Processing and Machine Vision Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXDLL605	Department Level Elective Course – II Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	DLE
EXPR64	Project Based Learning – Minor Project Lab - II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
EXXS69	Skill Based Learning –IX	0 – 2* – 0	02	0 – 1 – 0	01	SAT
EXXT610	Technology Based Learning - X	0 – 2* – 0	02	0 – 1 – 0	01	SAT
Total		**15– 14– 0**	**29**	**15 - 07 - 0**	**22**	

Minor Project Lab - II:

- Students can form groups with minimum 2 (Two) and not more than 4 (Four)
- Faculty Load: 1 hour per week per four groups

	Course Code	Course Title and Group^
Department Level Elective Course - II	EXDLC6051	Group A: Speech and Audio Processing
	EXDLC6052	Group B: IoT and Industry 4.0
	EXDLC6053	Group C: Mixed Signal VLSI Design
	EXDLC6054	Group D: Database Management System

^ Student have freedom to select any course from Group A / B / C / D from Semester V to VIII

Program Structure for Third Year UG Technology (EX)

Semester-VI- Examination Scheme

Course Code	Course Name	Examination Scheme								
		Marks								
		CA			IA	ESE	TW	O	P	Total
		T1	T2	Average (T1&T2)						
EXC601	Electromagnetic and Antenna	30	30	30	10	60	-	-	-	100
EXC602	Machine Learning	30	30	30	10	60	-	-	-	100
EXC603	Image Processing and Machine Vision	30	30	30	10	60	-	-	-	100

EXC604	Computer Communication Networks	30	30	30	10	60	-	-	-	100
EXDLC605	Department Level Elective Course – II	30	30	30	10	60	-	-	-	100
EXL601	Electromagnetic and Antenna Laboratory	-	-	-	-	-	25	25	-	50
EXL602	Machine Learning Laboratory	-	-	-	-	-	25	25	-	50
EXL603	Image Processing and Machine Vision Laboratory	-	-	-	-	-	25	-	25	50
EXDLL605	Department Level Elective Course – II Laboratory	-	-	-	-	-	25	-	-	25
EXXPR64	Project Based Learning – Minor Project Lab - II	-	-	-	-	-	25	25	-	50
EXXS69	Skill Based Learning - IX	-	-	-	-	-	25	-	-	25
EXXT610	Technology Based Learning - X	-	-	-	-	-	25	-	-	25
Total		150	150	**150**	**50**	**300**	**175**	**75**	**25**	**775**

Course Code	**Course Name**	**Credits (TH+P+TUT)**
EXC601	**Electromagnetics & Antenna**	**3+0+0**
Prerequisite:	Applications of Mathematics in Engineering – I (Vector Calculus, Fundamentals concepts of electricity and magnetism, Two-Port Networks)	
Course Objectives:	To make student familiar with Maxwell's equation and its usefulness to describe different electromagnetic phenomena such as wave propagation, radiations from antenna etc. To learn Electromagnetic radiation and propagation in space and within transmission lines To learn different Antennas and its parameter. To learn design of wired and patch Antenna.	
Course Outcomes:	1. Describe electromagnetic field including static and dynamic in terms of Maxwell's equations. 2. Apply Maxwell's equation to solve various electromagnetic fields. Determine the parameters of transmission line for various frequencies. 3. Explain the wave propagation and propagation in different media. 4. Determine basic antenna parameters like radiation pattern, input impedance directivity, gain and polarization. 5. Design of different types of the antenna structures such as Antenna arrays, Microstrip patch antennas and aperture antennas.	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Introduction to Static fields	**1.** Charge, Coulomb's law, Charge configurations, Electric field intensity, Electric flux density, Gauss's law and applications, Current density, and Continuity equation.	1	02	05
	2. Scalar Electric Potential, Potential gradient, Laplace's and Poison's equations.		02	
	3. Biot Savart Law, Ampere Circuit law, Gauss's law for magnetic field, Vector magnetic potential		01	
2. Electromagnetic Field and Maxwell's Equations	1 Faraday's Law, Displacement current density, Maxwell's equation for time varying filed, Boundary conditions.	2	02	05
	2 EM wave propagation through lossy, perfect dielectric and conducting medium.		02	
	3 Power in EM Wave: Poynting theorem and Poynting vector, Applications of EM waves(add 2-3 applications)		01	
3. Transmission Line	1 Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio, Power, Transients on transmission lines.	3	03	07
	2 Smith Chart, Applications of Smith Chart in finding VSWR, and reflection coefficient, admittance calculations, impedance calculations over length of line		04	
4. Basic of Antennas & Wave Propagation	Basic concepts: Radiation mechanism, near field and far field radiation, retarded potential.	4	02	07
	Antenna Parameters: Isotropic		03	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	antenna, Radiation pattern, radiation intensity, Beam width, directivity, Gain, beam efficiency, bandwidth, polarization, Input impedance, Antenna efficiency, Radiation resistance, Loss resistance, aperture concept, FRII's transmission formula.			
	Ground Wave Propagation, Sky Wave Propagation and Space Wave Propagation.		02	
5. Wire Elements & Antenna Arrays	Infinitesimal dipole, Wire dipole, Monopole antennas: radiation field derivations and related parameters, Introduction to loop antenna.	5	03	09
	Yagi antenna, Broadband antenna like Helical and Log Periodic antenna (Design of Yagi & Log periodic).		03	
	Linear arrays of two isotropic point sources, linear arrays of N elements, Principle of pattern multiplication (Design)		02	
	5.4 Introduction and types to Planner arrays.		01	
6. Aperture & Patch antennas	Horn Antennas**:** E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn and Conical Horn (No Design).	6	02	06
	2 Reflector Antennas: Plane Reflectors, Corner Reflectors and Parabolic Reflector (No Design).		02	
	3 Patch Antenna: Microstrip antenna, Feeding Techniques, Introduction to design of Microstrip antenna (Rectangular and circular patch) (Design)		02	
. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	1. Electromagnetic Waves and Radiating Systems- Jordan and Balmain, PHI, 2nd edition 2. Engineering Electromagnetics, William H Hayt and John A Buck - Tata McGraw-Hill Publishing Company Limited, Seventh Edition 3. "Electromagnetic Waves" written by Prof R K Shevgaonkar 4. Principles of Electromagnetics Engineering- Matthew N. O.Sadiku , S.V. Kulkarni, Oxford university press, 6th edition 5. Antenna Theory: Analysis and Design, Costantine A. Balanis, John Wiley Publication, 4th edition 6. Antenna and wave Propagation, John D Kraus, A S Khan, McGraw Hill, 4th edition 7. Antenna Theory and Design. Stutzman, Theile, John Wiley and Sons, 3rd edition
Reference Books	Antennas and Radio Wave Propagation, R. E. Collin, McGraw Hill, International Student Edition.
eful Links:	
1. https://nptel.ac.in/courses/108/104/108104087/ 2. https://www.udemy.com/course/electromagnetic-theory/	

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC602	**Machine Learning**	**3+0+0**

Prerequisite:	Skill lab Python Programming
Course Objectives:	. To appreciate machine learning approach to Artificial Intelligence, and understand fundamental issues and challenges of supervised and unsupervised learning techniques . To understand the underlying mathematical relationships within and across Machine Learning algorithms.
Course Outcomes:	1. Explain the concepts related Machine Learning 2. Mathematically analyse various machine learning approaches and paradigms 3. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach 4. Deploy machine learning algorithms using various evaluation techniques. 5. Implement supervised and unsupervised machine learning algorithms for real-world applications, while understanding the strengths and weaknesses. 6. Fine tune machine learning algorithms and evaluate models generated from data.

Module No. & Name	Sub Topic	CO Mapped	Hrs./ Sub Topic	Total Hrs.
i. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Introduction	1 Definition, Types of machine learning : Supervised/unsupervised/reinforcement	1	02	03
	2 Applications of machine learning		01	
2. Linear Regression	1 Univariate Linear Regression: Model representation, Cost Function, Gradient Descent, Gradient Descent for linear regression, Optimization, Overfitting, Regularization, Feature selection	2,6	06	10
	2 Multivariate Linear Regression: Multiple features: Model representation, Gradient Descent for multivariate linear regression, Feature scaling, Normal Equation		04	
3. Logistic Regression	1 Classification : Model representation, Decision boundary, Cost function, Gradient Descent, Optimization	3,6	02	12

	2 Feature selection, Multiclass Classification, Over fitting, ROC curve, Confusion Matrix		02	
	3 KNN		01	
	4 Decision Tree algorithms		02	
	5 Random forest		02	
	6 Support Vector Machine: Introduction, Kernel, Application, Difference between logistic regression and SVM		03	
4. Deployment of Machine learning algorithm	1 Evaluation of hypothesis	4	1	05
	2 Cross validation		1	
	3 K-fold Cross validation		2	
	4 Learning Curve		1	
5. Unsupervised Learning	1 Introduction	3	2	05
	2 Clustering : K Mean Algorithm			
	3 Dimensionality reduction		1	
	4 Principal Component Analysis		2	
6. Advance Machine Learning topics	1 Anomaly Detection	5	1	04
	2 Recommender System		1	
	3 Gradient Descent with large dataset			
	4 Online learning		1	
	5 Map reduce and data parallelism		1	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total	**42**

Books:	
Text Books	1. Introduction to statistical Learning 7th Edition Gareth James Daniela Witten Trevor Hastie Robert Tibshirani Springer 2017 2. Foundation of Machine Learning 2nd Edition Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar MIT Press 2018 3. Introduction to Machine Learning 2nd Edition Ethem Alpaydın The MIT Press 2010
Reference Books	1. Pattern Recognition and Machine Learning C. M. Bishop Springer 2010 2. Understanding Machine Learning: From Theory to Algorithms Shai Shalev-Shwartz and Shai Ben-David Cambridge University Press 2014
Useful Links:	

1. https://www.coursera.org/learn/machine-learning
2. https://paperswithcode.com/
3. https://nptel.ac.in/courses/106/106/106106139/

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC603	**Image Processing and Machine Vision**	**3+0+0**
Prerequisite:	1. Signals and Systems 2. Discrete Time Signal Processing	
Course Objectives:	1. To introduce students to the fundamental concepts of Image Processing and Image Enhancement Techniques 2. To make the students well versed with image morphology and restoration techniques 3. To impart knowledge on the concepts of the students to segmentation and feature extraction 4. To teach modern techniques of Classification and Basics of Machine Vision.	
Course Outcomes:	1. Explain the basic fundamentals required for Image processing 2. Explain the theory and models in Image Processing. 3. Implement image-processing operations on 2D signals in spatial & frequency domain. 4. Discuss segmentation and restoration of 2D signals in spatial & frequency domain. 5. Explain the image representation techniques. 6. Describe the image classification of 2D signals	

Module No & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
i. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Digital Image Fundamentals and Processing	1 Introduction – Steps in Digital Image Processing, concept of Sampling and quantization, spatial and intensity resolution, Relationships between pixels: Neighbourhood relations between pixels, Distance measures, connectivity of pixels, Definitions of path, Region and Boundary. Numericals on distance measures and connectivity	1, 2	02	04
	2 Point Processing: Image Negative, Log Transform, Power Law transform, Bit plane slicing, Contrast stretching, Histogram equalization and Histogram Specification		02	
2. Image Enhancement with Time Domain and Frequency Domain Filters	1 Spatial Domain filtering : The Mechanics of Spatial Filtering, Smoothing Spatial Filters-Linear Filters-Averaging filter, Order-Statistic Filters- Median filter, Application of Median filtering for Noise removal Sharpening Spatial Filters- The Laplacian, Unsharp Masking and High boost Filtering, Using First-Order Derivatives —The Gradient- Sobel, Prewitt and Roberts masks	2 & 3	03	08
	2 Frequency Domain Filtering: Introduction to 2-D DFT and its application in frequency domain filtering, Wavelet transform, Haar transform		02	
	3 Frequency Domain Filtering Fundamentals, Fourier Spectrum and Phase angle, Steps for Filtering in the Frequency Domain, Correspondence Between Filtering in the Spatial and Frequency Domains, Frequency domain Image Smoothing and sharpening filter - Ideal, Butterworth, Gaussian	2	03	

Module No & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
3. Image Morphology and Restoration	1 Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Boundary extraction , Hole filling, Thinning and thickening	3	03	06
	2 Restoration: A Model of the Image Degradation/Restoration Process, Noise models, Removal periodic noise, Principle of Inverse filtering.	4	03	
4. Image Segmentation	1 Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, Canny's edge detection algorithm, Edge linking: Hough transforms and Graph Theoretical Method.	2,3	05	08
	2 Thresholding: Foundation, Role of illumination and reflectance, Basic global thresholding	2	01	
	3 Region Based segmentation: Region Growing, Region Splitting and Merging.		02	
5. Introduction to Machine Vision and Descriptors	1 Principle of machine vision, chain code, simple geometric border representation, Fourier Descriptors, (Specify Different Techniques), Regional Descriptors based on Histogram and Texture Features.	5	03	05
	2 Introduction to Texture, co-occurrence matrix		02	
6. Machine Vision Algorithms	1 Knowledge representation, Classification Principles, Classifier Design, Classifier Learning, Confusion Matrix	6	02	08
	2 Introduction to clustering, K-means clustering algorithm, Introduction, Bayes decision theory continuous case, Maximum Likelihood Classification Bayesian classifier, Introduction to Support Vector Machine. Comparison of Supervised and Unsupervised Classification		06	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total:	**42**

Books:

Text Books	1. "Digital Image Processing", 3rd Edition Gonzales and Woods PHI publications Indian Edition 2013 2. "Introduction to Image Processing", 2nd Edition Jayaraman, Isakkirajan Wiley 2009 3. "Digital Image Processing", 1st Edition S. Sridhar Oxford Education Press 2014 4. "Pattern Recognition and Machine Learning", 3rd Edition Christopher M. Bishop; Springer Publication Series 2006
Reference Books	1. Image Processing, Analysis, and Machine Vision 3rd Edition Milan Sonka, Vaclav Hlavac, Roger Boyle Pearson Edition 2013 2. Fundamentals of Image Processing 1st Edition Anil Jain Prentice Hall of India 1989 3. Digital Image Processing 3rd Edition W. Pratt Wiley Publication 2002 4. Image Processing and Pattern Recognition: Fundamentals and Techniques 1st Edition Frank Y Shish Wiley- IEEE Press, 2010 5. Pattern classification and scene analysis 2nd Edition R. O. Duda and P. E. Hart Wiley Inter Science Publication 2009

Useful Links:

Some important links of NPTEL Courses

1. https://onlinecourses.nptel.ac.in/noc21_ee78/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs70/course

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test (T-1)	30 marks
2.	Class Test (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):

Two class tests of 15 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):

Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC604	**Computer Communication Networks**	**3+0+0**
Prerequisite:	1. Principles of Communication Engineering 2. Digital Communication	
Course Objectives:	To introduce networking architecture and protocols. To understand and recognize the layer wise functions, services, data formats, protocols, hardware devices and addresses in the TCP/IP architecture. To build an understanding of application layer protocols. To apply different addressing and routing schemes.	
Course Outcomes:	Discuss network topologies, hardware devices, addressing schemes and the protocol stacks. Compare various transmission media and broadband technologies. Analyze the flow control, error control and the medium access control techniques. Analyze network layer addressing and routing schemes. Compare connection oriented and connectionless services. Explore application layer protocols.	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
i. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Introduction to Network Architectures, Protocol Layers, and Service models	1. Applications of computer networks. Network types: LAN, MAN, and WAN, Network topologies.	1	01	06
	2. Protocols and standards, need of layered protocol architecture, OSI reference model.	1	01	
	3. TCP/IP architecture: protocol suite, comparison of OSI and TCP/IP	1	01	
	4. Layer wise network hardware devices (NIC, Repeaters, Hubs, Bridges, Switches, Routers, Gateway and their comparison)	1	02	
	5. Addressing: physical / logical /port addressing/socket addressing.	1	01	
2. Physical Layer	Guided transmission media: comparison among coaxial, optical	2	01	04

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	fiber and twisted pair cables.			
	Unguided transmission media	2	01	
	2.3 Transmission impairments	2	01	
	3 Broadband standards: Cable modem, DSL, and HFC	2	01	
3. Data Link Layer	Data link services: Framing, Flow control, Error control	3	01	09
	2 ARQ methods: transmission efficiency, Piggybacking	3	03	
	3 High Level Data Link Control (HDLC): HDLC configurations, Frame formats, HDLC bit stuffing and de-stuffing, Typical frame exchanges.	3	02	
	4 Medium Access Control Protocols: ALOHA, Slotted ALOHA, CSMA, CSMA/CD	3	03	
4. Network Layer	1. Introduction to telephone networks and circuit switching principles, Introduction to data networks and packet switching principles, Routing in Packet Switching Networks: Characteristics, Routing strategies, Network layer services and functions.	4	02	12
	2. Internet Protocol: Principles of Internetworking, requirements, IPv4 packet, IPv4 addressing (classful and classless (CIDR)), IPv6 (IPv6 Datagram format, comparison with IPv4, and transition from IPv4 to IPv6).	4	03	
	3. Routing algorithms: Link state Routing, Distance vector Routing and Path vector routing, Routing protocols: RIP, OSPF, BGP and EIGRP.	4	04	
	4. Subnetting, Supernetting,	4	01	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	VLSM, and NAT			
	5. Introduction to ICMP, ARP, RARP	4	01	
	6. Quality of service	4	01	
5. Transport Layer	1. Connectionless and Connection–oriented services at transport layer, Transmission Control Protocol (TCP): TCP Services, TCP Segment, TCP three way handshake	5	03	06
	2. User datagram Protocol (UDP), UDP Services, UDP Datagram	5	01	
	3. TCP and UDP checksum calculation	5	01	
	4. Flow control, error control and congestion control	5	01	
6. Application Layer	Introduction to Application layer Protocols: HTTP, FTP, DNS, SMTP, TELNET, SSH, DHCP.	6	02	02
. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			TOTAL	**42**

Books:	
Text Books	Data Communications and Networking, Behrouz A. Forouzan, TMH, 5th Edition, 2013 Computer Networks, Andrew S Tanenbaum, Pearson Education, 5th Edition, 2013 Computer Networking: A Top-Down Approach, J. J. F. Kurose and K. W. Ross, Addison Wesley, 5th Edition, 2010
Reference Books	Communication Networks, Alberto Leon Garcia, McGraw Hill Education, 2nd &4th edition, 2008 An Engineering Approach to Computer Networks, S. Keshav, Pearson Education, 2nd Edition, 2015 Understanding communications and Networks, W. A. Shay, Cengage Learning, 3rd Edition, 2008 Data and Computer Communications, William Stallings, Pearson Education, 10th Edition, 2014
Useful Links:	

NPTEL course videos on Computer Networks and Internet Protocol- https://nptel.ac.in/courses/106/105/106105183/

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Department Level Elective Course – II	Credits (TH+P+TUT)
EXDLC6051	**Speech and Audio Processing**	**3+0+0**
Prerequisite:	1. Signal Systems 2. Discrete Time Signal Processing	
Course Objectives:	To understand basic concepts and methodologies for the analysis and modelling of speech signal To characterize the speech signal as generated by a speech production model To understand the mechanism of speech and audio perception To extract the information of the speech or audio signals. To provide knowledge of Compression of Audio signals.	
Course Outcomes:	Demonstrate advanced Knowledge in Digital model representation of speech signals. Analysis of Speech by Time Domain Approach and Frequency Domain Approach. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing. Analyse speech signals to extract the characteristics of vocal tract (formants) and vocal cords (pitch). Acquired knowledge about audio compression, speech signal estimation and detection.	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Digital Models for Speech signals	Speech production and acoustic tube modelling, acoustic phonetics, anatomy, and physiology of the vocal tract and ear, hearing and perception.	1	05	05
2. Time Domain Approach	Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech V/S silence discrimination using energy & Zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.	2	10	10
3. Frequency Domain Approach	Introduction- Definition and Properties, Fourier Transform Interpretation, Linear Filtering Interpretation, Sampling rates of Xn (ejw) in Time and Frequency, Filter Bank 6 Summation Method of Short -Time Synthesis, Overlap Addition Method for Short -Time Synthesis.	2	10	10
4. Speech Coding, Recognition and Enhancement	Vocoder, LPC vocoder, CELP, Adaptive predictive coding of speech, Speech Recognition, Speaker verification, Speech Enhancement, Speech recognition pattern comparison techniques.	4	06	06
5. Fundamentals of Audio Signal Processing	Signal processing model of Audio perception, Basic anatomy of hearing system, Auditory filter bank, Psyco acoustic model/analysis, Threshold of hearing,- Temporal masking and Spectral masking, MPEG Psycho acoustic model, Audio signal processing for Music applications.	3, 5	06	06
6. Audio Compression method	Sampling rate and bandwidth requirement for digital audio, redundancy removal and perceptual	6	03	03

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	irrelevancy removal, transform coding of digital audio,- MPEG 2, MDCT			
i. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
Total:				**42**

Books:	
Text Books	1. Digital processing of speech signals# L R Rabiner and S W Schafer Pearson Education 2009 2. Speech & Audio Signal Processing# Ben Gold and Nelson Morgan Wiley 2007 3. Fundamentals of speech Recognition# L R Rabiner, B H Juang, B Yegnanarayana Pearson Education 1993 # refer latest addition
Reference Books	1. Discrete Time Speech Signal Processing# Thomas F Quateri Pearson Edition 2006 2. Speech Communications 2nd Edition Douglas O Shaughnessy Oxford University Press 2000
Useful Links:	
1. https://nptel.ac.in/courses/117/105/117105081/ 2. https://nptel.ac.in/courses/117/105/117105145/	

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Department Level Elective Course – II	Credits (TH+P+TUT)
EXDLC6052	**IoT and Industry 4.0**	**3+0+0**
Prerequisite:	Microcontrollers	
Course Objectives:	1. To offer introduction to Internet of Things and industry 4.0 standard 2. To understand the design features of Internet of Things (IoT) 3. To understand concepts of data management and data analytics in IoT 4. To understand the concept and framework of industry 4.0 standard 5. To understand the application of IoT and Industry 4.0 standard.	
Course Outcomes:	1. Describe the concepts of Internet of Things. 2. Illustrate various protocols of web connectivity. 3. Analyse and compare tools for data management and analytics in IoT. 4. Explain various frameworks for industry 4.0 standards. 5. Prepare case studies on applications of IIOT. 6. Explain advanced concepts and applications of industry 4.0	

Module No & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Tota Hrs Modu
. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
Introduction to IoT	Introduction - Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Sources of IoT, IoT and M2M - IoT/M2M System layers and Design standardization, Difference between IoT and M2M	1	02	04
	Defining Specifications About - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, Application Development,		02	
2. Network & Communication aspects	Design Principles & Web Connectivity - Web Communication Protocols for connected devices, Web connectivity using Gateway, SOAP, REST, HTTP, RESTful and Web Sockets (Publish —Subscribe), MQTT, AMQP, CoAP Protocols	2	04	08
	Internet Connectivity: - Internet connectivity,		04	

Module No & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Tota Hrs Modu
	Internet based communication, IP addressing in IoT, Media Access Control, Application Layer Protocols. LPWAN Fundamentals: LORA, NBIoT, CAT LTE Ml, SIGFOX,			
. Data Management and Analytics for IoT	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, ApacheStorm, Using Apache Storm for Real-time Data Analysis	3	04	08
	Analysis, Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study- Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generation		04	
Introduction to Industry 4.0	Industry 4.0: Managing the Digital Transformation, Conceptual framework for Industry 4.0, Industrial IoT (IIoT) - Introduction, Business Model and Reference Architecture, Industrial IoTLayers, Sensing, Processing, Communication.	4	04	08
	Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality		04	
Introduction to Industrial IoT (IIoT)	Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Facility Management.	5	03	06
	Artificial Intelligence, Cybersecurity in Industry 4.0, Internet of Things for Industry 4.0 Design, Challenges and Solutions		03	
Industry 4.0 Technologies and Applications	Internet of Things and New Value Proposition.: Examples for IoTs Value Creation in Different Industries., IoTs Value Creation Barriers: Standards, Security and Privacy Concerns	6	03	05
	Introduction to Industry 5.0, Human Machine Interaction, cognitive computing with human intelligence, Case study on AI based solution		02	
. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	1. ArshdeepBahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, Universities Press. 2. Raj Kamal, “ Internet of Things: Architecture and Design Principles”, McGraw Hill Education ,First edition 3. Radha Shankarmani, M Vijayalakshmi, ”Big Data Analytics”, Wiley Publications, 4. Andrew Minteer ,”Analytics for the Internet of Things(IoT)”,Kindle Edition 5. Giacomo Veneri , Antonio Capasso,” Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0”, Packt
Reference Books	1. Alp Ustundag Emre Cevikcan,” Industry 4.0: Managing The Digital Transformation”,Springer Series in Advanced Manufacturing 2. G. R. Kanagachidambaresan, R. Anand, E. Balasubramanian, V. Mahima, Internet of Things for Industry 4.0. EAI/Springer Innovations in Communication and Computing 3. The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications). 4. The Internet of Things (MIT Press) by Samuel Greengard 5. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things”, Paperback,First Edition

Useful Links:

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

Suggested MOOCs:

1. 1.https://onlinecourses.nptel.ac.in/noc20_cs69 - Introduction to Industry 4.0 and Industrial Internet of Things, By Prof. Sudip Misra, IIT Kharagpur
2. https://www.edx.org/course/industry-40-how-to-revolutionize-your-business - Industry 4.0: How to Revolutionize your Business
3. https://onlinecourses.nptel.ac.in/noc21_cs17 - Introduction to internet of things, by Prof. Sudip Misra , IIT Kharagpur
4. 4 https://onlinecourses.nptel.ac.in/noc21_cs08 - Embedded Systems Design By Prof. Anupam Basu, IIT Kharagpur

Recommended list of tools:

1. Node Red - https://nodered.org/
2. M2MLabs Mainspring - http://www.m2mlabs.com/
3. Tensor Flow - https://www.tensorflow.org/
4. Things Speak - https://thingspeak.com

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	**Department Level Elective Course - II**	**Credits (TH+P+TUT)**
EXDLC6053	**Mixed Signal VLSI Design**	**3+0+0**
Prerequisite:	1. Electronics Devices & Circuits 2. Digital Logic Design 3. Digital VLSI Design 4. Linear Integrated Circuits 5. Microelectronics	
Course Objectives:	1. To know the importance of Mixed Signal VLSI design in the field of Electronics and Telecommunication and emerging technologies. 2. To understand various methodologies for analysis and design of fundamental CMOS analog and mixed signal Circuits 3. To learn various issues associated with high performance Mixed Signal VLSI Circuits 4. To design, implement and verify various mixed signal VLSI circuits using open source tools like NGspice and Magic	
Course Outcomes:	1. Explain operation of the various building blocks of analog and mixed signal VLSI circuits 2. Demonstrate the understanding of various building blocks and their use in design of analog and mixed signal circuits. 3. Derive expression for various performance measures of analog and mixed signal circuits in terms of parameters of various building blocks used to build the circuit 4. Analyse and relate performance of analog and mixed signal VLSI circuits in terms of design parameters 5. Evaluate and select appropriate circuit/configuration for given application	

	6. Design analog and mixed signal VLSI circuits for given application

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
1. Integrated Circuit Biasing Techniques	1. Need for CMOS analog and mixed signal designs, MOS Transistor as sampling switch	1, 2	03	06
	2. Active resistance, current source, current sink, simple current mirror, cascode current mirror			
	3. Current and voltage references, Band gap reference generator		03	
2. Noise in MOS Circuits	1. Noise spectrum, correlated and uncorrelated noise sources, thermal noise, flicker noise, shot noise	4	02	06
	2. Representation of noise in circuits, noise in single stage CS, CD and CG amplifier		02	
	3. Noise in differential pairs, noise bandwidth		02	
3. MOS Operational Amplifiers	Op-amp Design: General Considerations, performance parameters, One- stage op-amps, Two-stage op-amps, Gain Boosting, Common-mode feedback, Input range limitations(ICMR), Slew Rate, Power supply rejection, Noise in op-amps. Design of single ended and double ended two stage Op-amps	6	06	06
4. Phase-Locked Loop and Switched Capacitor circuits	1. PLL: Simple PLL, Charge-pump PLL, Non-ideal effect in PLL, Delay-Locked Loop, Applications	1, 4	04	09
	2. Switched Capacitor circuit: General consideration, Sampling Switches, Switched-capacitor amplifier, Switched-capacitor integrator		05	
5. Data Converter Fundamentals	1. Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics	3	03	06
	Mixed signal Layout issues, Floor planning, power supply and Ground issues, other interconnect Considerations		03	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
6. Data Converter architectures	1. DAC architectures, digital input code, charge scaling DACs, Cyclic DAC, pipeline DAC	5	03	06
	2. ADC architectures, flash, pipeline ADC, integrating ADC, and successive approximation ADC		03	
. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	1. Design of Analog CMOS Integrated Circuits first edition B. Razavi McGraw Hill 2001 2. CMOS Circuit Design, Layout and Simulation Second edition R. Jacob Baker Wiley 2013 3. CMOS Analog Circuit Design Second edition P. E. Allen and D R Holberg Oxford University Press 2002
Reference Books	1. Analog Circuit Design Second Edition Tony Chan Carusone, David Johns, Kenneth Martin Wiely 2012 2. Microelectronics Circuits Theory and Applications Fifth Edition Adel S. Sedra, Kenneth C. Smith, A.N. Chandorkar Oxford University Press 3. Analysis and design of Analog Integrated Circuits Fourth Edition Gray, Meyer, Lewis and Hurst Willey International 2002
Useful Links:	
1. https://nptel.ac.in/courses/117/101/117101105/ 2. http://cmosedu.com/	

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA): Marks will be awarded based on the rubrics designed.
End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Department Level Elective Course – II	Credits (TH+P+TUT)
EXDLC6054	**Database Management System**	**3+0+0**
Prerequisite:	Basic knowledge of programming	
Course Objectives:	To learn and practice data modelling using the entity-relationship and developing database designs To understand the use of Structured Query Language (SQL) and learn SQL syntax. To understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access	
Course Outcomes:	Explain the fundamentals of database systems. Design ER and EER diagram for real life problems. Apply concepts of Normalization to relational database design Explain the relational algebra queries Solve database Query using SQL. Explain the concept of transaction, concurrency and recovery.	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outlines	Prerequisite Concepts and Course Introduction	-	02	02
. Introduction to Databases and Transactions	Introduction to databases, History of database system, Benefits of Database system over file system, relational databases, database architecture, transaction management	1	02	02
2. Data Models	The importance of data models, Basic building blocks, Business rules, Evolution of data models (hierarchical, Network, Relational, Entity relationship and object model), Degrees of data abstraction.	2	05	05
3. Database	Database design and ER Model: overview,	3	08	08

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
Design, ER-Diagram and Unified Modelling Language	ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, and integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).			
. Relational Algebra and Calculus	Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, Calculus Vs Algebra, computational capabilities.	4	08	08
Constraints, Views and SQL	What are constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.	5	08	08
Transaction management and Concurrency control	Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	6	08	08
Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", Fifth Edition McGraw-Hill Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", Seventh Edition, Person. G. K. Gupta: "Database Management Systems", McGraw – Hill.
Reference Books	Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition

	P.S. Deshpande, "SQL and PL/SQL for Oracle 11g, Black Book", Dreamtech Press Mark L. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

Useful Links:

. https://www.tutorialspoint.com/dbms/index.htm
2. https://www.studytonight.com/dbms/
3. https://beginnersbook.com/2015/04/dbms-tutorial/
4. https://www.w3schools.in/dbms/
5. https://www.tutorialcup.com/dbms

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):

Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):

Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Lab Code	Lab Name	Credits (P+TUT)
EXL601	**Electromagnetics and Antenna Laboratory**	**1+0**
Lab Prerequisite:	Applications of Mathematics in Engineering-I (Vector Calculus, Fundamental concepts of electricity and magnetism, Two Port Network)	
Lab Objectives:	1. To learn the fundamentals of Electromagnetics 2. To learn the basic parameters and design of Transmission Line 3. To learn the applications of Electromagnetics 4. To learn about Antenna measurements and radio wave propagation. 5. To learn about linear wire antenna elements and Antenna arrays.	

	6. To learn Aperture Antenna, Patch antenna and its designing.
Lab Outcomes:	1. Design of Electromagnetic application using Simulation. 2. Design of Transmission Line using Simulation. 3. Define Basic Antenna parameters like radiation pattern, directivity and gain. 4. Design of uniform linear, basic radiating elements like wire antenna, loop antenna, planar antenna, arrays using isotropic and directional Sources, Micro strip and aperture antennas and reflectors. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
0	Lab Prerequisites	-	02
1	Electromagnetics Simulation using HFSS	1,5,6	02
2	Transmission line design using HFSS	2,5,6	02
3	Plot Radiation pattern of i. Dipole Antenna ii. Monopole iii. Folded Dipole Antenna through measurement setups iv. Broadside Array Antenna v. End Fire Array Antenna vi. Helical through measurement setups	2,5,6	02
4	Analyse and design: Monopole Antenna for a frequency 2.4 GHz using HFSS software Dipole Antenna for a frequency 2.4 GHz using HFSS software	3,5,6	02
5	Design Yagi-Uda Antenna for a frequency of 2.4 GHz using HFSS software.	3,5,6	02
6	Design Rectangular Micro strip Antenna (RMSA) for a frequency of 2.4 GHz using HFSS software.	4, 5, 6	02
7	Design Circular Micro strip Antenna (CMSA) for a frequency of 2.4GHz using HFSS software.	4, 5, 6	02
8	Design Horn Antenna for a frequency of 2.4 GHz using HFSS software.	4, 5, 6	02
9	Case Study of Recent reported variations of Antenna types	1 to 6	10
		Total	**28**

Virtual Lab Links:

1. https://www.labster.com/simulations/electromagnetic-spectrum/
2. https://www.ee.iitb.ac.in/course/~vel/

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Oral/Practical/P&O :

Oral examination will be based on the experiment list and content of the entire theory syllabus and carries 25-Marks

Lab Code	Lab Name	Credits (P+TUT)
EXL602	**Machine Learning Laboratory**	**1+0**
Lab Prerequisite:	Skill lab Python Programming	
Lab Objectives:	**1.** To learn how to process the data **2.** To apply machine learning algorithms to the real lie data	
Lab Outcomes:	**1.** Understand the basics of machine learning **2.** Apply optimization and regularization techniques to train machine. **3.** Construct and train machines using various algorithms. **4.** Implement and apply machine learning algorithms. **5.** Write accurate documentation for experiments performed. **6.** Write the report on experiments performed.	

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
0	Lab Prerequisites	-	02
1	Linear regression using python	1,2,3,4,5,6	02
2	Logistic regression using python	1,2,3,4,5,6	02
3	KNN using python	1,2,3,4,5,6	02
4	SVM using python	1,2,3,4,5,6	02
5	Random forest using python	1,2,3,4,5,6	02
6	Random forest using python	1,2,3,4,5,6	02
7	K-mean using python	1,2,3,4,5,6	02
8	PCA using python	1,2,3,4,5,6	02
9	Mini Project	1,2,3,4,5,6	10
		Total	**28**
Virtual Lab Links:			
https://vlab.spit.ac.in/ai/#/experiments			

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.

3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)
Oral/Practical/P&O : **Oral** examination will be based on the experiment list and content of the entire theory syllabus and carries 25-Marks

Lab Code	Lab Name	Credits (P+TUT)
EXL603	**Image Processing and Machine Vision Laboratory**	**1+0**
Lab Prerequisite:	Knowledge of Programming languages, Python / any other suitable tool available	
Lab Objectives:	1. To implement the basic of Image Processing and Machine Vision on Image Enhancement, Image transforms, Morphology and Segmentation. 2. To hands on Practice to students to object recognition/ classification techniques in Machine Vision. 3. To facilitate students for understanding practical aspects of Image Processing and Machine Vision through an application.	
Lab Outcomes:	1. Perform enhancement of digital images in spatial and frequency domain 2. Perform edge detection and morphological operations on digital images 3. Classify patterns using standard Machine vision classification techniques like SVM 4. Apply theoretical knowledge in image processing and machine vision to practical case studies 5. Adhere to the Ethical Practices in the lab while building codes. 6. Work in teams to solve any problem based on Activity, Skill or Technology based Methods.	

Lab No.	Experiment Title	LO Mapped	Hrs./ Lab
0	Lab Prerequisites	-	02
1	Point Processing Methods – Negative, Log, Power law, Contrast stretching, Bit plane slicing	1,5,6	02
2	Form Histogram of an image and its histogram equalization	1,5,6	02
3	Spatial Domain Filtering: 1. Smoothening filters 2. Sharpening with Laplacian 3. Unsharp masking & high boost filtering Edge detection using 1st and 2nd order derivatives	1,5,6	02
4	Frequency Domain Filtering : Ideal, Butterworth and Gaussian filters	1,5,6	02
5	Morphological operation – Erosion, dilation, opening, closing, hit-miss transform, Boundary extraction	2,5,6	02
6	Image segmentation using global Thresholding Algorithm	2,5,6	02

Lab No.	Experiment Title	LO Mapped	Hrs./ Lab
7	Shape representation using chain code	3,5,6	02
8	Canny edge detection	3,5,6	02
9	Feature extraction using co-occurrence matrix	4,5,6	02
10	Classification using k-means algorithm	4,5,6	02
11	Classification using Bayesian classifier	4,5,6	02
12	Basic binary classification of any data or pattern using Support Vector Machine	4,5,6	02
13	Case Studies	1 to 6	02
		Total	**28**

Virtual Lab Links:
https://ssp-iiith.vlabs.ac.in/

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Oral/Practical/P&O :

Practical examination will be based on the experiment list and content of the entire theory syllabus and carries 25-Marks

Lab Code	Department Level Elective Course Laboratory – II	Credits (P+TUT)
EXDLL6051	**Speech and Audio Processing Laboratory**	**1+0**
Lab Prerequisite:	1. Knowledge of open source simulator	
Lab Objectives:	1. To learn properties of Speech signal 2. To learn time domain and frequency domain analysis of speech 3. To learn speech coding, recognition and enhancement techniques 4. To learn application of Speech and Audio signal	
Lab Outcomes:	1. Distinguish properties of Speech signal 2. Demonstrate time domain and frequency domain approach 3. Demonstrate speech coding, recognition and enhancement techniques 4. Applications of Speech and Audio signal 5. Write accurate documentation for experiments performed 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory	

Lab No.	Experiment Title	LO Mapped	Hrs/ Lab

0	Lab Prerequisites	-	02
1	To simulate / demonstrate properties of speech signal	1,5,6	02
2	To simulate / demonstrate limitations of Fourier transform in speech signal	1,5,6	02
3	To simulate / demonstrate zero crossing rate and pitch period estimation	2,5,6	02
4	To simulate / demonstrate speech enhancement techniques	3,5,6	02
5	To simulate / demonstrate short term auto correlation method	2,5,6	02
6	To simulate / demonstrate voice/unvoice/salience classification of speech using short term time domain parameter	2,5,6	02
7	To simulate / demonstrate LPC of speech signal	3,5,6	02
8	To simulate / demonstrate Automatic speech recognition, Dynamic time warping and Hidden Markov model	3,5,6	02
9	To simulate / demonstrate Audio processing for music	4,5,6	02
10	Case Study/ Mini Project	1to 6	08
		Total	**28**

Virtual Lab Links:

1. https://ssp-iiith.vlabs.ac.in/
2. https://vlab.amrita.edu/index.php?sub=59&brch=164

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Lab Code	**Department Level Elective Course Laboratory - II**	**Credits (P+TUT)**
EXDLL6052	**IoT and Industry 4.0 Laboratory**	**1+0**
Lab Prerequisite:	1. Project Based Learning - Mini Project Lab-II 2. Skill Based Learning - IV 3. Project Based Learning - Minor Project Lab-I	
Lab Objectives:	1. To understand Internet of Things and its hardware and software components 2. To interface I/O devices, sensors & communication modules 3. To remotely monitor data and control devices 4. To understand the concepts of Industry 4.0 and basics of Industrial IoT.	
Lab Outcomes:	1. Demonstrate the concept of IoT, Arduino/Raspberry Pi, and also able to install software setup of Arduino/ Raspberry Pi 2. Retrieve data from sensors and display the data, status of devices and sensors from web cloud 3. Identify the use of Communication and Networking in Industrial IoT Application	

	4. Implementation of analytics in Industrial IoT. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
0	Lab Prerequisites	-	02
1	Familiarization with the concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.	1, 5, 6	02
2	LED and IR sensor interfacing with Nodemcu.	1, 5, 6	02
3	Ultrasonic sensor interfacing with Nodemcu for distance measurement.	2, 5, 6	02
4	Temperature/Humidity monitoring using Blynk App.	2, 5, 6	02
5	DHT sensor interfacing with Nodemcu and communication of data using MQTT protocol	2, 5, 6	02
6	To study the MQTT and ThingSpeak and upload the DHT sensor data on ThingSpeak	2, 5, 6	02
7	Identify the use of Communication and Networking in Industrial IoT Application	3, 5, 6	02
8	Study of IoT based industrial process monitoring and control system	3, 5, 6	02
9	Implementation of analytics in Industrial IoT Application	4, 5, 6	02
10	Design prototype of IoT based smart system	4, 5, 6	02
11	Case Study / Mini Project	1 to 6	06
		Total	**28**

Note: Suggested 8 lab exercises based on six modules of IoT and Industry 4.0 Syllabus

Virtual Lab Links:

https://www.vlab.co.in/

Useful Links:

1. Node Red - https://nodered.org/
2. M2MLabs Mainspring - http://www.m2mlabs.com/
3. Tensor Flow - https://www.tensorflow.org/
4. Things Speak - https://thingspeak.com

Term work:

1. Term work should consist of a minimum of 8 experiments
2. Journal must include assignments on content of theory and practical of the course
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Lab Code	Department Level Elective Course Laboratory – II	Credits (P+TUT)
EXDLL6053	**Mixed Signal VLSI Laboratory**	**1+0**
Lab Prerequisite:	1. Microelectronics Devices & Circuits 2. Electronics Devices & Circuits	
Lab Objectives:	1. To understand analysis and design of building blocks of CMOS Analog VLSI Circuits. 2. To highlight the issues associated with the CMOS analog VLSI circuit design. 3. To emphasize upon the issues related to mixed signal layout design.	
Lab Outcomes:	1. Simulate electrical characteristics of biasing techniques 2. Design and simulate analog circuits 3. Analyze the performance of the analog circuits 4. Design and simulate ADC and DAC circuits 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.	

Lab No.	Experiment Title	LO Mapped	Hrs/ Lab
0	Lab Prerequisites	-	02
1	Analysis of MOSFETs for analog performance	1,3,5,6	02
2	Transconductance plots (voltage bias, current bias and technology bias).	1,3,5,6	02
3	Design of regulated current sink.	2,5,6	02
4	Design and simulate various types of oscillators	2,5,6	02
5	Design and simulate ideal Opamp	2,5,6	02
6	10 bit ADC	4,5,6	02
7	Design of basic current sink.	4,5,6	02
8	Design of cascode current sink	4,5,6	02
9	Simulate noise in CMOS amplifier	3,5,6	02
10	Design and simulate differential amplifier	2,5,6	02
11	Design and simulate operational transconductance amplifier	2,5,6	02
12	Case Study / Mini Project	1 to 6	04
		Total	**28**

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.
   The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Lab Code	Department Level Elective Course Laboratory – II	Credits (P+TUT)
EXDLL6054	**Database Management System Laboratory**	**1+0**
Lab Prerequisite:	Any programming skills	
Lab Objectives:	1. To study and design modelling in database 2. To learn and apply SQL commands in queries. 3. To create database and apply transaction management command. 4. To use databases and solve real world problems.	
Lab Outcomes:	1. Demonstrate how to retrieve data from more than one table or views using the key 2. Apply the select information from the tables and manipulate it. 3. Apply create, alter and drop on tables and apply insert, update and delete statements. 4. Build a Database using all the concepts of DBMS 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.	

Lab No.	Experiment Title	LO Mapped	Hrs/ Lab
0	Lab Prerequisites	-	02
1	Identify the case study & detail statement of problem. Design an ER/ ERR model	4,5,6	02
2	Mapping ER/ERR to relational Schema Model	4,5,6	02
3	Create and populate database using DDL and DML commands for your specified system	3,5,6	02
4	To study and apply Integrity Constraint for the specified system	1,5,6	02
5	To study various select commands in SQL	2,5,6	02
6	To study Nested and Complex queries	2,5,6	02
7	To study and Perform Join operation	2,5,6	02
8	To study Views and Triggers in SQL	1,5,6	02
9	To study functions, cursor and Procedure	4,5,6	02
10	To study Transaction and concurrency	4,5,6	02
11	Write SQL queries for Sorting of the data in database.	4,5,6	02
12	Case Study/ Mini Project	1 to 6	04
		Total	**28**

Virtual Lab Links:

1. https://www.tutorialspoint.com/dbms/index.htm
2. https://www.studytonight.com/dbms/
3. https://beginnersbook.com/2015/04/dbms-tutorial/
4. https://www.w3schools.in/dbms/

Term work:

Term work should consist of a minimum of 8 experiments.
Journal must include assignments on content of theory and practical of the course.
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation:)-marks)

Course Code	Project Based Learning	Credits (TH+P+TUT)
EXPR64	**Minor Project Lab – II**	**0+1+0**
Prerequisite:	1. Digital Logic Design 2. Digital VLSI Design	
Minor Project Objectives:	1. To train students for FPGA based project implementation and management 2. To make students VLSI industry ready 3. To make students familiar with the Verilog Programming . To make students familiar with the targeted FPGA design and implementation 5. To familiarize the students with the Interfacing of FPGA boards	
Minor Project Outcomes:	1. Explain various FPGA families and method of FPGA synthesis and implementation 2. Program, simulate and synthesize circuits in Verilog HDL using modern tools. 3. Choose FPGA platform for an application 4. Design various digital systems using FPGA. 5. Analysis of FPAG fault detection and verification principles 6. Document the project development report	

Module No.	Topics	CO Mapped	Hrs/ Sub Topics	Total Hrs.
0	Lab Prerequisites	-	02	0
1. Introduction to FPGA and Synthesis	Compare FPGA, ASIC, SOC, Basic FPGA architecture, Compare various FPGA Boards, Understanding VLSI Design flow	1, 3	01	03
	Understanding Tools : Functional simulation , Synthesis and implementation, Synthesis tool flow, Implementation and bit generation, making User constraint files (UCF)	1	02	
	dy Material https://www.xilinx.com/support/university/ise/ise-workshops/ise-fpgadesign-flow.html			
2. Writing First program in	Introduction to Verilog: Module definition, port declaration, connecting ports, Writing	2	02	03

Module No.	Topics	CO Mapped	Hrs/ Sub Topics	Total Hrs.
Verilog	first Test bench			
	Exercise : Program for All gates, Writing Test bench and UCF	2	01	
	Study Material https://www.xilinx.com/support/university/ise/ise-teaching-material/hdldesign.html			
3. Combinational design using VERILOG	Gate Level Modelling, hierarchical name referencing, Data Flow Modelling: Continuous assignments, delay specification, expressions, operators, operands, operator types	2	03	06
	Exercise: Programming and FPGA implementation of Adders, 4-bit adders, Mux and decoders, Interfacing LED, switches with FPGA	2	03	
	dy Material: https://onlinecourses.nptel.ac.in/noc20_cs63/preview			
4. Sequential design using VERILOG	l Behavioural Modelling : Structured procedures, initial and always, blocking 'and nonblocking statements, delay control, event control, conditional statements, multi way branching, loops, sequential and parallel blocks Advanced topics: Tasks and Functions, generic programming with parameters.	2	03	06
	Exercise: Programming and FPGA implementation of Counters FFs and Shift registers Interfacing Seven Segment Display, UART with FPGA	2	03	
5. Project Outline	Clocked Synchronous State-Machine Analysis, State-Machine Structure, Output Logic, Characteristic Equations Analysis of State Machines with D Flip-Flops, Clocked Synchronous State-Machine Design, Designing State Machines Using State Diagrams, State Tables	4, 5	03	06
	Project Design Steps: Designing state diagram, block diagram of project, Selection of FPGA for project, Selection of synthesis and simulation tool.	4, 5	03	

Module No.	Topics	CO Mapped	Hrs/ Sub Topics	Total Hrs.
6. Project Implementation and management	Git Repositories, Learning of Project management software's like CVS, SVN etc.	6	02	02
	Project Implementation: Verilog coding, simulation, Synthesis, Bit generation and downloading on FPGA.	6		
	Result verification and testing	6		
			Total	**28**

Reference Books:

1. Samir Palnitkar, "Verilog HDL A guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2009
2. Simon D Monk, "Programming FPGAs : Getting started with Verilog", 1st Edition, McGraw Hill Eduction 2016
3. M. Morris Mano,Michael D. Ciletti, "Digital Design: With a Introduction to the Verilog Hdl", Pearson Prentice Hall, 2013
4. David Romano, "Make: FPGAs: Turning Software into Hardware with Eight Fun and Easy DIY", Shroff/Maker Media; First edition,2016
5. Frank Vahid, "Digital Design", Wiley India Private Limited; Preview edition, 2009
6. Behrooz Parhami ,"COMPUTER ARITHMETIC Algorithms and Hardware Designs", Oxford University Press, 2010
7. Clive Maxfield ,"Design Warrior's Guide to FPGA", 2004, Elsevier

Reference links:

1. https://www.sanfoundry.com/vlsi-questions-answers-aptitude-test/
2. Free Tool : https://www.edaplayground.com/
3. https://github.com/

****Suggested FPGA Hardware Boards:**

1. Numato FPGA boards -https://numato.com/shop/
2. Papilio FPGA boards -http://store.gadgetfactory.net/fpga/
3. CMOD s6 -https://store.digilentinc.com/cmod-s6-breadboardable-spartan-6-fpga-module/
4. TinyFPGA -https://tinyfpga.com/
5. Zync,Zed Board -https://www.xilinx.com/products/silicon-devices/soc/zynq-7000.html
6. Artix -7, Kinetex Boards -https://store.digilentinc.com/arty-a7-artix-7-fpga-development-board/

Suggested Software tools:

1. Xilinx ISE Webpack
2. Modelsim/Questasim
3. Leonardo spectrum

4. MATLAB
5. Quartus
6. Actel
7. Icarus Verilog Simulator

Suggested Projects (FPGA downloading is must)

1. Shift-Add Multiplication,
2. Hardware Multipliers
3. Programmed Multiplication
4. Shift-Subtract Division
5. CORDIC Algorithm
6. Design of functions such as reciprocal, square root, sine, cosine, exponential
7. Wallace Multiplier
8. 8- Bit ALU
9. Matrix Multiplication
10. Booths Multiplier
11. NRZ,NRZI etc. coding techniques

Suggested Courses

1. NPTEL Verilog Programming - Free
2. Workshops -Xilinx University Program- Freely available

Suggested Competitions for Funding

1. Government Swadeshi Microprocessor Challenge
2. IICDC – TI challenge
3. Sankalp Semiconductors Hackathons

General Guidelines of minor project are as follows :

1. To achieve proper selection of Minor Projects. Students should do survey of FPGA boards, tools and identify needs, which shall be converted into problem statement for minor project in consultation with faculty supervisor/head of department/ internal committee of faculties.
2. Students shall submit implementation plan in the form of Smart Report/Gantt/PERT/CPM chart, which will cover weekly activity of minor project.
3. A log book to be prepared by each group, wherein group can record weekly work progress, guide/ supervisor can verify and record notes/comments.
4. Faculty supervisor may give inputs to students during minor project activity; however, focus shall be on self-learning.
5. The solution to be verified with standard tools and procedures and report to be compiled in standard format of University of Mumbai.

Suggested steps for minor project selection and implementation

1. Minor project should be completely FPGA based
2. Follow these steps:

i. Take specification, using these specifications design project.
i. Select proper FPGA considering features and requirements of project. Create UCF file
i. Program it using Verilog and write test benches for verification of each module
v. Test Functional Simulation and verify it using simulation tool
v. Synthesize, map and place and rout the design using synthesis tool
i. Generate bit stream and download on FPGA
i. Verify results on FPGA hardware/hardware setup made for project

Project Topic selection and approval :-

1. The group may be of maximum **Three (03) students**.
2. Topic selection and approval by **2 Expert** faculty from department at the start of semester
3. **Log Book** to be prepared for each group to record the work progress in terms of milestones per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signature in it per week. The log book can be managed **online** with proper authentication method using google sheets/forms or open source project management software.

Project Report Format:

1. Report should not exceed **15 pages**. Simply staple it to discourage use of plastic.
2. The recommended report format is in LaTeX.

Term Work (25 Marks):

Term Work evaluation and marking scheme:

a. The review/ progress monitoring committee shall be constituted by Head of Departments of each institute.

b. The progress of minor project to be evaluated on continuous basis, minimum two reviews in each semester.

c. At end of semester the above 2 expert faculty who have approved the topic will internally evaluate the performance.

d. Students have to give presentation and demonstration on the FPGA Based Mini Project-2B

e. In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. Based upon it the marks will be awarded to student.

Distribution of 25 Marks scheme is as follows:

i. Marks awarded by guide/supervisor based on log book : 10
i. Marks awarded by review committee : 10
i. Quality of Project report : 05

Practical (25 Marks):

Guidelines for Assessment of Minor Project Oral Examination:

a. Report should be prepared as per the guidelines issued by the University of Mumbai.

b. Minor Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and **External Examiners preferably from industry or research organisations** having experience of more than five years approved by head of Institution.

Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Skill Based Learning Code	**Skill Based Learning - IX**	**Credits (TH+P+TUT)**
EXXS69	**Linux , Networking & Server Configuration**	**0+1+0**

Prerequisite:	C-Programming
Skill Objectives:	1. To install Linux and implement standard Linux commands 2. To study basic theory of Linux Operating System 3. To implement the system administrative functionality 4. To write shell script programs to solve problems 5. To study basic commands of networking **6.** To develop implementation skill of different servers on Linux
Skill Outcomes:	1. Install Linux using different platforms and execute Linux commands 2. Apply the system administrative functionality and solve the problems using shell script programming. 3. Develop network based applications. 4. Apply the Linux commands using programming skills to different servers like FTP, Telnet 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No.	**Experiment Title**	**SO Mapped**	**Hrs/Lab**
	Linux Installation process using following method CD-ROM, Network Installation or Kickstart Installation.	1, 5, 6	02
	Basic commands to create users, change permission, software	1, 5, 6	02

Lab No.	Experiment Title	SO Mapped	Hrs/Lab
	selection and installation and do changes in Grub file.		
	Practical on configuration of Linux disk Management such as SWAP, LVM, RAID, Primary Partition, Extended Partition and Linux files system.	1, 5, 6	02
	Write a shell script to show various system configuration like currently logged user and his log name, your current shell, home directory, operating system type, current path setting, current working directory, show currently logged number of users, show memory information, Hard disk information like size of hard-disk, cache memory, model etc. and file system mounted.	2, 5, 6	02
	Write a shell script to add user and password on Linux system.	2, 5, 6	02
	Write a shell script to print last login details.	2, 5, 6	02
	Write a shell script to upgrade and cleans the system automatically instead of doing it manually	2, 5, 6	02
	Write a shell script to delete all log files present inside your var/log directory.	2, 5, 6	02
	Write a script that accepts the hostname and IP address as command-line arguments and adds them to the /etc/hosts file.	2, 5, 6	02
	Write a awk script to find the number of characters, words and lines in a file?	2, 5, 6	02
	Write a shell script that delete all lines containing a specified word	2, 5, 6	02
	write a shell script to find the factorial of given integer	2, 5, 6	02
	Configuration of DHCP Server and Client	3, 5, 6	02
	Configuration of DNS Server with Domain Name.	3, 5, 6	02
	Configuration of NFS File server and transfer files to a windows client.	3, 5, 6	02
	Setting up a Samba Server and creating a print server.	4, 5, 6	02
	Configuration of Internet Server by creating a Proxy Server and configure browser to use as a proxy	4, 5, 6	02
	Configuration of Mail Server	4, 5, 6	02
	Configuration of Web Server.	4, 5, 6	02
	Configuration of FTP server and transfer files to demonstrate the working of the same	4, 5, 6	02
		Total	**40**

Online Repository:

1. How to Install a DHCP Server in Ubuntu and Debian (tecmint.com)

How to Install and Configure Postfix as a Send-Only SMTP Server on Ubuntu 16.04 | Digital Ocean

3. Network - DHCP | Ubuntu

Books:	
Text Books	1. Yeswant Kanetkar – "UNIX Shell Programming", First edition, BPB 2. Cristopher Negus – "Red Hat Linux Bible", Wiley Dreamtech India 2005

	edition 3. Jason Cannon ,"Linux for Beginners: An Introduction to the Linux Operating System and Command line" 4. W. Stevens, Stephen Rago, "Advanced Programming in the UNIX Environment", Addison- Wesley Professional Computing Series
Reference Books	1. Official Red Hat Linux Users guide by Redhat, Wiley Dreamtech India 2. Graham Glass & King Ables – UNIX for programmers and users, Third Edition, Pearson Education. 3. Neil Mathew & Richard Stones – Beginning Linux Programming, Fourth edition, Wiley Dreamtech India. 4. Richard Petersen, Linux: The Complete Reference, Sixth Edition

Term Work (25 Marks):

Term Work shall be awarded on basis of

1. Student's active participation in skill based learning.
2. Presenting / showcasing learned skills through Social / outreach / extension activities / Events / Competitions / Trainings / Internships etc.
3. Submission of Report / act / demonstrations / specific participation / Idea creation / scope / creativity / Case study etc.
4. Assessment Rubrics.

Students have to perform any 8 experiments.

Technology Based Learning Code	SAT Courses	Credits
EXXT610	**Technology Based Learning - X**	**01**

Prerequisite:	Knowledge of SE subjects
TBL Objectives:	1. Identify, describe, and apply emerging technologies in teaching and learning environments 2. Plan, design, and assess effective learning environments and experiences 3. Compare and contrast social, ethical, and legal issues surrounding technology 4. Facilitate instruction in the new literacies that emerge within digital / interactive learning environment
TBL Outcomes:	1. Identify, describe, and apply emerging technologies in teaching and learning environments 2. Demonstrate knowledge, attitudes, and skills of digital age work and learning 3. Plan, design, and assess effective learning environments and experiences 4. Implement curriculum methods and strategies that use technology to maximize student learning

	5. Develop technology-enabled assessment and evaluation strategies **6.** Compare and contrast social, ethical, and legal issues surrounding technology

Guidelines for Technology Based Learning:

Selection of course with 4 weeks/8 weeks Duration (Subject related to Emerging Technology and approval from department)
Faculty supervisor is allotted at department level.
The faculty supervisor will monitor the activities and documentation of the students assigned to them.

1. Whether students are going through the four lectures, weekly
   (One lecture will be of duration 25 to 30 minutes.)
2. Weekly submission of Assignments.
3. Registration for the Exam.
4. Appearing for the Exam on schedule date and time.
5. Submission of Certificate

Term Work (25 Marks):

1. Marks will be awarded based on Assessment Rubrics designed
2. Use of Technology for Minor Project development
3. Technical Competition Participation
4. Course Completion Certificate
5. Certification Grades/performance