

**Shree Rahul Education Society's
(Regd.)**

**Shree L.R. Tiwari College of
Engineering**

Shree L.R. Tiwari Educational

Campus, Mira Road–East, Thane-401

107.Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai



Department of Electronics and Computer Science

A.Y 2025-26

Final Year: Semester VII

Prepared by: Board of Studies for Electronics and Computer Science

**Approved By: Academic Council of Shree L.R. Tiwari College of
Engineering**

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class center for socio-economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-concentric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socioeconomic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2. Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impact solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. Empowering Faculty as Mentors and Innovators SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.

Sincerely,

**IQAC Chairperson
SLRTCE**

**COO
Rahul Education**

PREFACE FROM CHAIRPERSON (BOS)

Dear Colleagues and Esteemed Members of the Board,

It is my pleasure to present the newly revised Electronics and Computer Science curriculum—crafted under our recently granted Autonomous status and in compliance with NEP 2020 Building upon the strong foundational framework of SLRTCE’s legacy—where industry-oriented, tools-based learning complements core computing principles—this syllabus ushers in a truly student-centric, flexible, and future-ready program.

The Electronics and Computer Science (ECS) program at our autonomous institute under Mumbai University is a forward-looking, interdisciplinary course that combines the robust foundations of electronics with the transformative capabilities of computer science. The program equips students with the knowledge and skills needed to design, develop, and optimize intelligent systems, enabling innovation at the intersection of hardware and software.

As an autonomous institution, we utilize academic independence to continuously update and enrich the curriculum to reflect emerging technologies and industry demands, including areas such as Internet of Things (IoT), artificial intelligence, embedded systems, robotics, and cyber-physical systems.

A key feature of the program is the integration of the Idea Lab, a dynamic innovation ecosystem where students engage in hands-on, project-based learning. This lab nurtures creativity, design thinking, and entrepreneurial mindsets, enabling students to take ideas from concept to prototype, often in collaboration with industry, faculty, and the community.

The ECSE program strongly emphasizes societal impact. Students are encouraged to develop technology-driven solutions to address real-world challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs). Whether it is promoting quality education (SDG 4) through ed-tech innovations, enhancing good health and well-being (SDG 3) with biomedical devices, contributing to sustainable cities and communities (SDG 11) through smart systems, or driving climate action (SDG 13) using intelligent environmental monitoring, the curriculum instills a deep sense of purpose and responsibility.

Through a balance of theoretical grounding, practical application, ethical awareness, and social commitment, the ECSE program prepares graduates to become technological leaders, responsible citizens, and agents of sustainable development in a rapidly evolving global landscape.

Mrs. Samita Bhandari
Chairperson, Board of Studies (ECS), SLRTCE

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A. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

B. Academic Brief

1. Internal Assessment (Formative Assessment):

These assessments aim to evaluate students' continuous academic progress. Internal Assessment (IA) will consist of two compulsory Internal Assessment Tests of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour. Summation of the two tests will be considered as IA marks. The first IA will be scheduled around the 6th week, and the second IA around the 13th week from the commencement of the semester.

2. End Semester Examination (60-Marks):

- i. Question paper will comprise of total 06 questions, each carrying 10 marks
- ii. The questions for 10M will be based on each module of the syllabus.
- iii. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
- iv. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B. Remaining questions will be in similar nature and selected from the respective module.
- v. Total 06 questions need to be attempted.

3. Monthly Defaulter List:

A defaulter list identifying students with attendance or academic performance concerns will be prepared and circulated every month.

4. Defaulter Meeting with Attendance Committee:

Students listed as defaulters will meet with the Attendance Committee on the first Saturday of every month.

C: Curriculum Structure – BE Semester-VII

Table 1: Course-wise Teaching Scheme and Credit Structure

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECC701	VLSI Design	3	-	-	3	-	-	3
PCC	ECC702	Internet of Things	3	-	-	3	-	-	3
PCC	ECC73X	Professional Elective Course – 3	3	-	-	3	-	-	3
PCC	ECC74X	Professional Elective Course – 4	3	-	-	3	-	-	3
OE	OEC75WW	Open Elective - 1	3	-	-	3	-	-	3
PCCL	ECL706	VLSI Design Lab	-	2			1		1
PCCL	ECL707	Internet of Things Lab	-	2	-	-	1	-	1
PCCL	ECL78X	Professional Elective Course -3 Lab	-	2	-	-	1	-	1
MJP	ECL709	Major Project - I	-	4 #	-	-	2	-	2
		Total	15	10	-	15	5	-	20

D: Examination Scheme – BE Semester-VII

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		IAT 1	IAT2	Total					
ECC701	VLSI Design	20	20	40	60	2.5	-	-	100
ECC702	Internet of Things	20	20	40	60	2.5	-	-	100
ECC73X	Professional Elective Course – 3	20	20	40	60	2.5	-	-	100
ECC74X	Professional Elective Course – 4	20	20	40	60	2.5	-	-	100
OEC75 WW	Open Elective - 1	20	20	40	60	2.5	-	-	100
ECL706	VLSI Design Lab	-	-	-	-	-	25	25	50
ECL707	Internet of Things Lab	-	-	-	-	-	25	25	50
ECL78X	Professional Elective Course – 3 Lab	-	-	-	-	-	25	25	50
ECL709	Major Project - I	-	-	-	-	-	25	25	50
Total				200	300	-	100	100	700
		Professional Elective Course – 3 (ECC73X)							
ECC731		1. Deep Learning							
ECC732		2. Image Processing							
ECC733		3. Big Data Analytics							
ECC734		4. Advanced Database Management Systems							

Professional Elective Course –4

	Professional Elective Course - 4 (ECC74X)
ECC741	1. Cloud Computing
ECC742	2. Mobile Communication
ECC743	3. Cyber Security
ECC744	4. Block chain Technology

Open Elective Course (OE)

Every student is required to take one Open Elective Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in both the semesters.

OEC75WW	Open Elective - 1 (Common for all branches will be notified)
OEC7501	Product Lifecycle Management
OEC7502	Reliability Engineering
OEC7503	Management Information System
OEC7504	Design of Experiments
OEC7505	Operation Research
OEC7506	Cyber Security and Laws
OEC7507	Disaster Management and Mitigation Measures
OEC7508	Energy Audit and Management
OEC7509	Development Engineering



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R-2025- B.E (Sem-VII) Electronics and Computer Science

SEM VII

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC701	VLSI Design	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC701	VLSI Theory	20	20	40	60	2.5	25	25	50

Rationale : The VLSI (Very-Large-Scale Integration) Design course is essential in BE Electronics & Computer Science as it equips students with the knowledge to design and implement integrated circuits used in modern electronic systems. With the rapid advancement of semiconductor technology, understanding VLSI is critical for developing efficient, high-performance, and low-power chips. The course bridges the gap between theoretical electronics and real-world chip design, preparing students for careers in chip design, embedded systems, and semiconductor industries.

Course Objectives:

1. To understand VLSI Design flow and technology trends.

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2. To understand MOSFET based Inverter fundamentals
3. To realize MOS based circuits using different design styles.
4. Understand MOS based combinational/sequential circuits using different design styles.
5. To study semiconductor memories using MOS logic.
6. To study adder, multiplier and shifter circuits for realizing data path design.

Course Outcomes:

After successful completion of the course students will be able to:

1. Demonstrate a clear understanding of VLSI Design flow, technology trends, scaling and MOSFET models.
2. Design and analyse MOS based inverters.
3. Realise MOS based circuits using different design styles.
4. Realise MOS based combinational circuits using different design styles.
5. Realise semiconductor memories using CMOS logic.
6. Realise adder, multiplier and shifter circuits using CMOS logic.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	VLSI Design flow and Technology Trends	VLSI Design Flow: Full custom and Semi Custom IC design flow Semiconductor Manufacturing: Semiconductor technology trend, clean rooms, Wafer cleaning and Gettering. Fabrication flowchart for steps in IC fabrication Scaling: Types of scaling, comparison of MOSFET Model levels Technology Comparison: Comparison of BJT and MOS technologies, long channel and short channel MOS devices	05	CO1

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II	MOSFET Inverters	Introduction to MOS inverters: Active and passive load nMOS inverters, CMOS inverter and their comparison Circuit Analysis of MOS Inverters Static Analysis of Resistive nMOS and CMOS Inverters: Calculation of critical voltages and noise margins Design of symmetric CMOS inverter Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay Various components of power dissipation in CMOS circuits	08	CO2
III	MOS design Styles	Static CMOS, Pseudo NMOS design styles, Pass transistor, Transmission gate, Dynamic, C ² MOS, Significance of Stick diagram and Design rules, Layout of CMOS NAND, CMOS NOR Self learning topics: Design of various gates using software tools.	07	CO3
IV	Combinational and Sequential Circuit Realization	Analysis and design of 2-I/P NAND, 2-I/P NOR and complex Boolean function realization using equivalent CMOS inverter for simultaneous switching, Complex Boolean function realization using various design styles and Basic gates and MUX realization using pass transistor and transmission gate logic SR Latch, JK FF, D FF, 1 Bit Shift Register realization using CMOS logic	07	CO4
V	Semiconductor Memories	SRAM: 6T SRAM operation, design strategy, read/write circuits, sense amplifier, DRAM: 1T1R, operation modes, leakage currents, refresh operation, physical design ROM Array: NAND and NOR based ROM array Flash memory: F-N tunnelling	06	CO5
VI	Data Path Design	Adder: CLA adder, MODL, Manchester carry chain, High-speed adders: carry skip, carry select and carry save Multipliers and shifter: Array multiplier and barrel shifter	06	CO6

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Total		39	
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Text Books:

1. CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw Hill, Revised 4th Edition.
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley India Pvt. Ltd.
3. Sorab K. Gandhi, "VLSI Fabrication Principles", Wiley, Student Edition.

Reference Books:

1. Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Pearson Education, 2nd Edition
2. Basic VLSI Design, Douglas A Pucknell, Kamran Eshraghian, Prentice Hall of India Private Ltd.
3. Logical Effort: Designing Fast CMOS Circuits, Ivan Sutherland and Bob Sproull
4. Basics of CMOS Cell Design, Etienne Sicard and Sonia Delmas Bendhia, Tata McGraw Hill
5. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste, David Harris and Ayan Banerjee, Pearson Education
6. Analysis and Design of Digital Integrated Circuits, David Hodges, Horace Jackson, Resve Saleh, McGraw-Hill, Inc.
7. Advanced Semiconductor Memories: Architectures, Designs, and Applications, Ashok K. Sharma, Wiley Publication

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117106092
2.	https://www.nielit.gov.in/calicut/calicut/content/vlsi-beginners

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC702	Internet of Things	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC702	Internet of Things	20	20	40	60	2.5	--	--	100

Rationale:

The subject "Internet of Things (IoT)" introduces students to smart, connected devices and real-time data exchange. It builds practical skills in sensors, communication, and automation, preparing them for careers in modern tech-driven industries.

Course Objectives:

1. To understand the basic building blocks of IoT
2. To understand various IoT protocols.
3. To introduce data handling in IoT
4. To understand web protocols
5. To design IOT Methodology
6. To understand the Design Methodology in IoT through case studies

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Course Outcomes:

1. Understand concepts, functional blocks and communication methodology relevant to IoT.
2. Identify various components of IoT.
3. Compare various communication protocols for IoT.
4. Understand various methods for data handling in IoT-based systems
5. Design basic applications based on IoT using specific components.
6. Introduce various security issues in IoT.

Prerequisite:

- 1) Computer Networks
- 2) Embedded Systems
- 3) Web Technologies

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to IoT	Definition and Characteristics of IoT, IoT Protocols IoT Functional Blocks IoT Communication Models IoT Communication APIs :- REST and WebSockets IoT Enabling Technologies Introduction to M2M and Difference between IoT and M2M	5	CO1

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II	Components (Things) in IoT	Sensor Technology, Examples of Sensors Actuators Applications of RFID and WSN in IoT Exemplary Device: - R-Pi and its Interfaces, PCDuino, BeagleBone	5	CO2
III	Data Handling in IoT	Data Acquiring and Storage, Organizing the Data, Transactions and Business Processes, Analytics Data Collection, Storage and Computing Using Cloud Platform, Introduction to Cloud Computing, Virtualization, Cloud Models Cloud Services IoT Cloud-based Data Collection, Storage, Computing using Xively	9	CO3
IV	Design Principles for Web Connectivity	Communication Technologies – A comparison Web Communication Protocols for connected devices:- CoRE Environment, CoAP, LWM2M, MQTT, XMPP, HTTP, SOAP Protocols LPWAN Fundamentals: LORA and NB-IoT	10	CO4
V	IoT Design Methodology	Defining Specifications About: - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration: - Case Studies of Home automation, Weather Monitoring IoT Levels and Deployment Templates Supply Chain Management	6	CO5
VI	IoT Security and Vulnerabilities Solutions	IoT Security Tomography and Layered Attacker Model Identity Management, Establishment, Access Control and Secure Message Communication	4	CO6

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		Security Protocols		
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Text Books:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, University Press.
2. Raj Kamal, “ Internet of Things: Architecture and Design Principles”, McGraw Hill Education ,First edition
3. David Hanes ,Gonzalo salgueiro “IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, Kindle 2017 Edition
4. Andrew Minter ,”Analytics for the Internet of Things(IoT)”, Kindle Edition

References:

1. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things”, Paperback, First Edition
2. Yashavant Kanetkar, Shrirang Korde: Paperback “21 Internet of Things (IOT) Experiments”, BPB Publications

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://nptel.ac.in/courses/106105166

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC731	Deep Learning	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC731	Deep Learning	20	20	40	60	2.5	--	--	100

Rationale

Deep Learning is a specialized branch of Artificial Intelligence and Machine Learning that focuses on training neural networks with multiple layers to learn complex patterns and representations from large amounts of data. The rationale for studying Deep Learning lies in its powerful ability to solve high-dimensional and unstructured problems such as image recognition, natural language processing, speech recognition, and autonomous systems. It forms the backbone of modern AI applications like virtual assistants, self-driving cars, recommendation systems, and medical diagnosis tools. By understanding Deep Learning, students gain essential knowledge and practical skills

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needed to build intelligent systems, innovate across industries, and contribute to cutting-edge research and technological development.

Course Objectives:

1. To develop mathematical concepts required for Deep Learning algorithms.
2. To gain an in-depth understanding of training Deep Neural Networks.
3. To acquire knowledge of advanced concepts of Convolution Neural Networks, Auto encoders and Recurrent Neural Networks.
4. To get familiarized with the recent trends in Deep Learning.

Course Outcomes:

1. Understand the basic knowledge of Neural Networks.
2. Explain the process of training, optimization and Regularization of Deep Neural Networks.
3. Design supervised models for DNN.
4. Design unsupervised model for DNN.
5. Select a suitable DNN model for a given application.

Prerequisite: Knowledge of Basic Electrical Engineering, Basic Electronics, Digital Electronics, Electronics Measurement and Instruments

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly	05	CO1

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		non-separable classes. Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning		
II	Training, Optimization and Regularization of Deep Neural Network	Training Feedforward DNN: Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function. Optimization: Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp. Regularization: Overview of Overfitting, Types of biases, Bias Variance Tradeoff Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output.	06	CO2
III	Convolutional Neural Networks (CNN): Supervised Learning	Convolution Operation, Motivation, Basic structure of a convolutional neural network: Padding, strides, pooling, fully connected layers, interleaving between layers. Training a convolutional network: Backpropagation through convolution, Backpropagation as convolution with inverted filter, Convolution/backpropagation as matrix multiplication.	08	CO3

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		Modern Deep Learning Architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.		
IV	Recurrent Neural Networks (RNN)	Sequence Learning Problem, Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT. Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit.	8	CO4
V	Autoencoders: Unsupervised Learning	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders. Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders.	08	CO5
VI	Recent Trends and Applications	Generative Adversarial Network (GAN): Architecture. Applications: Image Compression, Brain Tumour Detection, Fraud Detection, Expression identification.	06	CO6
Total			39	

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Li Deng and Dong Yu, "Deep Learning Methods and Applications", now publishers Inc (30 June 2014)
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. J M Zurada "Introduction to Artificial Neural Systems", Jaico Publishing House

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5. M. J. Kochenderfer, Tim A. Wheeler. “Algorithms for Optimization”, MIT Press.

References:

1. Jon Krohn, Grant Beyleveld, Aglae Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Pearson Education.
2. Buduma, N. and Locascio, N., “Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc."
3. François Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Douwe Osinga. “Deep Learning Cookbook”, O'REILLY, SPD Publishers, Delhi.
5. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/106/106/106106184/
2.	https://www.machinemetrics.com/blog/industrial-automation
3.	https://www.clarify.io/learn/industrial-automation



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC732	Image Processing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC732	Image Processing	20	20	40	60	2.5	--	--	100

Rationale: The Image Processing course is vital for understanding how to analyze, enhance, and interpret visual information using digital techniques. It lays the foundation for applications in medical imaging, surveillance, robotics, and machine vision. By learning image acquisition, filtering, and feature extraction, students gain practical skills relevant to modern electronics and AI-driven systems.

Course Objectives:

1. To learn the basic concepts of image processing.
2. To learn the fundamental concepts of image processing for image enhancement.
3. To learn concepts of image segmentation & morphology.
4. To learn image compression with practical applications.
5. To learn computer vision basics.
6. To provide basic concepts of computer vision and its applications.

Course Outcomes:

After successful completion of the course students will be able to:

1. Represent image in its numerical and graphical form.

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2. Perform different image enhancement approaches for improving image quality.
3. Elucidate the mathematical modelling of image segmentation and morphology.
4. Apply the concept of image compression.
5. Understand computer vision system elements.
6. Develop a computer vision system based on requirement

Prerequisite: Engineering Mathematics, Digital Signal Processing

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Fundamentals of Digital Image Processing	Introduction: Background, Representation of a Digital Image, Fundamental steps in Image Processing, Elements of a Digital Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Model, Two-dimensional Sampling and Quantization, Tonal and Spatial Resolutions, Introduction to ColorModel(RGB, CMYK, YIQ, HSI).	4	CO1
II	Enhancement in Spatial and Frequency domain	Enhancement in the spatial domain: Intensity Transformations, Histogram Processing, Arithmetic and logical operations. Spatial domain filters: Smoothing Filters, Sharpening Filters, High boost Filter. Image Transforms: 2D-DFT, FFT, DCT and Haar Transform. Frequency domain enhancement, Homomorphic filtering.	10	CO2
III	Image Segmentation and Morphology	Image Segmentation: Detection of discontinuities Edge linking and Boundary detection Thresholding, Region based segmentation. Image Morphology: Dilation, Erosion, Opening Closing, Hit-Or-Miss Transformation, Boundary	06	CO3



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		Detection, Thinning, Thickening.		
IV	Image Compression	Need of compression, Redundancy, Objective and subjective fidelity criteria. Lossless compression: Run Length Coding, VLC (Huffman coding), Arithmetic coding, LZW Coding, Vector Quantization. Lossy compression: Bit plane coding, Predictive Coding, Transform Coding, JPEG Compression standard.	6	CO4
V	Computer Vision Basics	Introduction, definition, Computer vision components, Boundary Pre-processing: Chain code, Boundary approximation, Signatures, Skeletonization. Image Feature Extraction: Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, Gabor Filters and DWT. Boundary feature descriptors: Basic descriptors, Shape descriptor, Fourier descriptors, Statistical moments. Region feature descriptors: color, intensity and texture.	9	CO5
VI	Computer Vision applications	Computer Vision applications: Visual inspection of equipments, object detection like locating pedestrians, face detection and recognition, counting vehicles, content-based image retrieval, applications of computer vision in agriculture, health care, industry, sports etc	4	
	Total		39	

Text Books:

1. Rafael C. Gonzalez and Richard E.Woods, "Digital Image Processing," Pearson Education, edition 4, 2018.
2. Anil K.Jain, "Fundamentals of Digital Image Processing," Pearson Education, 2010.
3. S. Jayaraman, T. Veerakumar, A. Esakkirajan, "Digital Image Processing," First Edition, McGraw Hill Education, 2017

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4. Robert J. Schallkoff , “Digital Image Processing and Computer Vision”, John Wiley and Sons, 1989.
5. J. R. Parker , “Algorithms for Image Processing and Computer Vision” John Wiley and Sons, 1997.

Reference Books:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003
2. B.Chanda and D.Dutta Majumder, “Digital Image Processing and Analysis,” Prentice Hall of India, 2002
3. William K. Pratt, “Digital Image Processing,” John Wiley & Sons, 2nd edition, 2004
4. Alan C. Bovik, "Handbook of Image and Video Processing," Elsevier Science Publishing Co Inc, 2009
5. Richard Szeliski, "Computer Vision: Algorithms and Applications," 2nd edition, The University of Washington, 2022
6. Kenneth R. Castleman, "Digital Image Processing," Pearson Education, 2006.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC733	Big Data Analytics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC733	Big Data Analytics	20	20	40	60	2.5	--	--	100

Rationale :

The syllabus addresses core technologies and architectures used in large-scale data systems, equipping students with practical skills in Hadoop, NoSQL, and data mining techniques.

Course Objectives:

1. Understand the fundamental concepts, architecture, and characteristics of Big Data and its analytics techniques.
2. Explore and work with the Hadoop ecosystem and its tools for large-scale data processing.
3. Learn NoSQL databases, their design patterns, and use cases for managing unstructured and semi-structured data.

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- 4 Understand the MapReduce framework and implement distributed algorithms for Big Data.
5. Apply big data analytics techniques such as similarity detection, stream mining, and graph analysis to solve real-world problems.
6. Analyze application domains such as recommendation systems and social network mining using Big Data tools and concepts.

Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Describe the characteristics, types, and challenges of Big Data, and explain traditional vs big data.
- 2) Demonstrate the architecture and working of the Hadoop ecosystem and its associated tools.
- 3) Use NoSQL database systems to manage and query semi-structured and unstructured data.
- 4) Design and implement data processing algorithms using the MapReduce programming model
- 5) Apply techniques like similarity measures, stream mining, and PageRank for real-world data analytics.
- 6) Evaluate Big Data applications such as recommendation systems and social network analytics.

Prerequisite: Database Management Systems, Basic Data Structures and Algorithms, Programming (Python or Java)

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hou rs	CO Mapping
I	Introducti on to Big Data	Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data a business approach,	3	CO1



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	Analytics	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.		
II	Introduction to Big Data Frameworks	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem-Apache HBase, Hive, HCatalog, Pig, Mahout, Oozie, Zookeeper, Sqoop, Physical Architecture, Hadoop limitations.	5	CO2
III	NoSQL	Introduction to NoSQL, NoSQL business drivers, NoSQL database case studies. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems, Managing MongoDB database with CRUD operations.	6	CO3
IV	MapReduce Paradigm	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization. MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures Algorithms Using MapReduce: MapReduce WordCount Program, Matrix-Vector Multiplication by MapReduce ,	6	CO4



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		Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce		
V	Techniques in Big Data Analytics	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents, Distance Measures: Euclidean, Jaccard , Cosine , Edit and Hamming Distance with its Examples Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis Filtering streams: The Blooms filter. Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce Frequent Itemset Mining: Market-Basket Model, Apriori Algorithm, Algorithm of Park- Chen-Yu	13	CO5
VI	Cluster Analysis	Recommendation Systems: Introduction, A Model for Recommendation Systems: Collaborative-Filtering System, Content based system and its Examples. Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using map	6	CO6
Total			39	

Text Books:



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1. Radha Shankarmani and M Vijayalakshmi —Big Data Analytics, Wiley
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.

References:

1. Bill Franks, —Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Wiley.
2. Chuck Lam, —Hadoop in Action, Dreamtech Press

Online References:

Sr. No.	Website Name
1.	https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified
2.	https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
3.	https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html
4.	https://www.pdfdrive.com/data-science-and-big-data-analytics-e58447171.html

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC734	Advanced Database Management Systems	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC734	Advanced Database Management Systems	20	20	40	60	2.5	25	25	150

Rationale :

The Advanced Database Management System subject equips students with in-depth knowledge and practical skills to design, optimize, and manage complex databases for efficient data handling and decision-making

Course Objectives:

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1. To impart knowledge related to query processing and query optimizer phases of a database management system
2. To introduce concepts of advanced access control techniques like role based and discretionary methods
3. To impart knowledge related to indexing in database management system
4. To introduce advanced database models like parallel and distributed databases
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To introduce concepts of Big data

Course Outcomes:

At the end of the course learner will be able to

1. Measure query costs and design alternate efficient paths for query execution.
2. Apply sophisticated access protocols to control access to the database.
3. Implement alternate models like Parallel and Distributed databases and Design applications using advanced models like mobile, spatial databases
4. Apply indexing techniques on large data in database
5. Apply Big data concepts in real world applications

Prerequisite: Data structure concepts, Discrete structure

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Query Processing and Optimization	Query Optimization Overview, Measures of Query Cost Selection Operation	07	CO1



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		Sorting, Join Operation, Other Operations, Evaluation of Expressions Transformation of Relational Expressions Estimating Statistics of Expression Results, Choice of Evaluation Plans		
II	Advanced Data Management Techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges; Mandatory Access Control and Role-Based Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.	06	CO2
III	Indexing	Indexed Sequential Access Method (ISAM) B+ Trees: A Dynamic Index Structure, Format of a Node Search, insert, delete operations in B+ Tree Hashing Techniques; Types of Indexes: Single Level Ordered Indexes; Multilevel Indexes; Overview of B-Trees and B+-Trees	06	CO3
IV	Parallel Databases	Architectures for Parallel Databases, Parallel Query Evaluation and Optimization Data Partitioning, Parallelizing Sequential Operator Evaluation Code Parallelizing Individual Operations: Bulk Loading and Scanning, sorting, joins	08	CO4

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V	Distributed Databases	Introduction: Distributed Data Processing, What is a Distributed Database System Design Issues, Distributed DBMS Architecture. Distributed Database Design: Top-Down Design Process, Distribution Design Issues, Fragmentation, Allocation. Overview of Query Processing: Query Processing Problem, Objectives of Query Processing Characterization of Query Processors, Layers of Query Processing, Query Optimization in Distributed Databases;	06	CO5
VI	Introduction to Big Data	Sources and Uses of Big Data, Querying Big Data Big Data Storage Systems: Distributed File Systems, Key-Value Storage Systems The MapReduce Paradigm: MapReduce in Hadoop with the example of word count Streaming Data: Querying Streaming Data Introduction to Graph Databases	06	CO5
Total			39	

DETAILED SYLLABUS:

Text Books:

1. Korth, Silberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON .

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3. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems” 3rd Edition McGraw Hill

References:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom “Database System Implementation”, Pearson Ltd. 1/e
2. Thomas M. Connolly Carolyn Begg, Database Systems: A Practical Approach to Design Implementation and Management, 4/e, Pearson Ltd.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106095
2.	https://www.scaler.com/topics/course/dbms/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC741	Cloud Computing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Avg.					
ECC741	Cloud Computing	20	20	40	60	2.5	--	--	100

Rationale : Cloud computing offers numerous benefits, including cost reduction, increased flexibility and scalability, enhanced security, and improved collaboration, making it a vital subject for students and professionals alike.

Course Objectives: Six Course Objectives

1. To provide an overview of cloud computing fundamentals.
2. To make students familiar with the key concepts of virtualization.
3. To explore various cloud computing services.
4. To create an open source cloud.
5. To identify risks and provide cloud security.
6. To analyze several cloud applications and recent trends in cloud computing.

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Course Outcomes: Six Course outcomes

After successful completion of the course students will be able to:

1. Define cloud computing and understand different cloud services and deployment models.
2. Implement different types of virtualization.
3. Use several cloud computing services.
4. Design of open source cloud.
5. Identification of threats and cloud-based risks for cloud security.
6. Understand cloud applications and recent trends.

Prerequisite: Computer networks, Basics of operating system (O.S.)

Sr. No.	Name of Module	Detailed Content	Hou rs	CO Mappi ng
I	Introduction to Cloud Computing	Definition of cloud computing and cloud data centre, NIST model and cloud cube model, and characteristics of cloud computing. Cloud deployment models (private, public, hybrid, and community) and service models (SaaS, PaaS, and IaaS). Impact of cloud computing on business, key drivers for cloud computing. Advantages and disadvantages of cloud computing.	04	CO1



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II	Virtualization	Introduction and benefits of virtualization, implementation levels of virtualization, VMM. Virtualization at O.S.level, middleware support for virtualization, virtualization structure/tools and mechanisms, hypervisor and xen architecture, binary translation with full virtualization, para virtualization with compiler support. CPU virtualization, memory virtualization and I/O virtualization, virtualization in multicore processors,demonstration of virtualization usingtype II hypervisor.	08	CO2
III	Cloud Computing Services	Exploring different cloud computing services: Software-as-a-Service (SaaS) (e.g.,Dropbox, Google Workspace, Salesforce, etc.), Platform as a Service(PaaS) (e.g., AWS Elastic Beanstalk, Windows Azure, Heroku, Google App Engine, etc.), Infrastructure-as-a-Service (IaaS) (e.g., DigitalOcean, AWS, Microsoft Azure, Google Compute Engine (GCE), etc.). Anything as a Service or Everything as a Service (XaaS), Security as a Service,Identity Management-as-a-Service, and Database as a Service. Storage as a Service,Collaboration as a Service,Compliance as Service,Monitoring as a Service,Communication as a Service, Network as a Service,DisasterRecovery as a Service,Analytics as a Service, and Backup as a Service	05	CO3
IV	Open Source Cloud Implementati	OpenStack Cloud Architecture, Features of OpenStack, Components of OpenStack, Mode of Operations of OpenStack	07	CO4

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	on of OpenStack and Eucalyptus	Eucalyptus Architecture, Features of Eucalyptus, Components of Eucalyptus, Mode of Operations of Eucalyptus Installation and configuration process of OpenStack and Eucalyptus		
V	Cloud Security	Security overview, cloud security challenges and risks, SaaS security, cloud computing security architecture, architectural considerations. General issues in securing cloud, securing data, application, and virtual machine security. AAA model, automatic security establishing trusted cloud computing, secure execution environments and communications, access control, disaster recovery in clouds.	07	CO5
VI	Cloud Applications and Recent Trends	Cloud Applications: Scientific Applications: Healthcare: ECG analysis in cloud IoT-enabled Cloud Applications: Smart Agriculture Business and Consumer Applications: CRM and ERP, Productivity, networking, media applications, multiplayer online gaming. Recent Trends: Mobile cloud computing, autonomic cloud computing, multimedia cloud, energy aware cloud computing.	06	CO6

Text Books:

- 1) Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education
- 2) Cloud Computing and Services by Arup Vithal, Bhushan Jadhav, StarEdu Solutions, SYBGEN Learning India Pvt. Ltd.
- 3) Cloud Computing: A Practical Approach for Learning and Implementation by A. Srinivasan, J. Suresh, Pearson.
- 4) Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines, Wiley & Sons.
- 5) Cloud Computing Bible by Barrie Sosinsky, Wiley Publishing.

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Text Books:

- 1) Cloud Computing Black Book by Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Dreamtech Press.
- 2) Amazon Web Services in Action by Michael Wittig, Andreas Wittig, Manning Publisher.

References Book:

- 3) To the cloud: cloud powering an Enterprise, Arora Pankaj, Tata Mc Graw Hill Education.
- 4) Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Kai Hwang, Morgan Kaufmann.

Online References:

Sr. No.	Website Name
1.	NPTEL: https://onlinecourses.nptel.ac.in/noc22_cs20/preview
2.	OpenStack Installation Guide: https://docs.openstack.org/install-guide/ 3) Eucalyptus Installation:
3.	AWS Management Console: https://aws.amazon.com/console/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC742	Mobile Communication	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC742	Mobile Communication	20	20	40	60	2.5	--	--	100

Rationale:

The Mobile Communication course provides foundational knowledge of wireless communication principles, cellular network architecture, and mobility management. It equips students with the skills to understand, analyze, and design mobile systems used in modern communication technologies. With the rapid growth of mobile networks like 4G, 5G, and beyond, this course is essential for careers in telecommunications, embedded systems, and IoT.

Course Objectives:

1. To understand the fundamentals of cellular communication systems, including

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propagation mechanisms, frequency reuse, and mobility management.

2. To study cellular system design parameters such as cluster size, interference, call setup, handoff strategies, and traffic theory.
3. To explore multiple access and spread spectrum techniques, including TDMA, FDMA, CDMA, and OFDMA used in mobile systems.
4. To analyze 2G to 5G mobile technologies, including GSM, IS-95, GPRS, EDGE, UMTS, LTE, and emerging 5G concepts.
5. To examine the mobile network and transport layer protocols, such as Mobile IP, mobility management, Mobile TCP, and related optimization techniques.
6. To understand application-level mobile communication protocols, including WAP architecture and associated services and standards..

Course Outcomes:

After successful completion of the course students will be able to:

1. Describe the principles of cellular communication systems and explain key concepts such as frequency reuse, handoff strategies, and interference management.
2. Analyze various multiple access techniques including FDMA, TDMA, CDMA, and their role in mobile networks.
3. Compare the architectures, features, and functioning of different generations of mobile communication systems from 2G to 5G.
4. Illustrate the architecture and working of Mobile IP and mobility management protocols in wireless networks.
5. Evaluate the performance of transport layer protocols like Mobile TCP and assess improvements for mobile environments.
6. Explain the structure and components of WAP and mobile application protocols and their role in mobile internet access.

Course Pre-requisite:

1. Analog and Digital Communication
2. Communication Networks
3. Digital Electronics

DETAILED SYLLABUS:



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Concept of Cellular Communication	Introduction to cellular communications, basic propagation mechanisms and multipath fading Cellular System design fundamentals: Cluster, frequency reuse, Call setup, Handoff strategies, interference and system capacity, cluster size and system capacity and Channel assignment strategies Traffic Theory: Trunking and Grade of service, Improving Coverage and capacity	7	CO1
II	Multiple Access Techniques	Multiplexing and Multiple Access: Time Division Multiple Access, Frequency Division Multiple Access, Space division multiple access technique Spread spectrum Multiple Access: Need for and concept of spread spectrum (SS) modulation, PN-sequence generation, properties of PN-sequence, Gold sequence generation, Direct-sequence SS, Frequency-hopping SS	6	CO2
III	2-G Technologies	GSM: Services and features, GSM air specifications, GSM network architecture, Physical and Logical Channels, Frame structure, Identifiers, Authentication and security, call procedure, Hand-off procedure IS-95 (CDMA): Air specifications of IS-95, Forward and Reverse CDMA	10	CO3

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		channels, Forward and Reverse CDMA channel modulation process block diagram, power control subchannel, Handoffs in IS 95 CDMA and RAKE receiver. GPRS, EDGE technologies, W-CDMA (UMTS), CDMA2000: features and network architectures LTE: LTE System Overview, Evolution from UMTS to LTE, LTE/SAE Requirements, SAE Architecture, EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to 5G		
IV	Evolution from 2G to 5G	GPRS, EDGE technologies, W-CDMA (UMTS), CDMA2000: features and network architectures LTE: LTE System Overview, Evolution from UMTS to LTE, LTE/SAE Requirements, SAE Architecture, EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to 5G	6	CO4
V	Mobile Network Layer	Mobile IP: IP Packet Delivery, Agent Advertisement and discovery, Registration, Tunneling and Encapsulation Mobility Management: Introduction, IP Mobility, Optimization, IPv6, Micro Mobility: CellularIP	5	CO5
VI	Mobile Transport and Application Layer	Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Selective Retransmission WAP: Architecture, WDP, WTLS, WTP, WSP, WAE, WML	4	CO6

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		Total	39	
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Text Books:

1. Theodore Rappaport, “Wireless Communications: Principles and Practice, 2nd Edition, Pearson Publication
2. Jochen Schiller, “Mobile Communications”, 3e, Pearson Publication.
3. William Stallings, “Wireless Communication and Networking”, PHI Publication.
4. Vijay Garg, “IS-95 CDMA and CDMA 2000: Cellular/PCS System Implementation”, Pearson Publication.

Reference Books:

1. T.L Singal, “Wireless Communication”, Tata McGraw Hill ,2010.
2. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.
3. Andreas F Molisch, "Wireless Communication", John Wiley, India 2006.
4. Vijay Garg, “Wireless communication and Networking”, Pearson Publication.
5. Christopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications”, Wiley publications.

Online References:

Sr. No.	Website Name
1.	https://www.udemy.com/course/5g-4g-lte-3g-2g-cellular-mobile-communications-wireless
2.	https://www.coursera.org/learn/wireless-communications



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC743	Cyber Security	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC743	Cyber Security	20	20	40	60	2.5	--	--	100

Rationale

This Cyber Security and Laws emphasizes the importance of taking daily actions to reduce online risks and stay safe when using connected devices. It aligns with the goal of raising cybersecurity awareness and promoting proactive security practices.

Objectives:

1. To understand and identify different types of cybercrime and cyber law.
2. To recognize Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.
4. To understand Information Security Standards compliance during software design and development.
5. To Interpret and apply IT law in various legal issues.
6. To Interpret Penalties, Adjudication and Appeals Under the IT Act.

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Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development.
5. To Interpret Penalties, Adjudication and Appeals Under the IT Act and Web and Network Security
6. Understand the Information Security Standard compliances.

Prerequisite: Knowledge of Basic Computer Network.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Cybercrime	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	05	CO1
II	Cyber offenses & Cybercrime	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures	06	CO2

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		for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		
III	Tools and Methods Used in Cybercrime	Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow. Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) Banner Grabbing Techniques, ransom wares, Crypto wares	08	CO3
IV	The Concept of Cyberspace	Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	8	CO4
V	Indian IT Act and Web and Network Security	Cyber Crime and Criminal Justice : Penalties, Adjudication Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments. Web Security: OWASP, Web Security Considerations, Management, Cookies, Privacy on Web, Web Browser Attacks, Web Bugs, Clickjacking, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security	08	CO5
VI	Information Security Standard	Role of AI/ML in Cyber Security SOX, GLBA, HIPAA	06	CO6

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	compliances	ISO, FISMA, NERC, PCI.		
Total			39	

Text Books:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

References Book:

1. William Stallings, *Cryptography and Network Security*, Pearson Publication
2. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
3. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.

Online Reference

Sr. No.	Website Name
1.	Websites for more information is available on :The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
2.	Website for more information , A Compliance Primer for IT professional



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC744	Block Chain Technologies	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC744	Block Chain Technologies	20	20	40	60	2.5	--	--	100

Rationale : Blockchain technology offers a decentralized, secure, and transparent method of recording digital transactions, enabling trustless peer-to-peer interactions and revolutionizing sectors such as finance, supply chain, healthcare, and governance by ensuring data integrity and reducing dependency on centralized authorities.

Course Objectives:

1. To learn the fundamentals of Blockchain
2. To obtain knowledge about technologies of Blockchain

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3. To incorporate the models of Blockchain- Ethereum
4. To learn the models of Hyperledger Fabric
5. To explore various applications of Blockchain.

Course Outcomes:

At the end of the course learner will be able to

1. Describe the primitives of the cryptography related to blockchain.
2. Understand and explore the working of Blockchain technology
3. Illustrate the concepts of Bitcoin and their usage.
4. Implement Ethereum block chain contract.
5. Explore Hyperledger Fabric and its working.
6. Investigate security features in blockchain technologies

Prerequisite: Computer Network, Operating System, Cryptography

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction of Cryptography	1.Basic Cryptographic primitives used in Blockchain - Public Key cryptosystem, Cryptographic Hash functions: Properties of Hash, MD5, SHA 256, Hash Pointers and Data Structures, Digital Signatures: ECDSA, Public Keys as Identities, Cryptocurrencies: Goofycoin	07	CO1



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II	Introduction to Blockchain	Centralization vs. Decentralization, What is Blockchain, History of Blockchain, Blockchain defined- peer to peer, Distributed Ledger, Cryptographically Secure, Append-only, Updatable via consensus, How Blockchain Works, Benefits and Limitations of Blockchain, Types of Blockchain, The Structure of a Block, Blockheader, Genesis block, Mining, Rewards, Consensus, Types of Consensus Mechanisms, Consensus in Blockchain.	06	CO2
III	Bitcoin and Cryptocurrency	What is Bitcoin, Private keys in Bitcoin, Public Keys in Bitcoin, Addresses in Bitcoin, Transactions, The Bitcoin Network, Bitcoin Wallets, Scripting language in Bitcoin, Bitcoin Mining- task of Bitcoin miners, Mining Hardware, Crypto Currencies, Anonymity and Pseudonymity in Bitcoin study Alt coins	06	CO3
IV	Introduction to Ethereum	Ethereum blockchain platform, explaining its structure, the Ethereum Virtual Machine (EVM), and how smart contracts enable decentralized application. Introduction to Ethereum, Ethereum's Consensus Mechanisms, MetaMask Setup, Ethereum Accounts, Ethers, Gas, Introduction to Smart Contracts, Remix IDE, Writing smart contracts using Solidity Self Study- Geth, Ganache-Creating Wallets	08	CO4
V	Introduction to Hyperledger	What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer, Transaction Flow Case Study of Supply Chain Management using Hyperledger	06	CO5

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VI	Privacy, Security issues in Blockchain	Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains (Sybil attacks, selfish mining, 51% attacks), prevention of attacks Self Study: Corda, Ripple, Quorum platforms and its security	06	CO6
Total			39	

Text Books:

1. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
2. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

References:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas M Antonopoulos 2018
2. D. Drescher, Blockchain Basics. Apress, 2017.
3. Merunas Grinčelaitis, “Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols”, Packt Publishing.
4. Blockchain with Hyperledger Fabric, Luc Desrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing.



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Online References:

Sr. No.	Website Name
1.	http://www.coursera.org/learn/ibm-blockchain-essentials-for-developers
2.	https://www.nptel.ac.in/courses/106105184/
3.	https://www.tutorialspoint.com/blockchain/index.htm

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL706	VLSI Design Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL706	VLSI Design Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize students with the complete VLSI design cycle, from specification to layout and verification.
2. To develop practical skills using industry-standard EDA tools for simulation, synthesis, and layout design (e.g., Cadence, Synopsys, Mentor Graphics).
3. To design combinational and sequential digital circuits using CADD tools
4. To gain insight into layout design including design rule checks (DRC)
5. To learn debugging strategies and verify digital designs for functional correctness and performance.
6. To motivate students to design and demonstrate real-time digital systems through project-based learning.

Lab Outcomes:

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By the end of this course, students will be able to:

1. Describe the VLSI design flow and its associated tools. Demonstrate understanding of various stages of VLSI design including specification, synthesis, simulation, and layout.
2. Write and simulate Inverter based digital designs using CAD tools
3. Develop and test combinational and sequential circuits using hardware description languages/Simulation tools.
4. Perform synthesis and analyze timing constraints of digital circuits such as Adders, Subtractors Multipliers etc
5. Design layouts and verify them using DRC and LVS tools.
6. Demonstrate the ability to work on VLSI-based mini projects. Integrate various components of VLSI design to solve practical engineering problems.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Plot Transfer and output characteristics of NMOS /COMS Inverter	2
02	Design CMOS inverter. Carry out static as well as transient simulation with different aspect ratio of pull up and pull-down devices	2
03	Find the equivalent CMOS inverter for the given 2-input NAND and NOR gates	2
04	Implement the given equation using various logic design styles.	2
05	Design and Simulate 4:1 multiplexer using NMOS pass transistor.	2
06	Implement different gates and various logic design styles.	2
07	Implement SR latch using CMOS inverter	2
08	Implement JK FlipFlop 1 using CMOS inverter	2
09	Implement 6-T SRAM cell using static CMOS logic	2
10	Implement Half adder/full adder cell using any design style	2

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11	Small project (groupwise)	2
12	Case Study (group wise)	2

Sr No	List of Assignments / Tutorials	Hrs
01	Write report on technological advancements in VLSI field since 2020	2
02	Solve given equations using boolean algebra and implement same using various design styles	2

Text Books:

1. CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw Hill, Revised 4th Edition.
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley India Pvt. Ltd.
3. Sorab K. Gandhi, "VLSI Fabrication Principles", Wiley, Student Edition.

Reference Books:

1. Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan Borivoje Nikolic, Pearson Education, 2nd Edition
2. Basic VLSI Design, Douglas A Pucknell, Kamran Eshraghian, Prentice Hall of India Private Ltd.
3. Logical Effort: Designing Fast CMOS Circuits, Ivan Sutherland and Bob Sproull
4. Basics of CMOS Cell Design, Etienne Sicard and Sonia Delmas Bendhia, Tata McGraw Hill
5. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste, David Harris and Ayan Banerjee, Pearson Education
6. Analysis and Design of Digital Integrated Circuits, David Hodges, Horace Jackson, Resve Saleh, McGraw-Hill, Inc.

Online Resources:



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Sr. No.	Website Name
1.	https://cse14-iiith.vlabs.ac.in/
2.	https://vlsiresources.com/opensourcevlsi/
3	https://vlsi-iitg.vlabs.ac.in/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL707	Internet of Things Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract./ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT 2	Total				
ECL707	Internet of Things Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To develop the ability to interface a variety of sensors with IoT devices and transmit real-time data to cloud platforms for monitoring and analysis.
2. To demonstrate competency in remotely controlling devices using mobile-based applications such as the Blynk App and flow-based development tools like Node-RED.
3. To explore and implement IoT communication protocols (such as MQTT, HTTP, CoAP) for enabling seamless and secure remote device control.
4. To integrate third-party IoT services like Google Assistant, Adafruit IO, IFTTT, and Firebase for smart automation and enhanced functionality.
5. To configure and utilize Amazon Web Services (AWS) for deploying scalable and reliable IoT applications, including cloud storage, processing, and analytics.

Lab Outcomes:

By the end of this course, students will be able to:

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1. Interface various sensors to any IoT device and push data onto the cloud.
2. Remotely control various devices using Blynk App and Node-red environment.
3. Implement IoT protocols to control devices remotely.
4. Implement services like Google Assistance, Adafruit I/O, IFTTT, Firebase etc in IoT.
5. Configure AWS Cloud and its Application in IoT
6. Publish sensor data to IOT cloud.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Interfacing Various Sensors like LDR, ultrasonic, DHT etc (data collection) and pushing data on to Thinkspeak cloud	2
02	Controlling IoT devices/sensors remotely using Node-red and rpi.	2
03	Application of MQTT in node red	2
04	Control a LED Remotely & Monitor Temperature values with a Raspberry Pi using Node-RED	2
05	Controlling IoT devices using Blynk App.	2
06	Temperature and Humidity monitor using Blynk	2
07	ESP8266 Voice Control with Google Assistant and Adafruit IO and IFTTT.	2
08	Implementing Publish-Subscribe model using MQTT protocol and DHT11 sensor	2
09	Google Firebase: - controlling LED using Android App	2
10	Publishing sensor data from ESP32 to AWS IoT Cloud.	2
11	Device controlling over cloud on android mobile app :- Monitoring sensor and different data on mobile phone	2
12	Creating an emergency push button to upload status on Facebook	2
13	To send Push notification to IoT device (R-pi to smart phone)	2
14	Google Assistant Controlled Switch Using NodeMCU	2
15	AWS and SNS service	2

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Sr No	List of Assignments / Tutorials	Hrs
01	Case study of home automation	2
02	Case study of Weather Monitoring	2

Text Books:

1. Arshdeep Bahga 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

Reference Books:

1. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things", Paperback, First Edition
2. Yashavant Kanetkar, Shrirang Korde: Paperback "21 Internet of Things (IOT) Experiments", BPB Publications.

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105166/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL781	Deep Learning lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract./ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL781	Deep Learning lab	--	--	--	--	25	25	50

Lab Objectives:

1. Implement basic neural network models to learn logic functions.
2. Design and train feed-forward neural networks using various learning algorithms.
3. Build and train deep learning models such as Auto-encoders, CNNs, RNN, LSTM etc.

Lab Outcomes:

By the end of this course, students will be able to:

1. To explore python libraries for deep learning e.g. Theano, TensorFlow etc (Apply)
2. Implement Perceptron algorithm to simulate any logic gate. (Analyze)
3. Implement a back-propagation algorithm to train a DNN with at least 2 hidden layers. (Create)
4. Design and implement a CNN model for digit recognition application. (Evaluate)

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5. Design the architecture and implement the auto-encoder model for Image Compression.(Apply, Analyze)
6. Design and implement GRU for Text / Image / Audio / Video / etc.(Create, Evaluate)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Based on Module 1 (Any two) using Virtual Lab Implement Mc-Culloch Pitts model for binary logic functions. Implement Perceptron algorithm to simulate any logic gate. Implement Multilayer Perceptron algorithm to simulate XOR gate. To explore python libraries for deep learning e.g. Theano, TensorFlow etc	2
02	Module 2 (Any Two) Apply any of the following learning algorithms to learn the parameters of the supervised single layer feed-forward neural network. a. Stochastic Gradient Descent b. Mini Batch Gradient Descent c. Momentum GD d. Nestorev GD e. Adagrad GD	2
03	Module 3 (Any One) Implement a back-propagation algorithm to train a DNN with at least 2 hidden layers. Design and implement a fully connected deep neural network with at least 2 hidden layers for a classification application. Use appropriate Learning Algorithm, output function and loss function.	2
04	Module 4 (Any One) Design and implement a CNN model for digit recognition application. Design and implement a CNN model for image classification.	2
05	Module 5 (Any One)	2



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	Design the architecture and implement the auto-encoder model for Image Compression. Design the architecture and implement the auto-encoder model for Image denoising.	
06	Module 6 (Any One) Design and implement LSTM for Text / Image / Audio / Video / etc. Design and implement GRU for Text / Image / Audio / Video / etc. Design and implement RNN for Text / Image / Audio / Video / etc.	2

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Li Deng and Dong Yu, "Deep Learning Methods and Applications", now publishers Inc (30 June 2014)
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. J M Zurada "Introduction to Artificial Neural Systems", Jaico Publishing House
5. M. J. Kochenderfer, Tim A. Wheeler. "Algorithms for Optimization", MIT Press.

References:

1. Jon Krohn, Grant Beyleveld, Aglae Bassens, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education.
2. Buduma, N. and Locascio, N., "Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc."
3. François Chollet, "Deep Learning with Python", Manning Publications, 2018.
4. Douwe Osinga. "Deep Learning Cookbook", O'REILLY, SPD Publishers, Delhi.
5. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.

Online Resources:

Sr. No.	Website Name
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1.	https://nptel.ac.https://deeplearning.cs.cmu.edu/S21/index.html 2
2.	http://www.cse.iitm.ac.in/~miteshk/CS6910.html 3
3.	https://nptel.ac.in/courses/106/106/106106184/ 4 https://www.deeplearningbook.org/ 5
4.	http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC782	Image Processing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECC782	Image Processing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Understand the Fundamentals of Digital Image Processing
2. Implement Image Transformation Techniques
3. Perform Image Segmentation and Feature Extraction
4. Develop Skills in Image Restoration and Compression
5. Use Image Processing Tools and Libraries
6. Design and Test Mini-Projects for Real-Time Applications

Laboratory Outcomes:

After successful completion of the laboratory, students will be able to:

- 1) Enhance the quality of images using spatial and frequency domain techniques.
- 2) Apply lossless and lossy compression techniques to reduce image size efficiently.
- 3) Segment image components based on discontinuity and similarity criteria.
- 4) Extract meaningful features from images for specific computer vision

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applications.

- 5) Perform image representation and description for object recognition tasks.
- 6) Implement image analysis algorithms for solving real-time visual problems.

List of Experiments:

Sr.No.	Experiment Name	Hrs
1	Gray level transformation: Negative, Log, Power law, gray level slicing, Contrast stretching.	2
2	Histogram Equalization.	2
3	Neighborhood Processing.	2
4	Filtering in Frequency domain - Smoothing and sharpening.	2
5	2D-DFT and DCT spectrum analysis.	2
6	Compression using Transform Coding (JPEG Baseline coding) with parameter evaluation (CR, MSE, PSNR etc.).	2
7	Morphological Operations: erosion, dilation, opening, closing, boundary detection	2
8	Segmentation based on discontinuity and similarity.	2
9	Use of transforms for face recognition.	2
10	Object detection using statistical moments.	2
11	CBIR using color, shape and texture (as an application).	2
12	Feature Extraction using HOG.	2

Text Books:

1. Rafael C. Gonzalez and Richard E.Woods, "Digital Image Processing," Pearson Education, edition 4, 2018.
2. Anil K.Jain, "Fundamentals of Digital Image Processing," Pearson Education, 2010.
3. S. Jayaraman, T. Veerakumar, A. Esakkirajan, "Digital Image Processing," First Edition, McGraw Hill Education, 2017
4. Robert J. Schallkoff , "Digital Image Processing and Computer Vision", John Wiley

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and Sons, 1989.

5. J. R. Parker, "Algorithms for Image Processing and Computer Vision" John Wiley and Sons, 1997.

Reference Books:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003
2. B.Chanda and D.Dutta Majumder, "Digital Image Processing and Analysis," Prentice Hall of India, 2002
3. William K. Pratt, "Digital Image Processing," John Wiley & Sons, 2nd edition, 2004
4. Alan C. Bovik, "Handbook of Image and Video Processing," Elsevier Science Publishing Co Inc, 2009
5. Richard Szeliski, "Computer Vision: Algorithms and Applications," 2nd edition, The University of Washington, 2022
6. Kenneth R. Castleman, "Digital Image Processing," Pearson Education, 2006.

Online Resources:

Sr. No.	Website Name
1.	https:// https://cse19-iiith.vlabs.ac.in/
2.	https://www.ee.iitb.ac.in/~viplab/
3	https://www.mathworks.com/products/image-processing.html

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC783	Big Data Analytics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Avg. of 2 Tests				
ECC783	Big Data Analytics Lab	--	--	--	--	25	25	50

Rational:

The Big Data Analytics Lab provides practical skills in handling, processing, and analyzing massive datasets using tools like Hadoop, Spark, and Python. It enables students to apply data analytics techniques for real-time insights and decision-making. This lab prepares learners for industry roles in data science, analytics, and intelligent systems.

Lab Objectives:

1. Understand and install the Hadoop ecosystem and related big data tools.
2. Implement basic data operations on HDFS, Hive, and NoSQL databases.
3. Develop MapReduce programs for data analytics.
4. Perform big data processing using stream mining and similarity analysis.

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5. Analyze and visualize social network and recommendation system data.
6. Solve real-time big data problems using case-based experiments.

Lab Outcomes:

On successful completion of the course learner will be able to:

1. Install and configure a Hadoop environment; demonstrate basic file operations in HDFS to understand distributed storage mechanisms.
2. Construct Hive tables and execute HiveQL queries; analyze unstructured data using Pig scripts.
3. Perform CRUD operations in MongoDB; apply key-value, document-store, and column-family NoSQL models to sample data.
4. Design, develop, and execute MapReduce programs for WordCount, matrix operations, and relational algebra queries.
5. Calculate similarity measures (Cosine, Jaccard, Hamming); simulate Bloom filters and implement PageRank using MapReduce.
6. Build a collaborative filtering recommendation system and apply clustering techniques on a social network graph.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Install and configure Hadoop in pseudo-distributed mode.	2
02	Perform HDFS file operations: upload, retrieve, delete, and list files.	2
03	Execute HiveQL queries for table creation, loading data, and querying large datasets.	2
04	Import/export data using Sqoop between MySQL and HDFS.	2
05	Install MongoDB and perform CRUD operations on structured and unstructured datasets.	2
06	Design and execute queries using document and column-store NoSQL patterns.	2
07	Write a WordCount program using MapReduce in Python.	2



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08	Simulate relational operations (JOIN, SELECT) using MapReduce.	2
09	Calculate document similarity using Cosine, Jaccard, and Hamming distances.	2
10	Build a simple recommendation system using collaborative filtering.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment 1: Big Data Concepts and Hadoop Ecosystem(CO1, Co2, CO6) 1. Define Big Data. Explain the five V's (Volume, Velocity, Variety, Veracity, and Value) with real-world examples. 2. Compare traditional RDBMS systems and Big Data systems from a business and technical perspective. 3. Describe the architecture of Hadoop. Illustrate the roles of HDFS and YARN. 4. Explain any three tools from the Hadoop ecosystem (Hive, Pig, HBase, Sqoop, Oozie, etc.) with examples. 5. Discuss one real-life case study of Big Data implementation in sectors such as retail, healthcare, or governance.	4
02	Assignment 2: Big Data Algorithms and Applications 1. Implement the WordCount problem using the MapReduce paradigm (pseudo code or real code in Python/Java). 2. Calculate the Jaccard and Cosine similarity between two short text documents. 3. Explain the concept of Bloom Filter and write a simulation for detecting duplicates in a data stream. 4. Briefly describe the working of the PageRank algorithm and its use in ranking web pages. 5. Design a basic content-based or collaborative filtering recommendation model (explain with steps or pseudocode).	4

Text Books:

1. Seema Acharya & Subhashini Chellappan – Big Data and Analytics, Wiley India.

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2. Tom White – Hadoop: The Definitive Guide, O'Reilly Media.
3. Paul Zikopoulos et al. – Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw-Hill.

References:

1. Chuck Lam – Hadoop in Action, Manning Publications.
2. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman – Big Data for Dummies, Wiley.
3. Dean Wampler and Jason Rutherglen – Programming Hive, O'Reilly Media.

Online Resources:

Sr. No.	Website Name
1.	Apache Hadoop Official Documentation https://hadoop.apache.org/docs/
2.	MongoDB University (Free Courses) https://university.mongodb.com/
3.	Hive and Pig Tutorials by TutorialsPoint https://www.tutorialspoint.com/hive/ https://www.tutorialspoint.com/pig/
4.	MapReduce Tutorials by GeeksforGeeks https://www.geeksforgeeks.org/mapreduce-program-wordcount-example/
5.	Big Data Analytics Course by NPTEL https://nptel.ac.in/courses/106/104/106104189/
6.	edX – Big Data Analysis with Scala and Spark (University of California) https://www.edx.org/course/big-data-analysis-with-scala-and-spark

Assessment

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL784	Advanced DBMS Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL784	Advanced Database Management Systems Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To implement advanced SQL queries including nested queries, views, triggers, and stored procedures for complex data operations.
2. To understand and apply query optimization techniques using cost-based and heuristic-based approaches.
3. To design and simulate indexing mechanisms like B-trees, hash indexing, and bitmap indexing for efficient data retrieval.
4. To implement concurrency control techniques such as locking protocols and timestamp ordering for transaction management.
5. To explore and simulate distributed and parallel database systems for managing data across multiple nodes.
6. To gain hands-on experience with NoSQL databases and big data tools to manage semi-structured and unstructured data efficiently.

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*R-2025- BE (Sem VII) Electronics and Computer Science***Lab Outcomes:**

- 1) Build and manage indexes to improve database query performance.
- 2) Analyze time series data using appropriate open-source tools.
- 3) Perform data partitioning and understand its impact on query optimization.
- 4) Develop and execute programs using the MapReduce programming model.
- 5) Apply data preprocessing techniques for efficient large-scale data handling.
- 6) Design and implement data-intensive applications using big data technologies.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Create an index on the given tables, observe execution time of queries and record your observations.	2
02	Demonstrate use of grant and revoke access	2
03	Find the cost of queries using DBMS tools (Postgresql, MySQL, Oracle etc)	2
04	Data distribution and partitioning using Apache Ignite	2
05	Collocating computations with data using Apache Ignite	2
06	Time series data analysis using Temporal database like TimescaleDB	2
07	Count number of words in a large file using map reduce	2
08	Compare the cost required for query execution and obtain the optimized query	2
09	Develop a distributed database application. (FileServer Implementation using RMI)	2
10	Create a node and relationships using neo4j	2
11	Select and display data using neo4j	2
12	Create index and add constraints using neo4j	2

Text Books:



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1. Korth, Silberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Editi McGraw Hill

Reference Book:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online Resources:

Sr. No.	Website Name
1.	https://docs.timescale.com/timescaledb/latest/tutorials/nyc-taxi-cab/#introduction-to-iot-new-york-city-taxi-cabs
2.	https://neo4j.com/developer/get-started/
3	https://docs.timescale.com/install/latest/
4	https://hadoop.apache.org/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC709	Major Project-I	--	04	--	--	02	-	02

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT2	Total					
ECC709	Major Project-I	--	--	--	--	--	25	25	50

Rationale : The Major Project–I syllabus is designed to encourage students to apply theoretical knowledge and technical skills acquired during their course to solve real-world problems through practical implementation. It promotes innovation, teamwork, and project management skills by guiding students through the initial stages of research, design, and development under faculty supervision. This course lays the groundwork for Major Project and internship, fostering analytical thinking, creativity, and readiness for industry or higher research.

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Course Objectives:

1. To acquaint yourself with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint yourself with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcomes:

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Major Project:

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plans in the form of Gantt/PERT/CPM charts, which will cover weekly activity of major project-I and major project-II.
- A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.

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- Faculty supervisors may give inputs to students during major project -I & Internship activity; however, focus shall be on self-learning.
- Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor.
- Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of institute.
- With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Major Project, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Major Project-I in semester VII and continue in semester VIII.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Major Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to Scopus paper publications in Journal/Conference or Copyright or Patent as an extension of the Major Project-1 with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on a case by case basis.

Guidelines for Assessment of Major Project:

Term Work:

- 1) The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major projects to be evaluated on a continuous basis, minimum two reviews in each semester VII and VIII.
- 2) In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- 3) Distribution of Term work marks for both semesters shall be as below;

a) Marks awarded by guide/supervisor based on log book:	10
b) Marks awarded by review committee	10
c) Quality of Project report	05

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Review/progress monitoring committee may consider following points for assessment based on either one year major project as mentioned in general guidelines.

One-year project:

- In semester VII entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype. Two reviews will be conducted based on the presentation given by the student group.
- First shall be for finalization of problem and proposed solution of the problem
- Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VIII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
- First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.
- Second review shall be based on paper presentation in conference/journal or motivation for copyright or Indian patent in the last month of the said semester.

Assessment criteria of Major Project.

Major Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual as member or leader
13. Clarity in written and oral communication

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- In **one year, project**, first semester evaluation may be based on the first six criteria and the remaining may be used for second semester evaluation of performance of students in the project.

Guidelines for Assessment of Major Project Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Major Projects 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 organizations having experience of more than five years approved by the head of Institution.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Major Project

shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact

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Curriculum Structure – BE Semester-VII

Every student is required to take one Open Elective Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters

OEC75WW	Open Elective - 1 (Common for all branches will be notified)
OEC7501	Product Lifecycle Management
OEC7502	Reliability Engineering
OEC7503	Management Information System
OEC7504	Design of Experiments
OEC7505	Operation Research
OEC7506	Cyber Security and Laws
OEC7507	Disaster Management and Mitigation Measures
OEC7508	Energy Audit and Management
OEC7509	Development Engineering

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Course Code	Course Name	Credits
OEC7501	Product Life Cycle Management	03

Course Objectives: Students will try:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM):Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies:Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10



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02	ProductDesign: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

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Course Code	Course Name	Credits
OEC7502	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08



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03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

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Course Code	Course Name	Credits
OECE7503	Management Information System	03

Objectives:

1. The course is a blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7



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04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8



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Course Code	Course Name	Credits
OEC7504	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

2.

Module	Detailed Contents	Hrs
01	Introduction Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06
02	Fitting Regression Models Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08



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03	Two-Level Factorial Designs The 2^2 Design The 2^3 Design The General 2^k Design A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07
05	Response Surface Methods and Designs Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07



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06	Taguchi Approach Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods Robust design examples	04
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Course Code	Course Name	Credits
OEC7505	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	14

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	Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
02	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

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Course Code	Course Name	Credits
OEC7506	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyber line Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms,	6

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	Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6



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Course Code	Course Name	Credits
OEC7507	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion. Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09

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03	Disaster Management, Policy and Administration Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority DMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06



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Course Code	Course Name	Credits
OEC7508	Energy Audit and Management	03

Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe the present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04

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R-2025- B.E.(SemVII) Electronics and Computer Science

02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment and appliances, star ratings. Energy efficiency measures in lighting systems, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03



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R-2025- B.E.(SemVII) Electronics and Computer Science

Course Code	Course Name	Credits
OEC7509	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Demonstrate understanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans	07

	and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

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(Regd.)**

**Shree L.R. Tiwari College of
Engineering**

Shree L.R. Tiwari Educational

Campus, Mira Road–East, Thane-401

107.Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai



Department of Electronics and Computer Science

A.Y 2025-26

Final Year: Semester VIII

Prepared by: Board of Studies for Electronics and Computer Science

**Approved By: Academic Council of Shree L.R. Tiwari College of
Engineering**

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class center for socio-economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-concentric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socioeconomic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2. Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impact solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. Empowering Faculty as Mentors and Innovators SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.

Sincerely,

**IQAC Chairperson
SLRTCE**

**COO
Rahul Education**

PREFACE FROM CHAIRPERSON (BOS)

Dear Colleagues and Esteemed Members of the Board,

It is my pleasure to present the newly revised Electronics and Computer Science curriculum—crafted under our recently granted Autonomous status and in compliance with NEP 2020 Building upon the strong foundational framework of SLRTCE’s legacy—where industry-oriented, tools-based learning complements core computing principles—this syllabus ushers in a truly student-centric, flexible, and future-ready program.

The Electronics and Computer Science (ECS) program at our autonomous institute under Mumbai University is a forward-looking, interdisciplinary course that combines the robust foundations of electronics with the transformative capabilities of computer science. The program equips students with the knowledge and skills needed to design, develop, and optimize intelligent systems, enabling innovation at the intersection of hardware and software.

As an autonomous institution, we utilize academic independence to continuously update and enrich the curriculum to reflect emerging technologies and industry demands, including areas such as Internet of Things (IoT), artificial intelligence, embedded systems, robotics, and cyber-physical systems.

A key feature of the program is the integration of the Idea Lab, a dynamic innovation ecosystem where students engage in hands-on, project-based learning. This lab nurtures creativity, design thinking, and entrepreneurial mindsets, enabling students to take ideas from concept to prototype, often in collaboration with industry, faculty, and the community.

The ECSE program strongly emphasizes societal impact. Students are encouraged to develop technology-driven solutions to address real-world challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs). Whether it is promoting quality education (SDG 4) through ed-tech innovations, enhancing good health and well-being (SDG 3) with biomedical devices, contributing to sustainable cities and communities (SDG 11) through smart systems, or driving climate action (SDG 13) using intelligent environmental monitoring, the curriculum instills a deep sense of purpose and responsibility.

Through a balance of theoretical grounding, practical application, ethical awareness, and social commitment, the ECSE program prepares graduates to become technological leaders, responsible citizens, and agents of sustainable development in a rapidly evolving global landscape.

Mrs. Samita Bhandari
Chairperson, Board of Studies (ECS), SLRTCE

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A. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

B. Academic Brief

1. Internal Assessment (Formative Assessment):

These assessments aim to evaluate students' continuous academic progress. Internal Assessment (IA) will consist of two compulsory Internal Assessment Tests of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour. Summation of the two tests will be considered as IA marks. The first IA will be scheduled around the 6th week, and the second IA around the 13th week from the commencement of the semester.

2. End Semester Examination (60-Marks):

- i. Question paper will comprise of total 06 questions, each carrying 10 marks
- ii. The questions for 10M will be based on each module of the syllabus.
- iii. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
- iv. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B. Remaining questions will be in similar nature and selected from the respective module.
- v. Total 06 questions need to be attempted.

3. Monthly Defaulter List:

A defaulter list identifying students with attendance or academic performance concerns will be prepared and circulated every month.

4. Defaulter Meeting with Attendance Committee:

Students listed as defaulters will meet with the Attendance Committee on the first Saturday of every month.

C: Curriculum Structure – BE Semester-VIII

Table 1: Course-wise Teaching Scheme and Credit Structure

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECC801	Robotics	3	-	-	3	-	-	3
PCC	ECC82X	Professional Elective Course – 5	3	-	-	3	-	-	3
PCC	ECC83X	Professional Elective Course-6	3	-	-	3	-	-	3
OE	OEC84WW	Open Elective -2	3	-	-	3	-	-	3
PCCL	ECL805	Robotics Lab	-	2	-	-	1	-	1
PCCL	ECL86X	Department Level Optional Course - V Lab	-	2	-	-	1	-	1
MJP	ECL807	Major Project II	-	8#	-	-	4	-	4
	OJT899	Internship /On Job training					4		4
	Total		12	12	-	12	10	-	22

D. Examination Scheme – BE Semester-VIII

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Oral	Total
		IAT-1	IAT-2	Total					
ECC801	Robotics	20	20	40	60	2.5	-	-	100
ECC82X	Professional Elective Course – 5	20	20	40	60	2.5	-	-	100
ECC83X	Professional Elective Course-6	20	20	40	60	2.5	-	-	100
OEC84WW	Open Elective -2	20	20	40	60	2.5	-	-	100
ECL805	Robotics Lab	-	-	-	-	2.5	25	25	50
ECL86X	Professional Elective Course – 5 Lab	-	-	-	-	-	25	25	50
ECL807	Major Project II	-	-	-	-	-	50	100	150
OJT899	Internship /On Job training						25		
	Total			160	240	-	125	150	675

indicates work load of Learner (Not Faculty), for Major Project Students group and load of faculty per week.

Professional Elective Course – 5

	Professional Elective Course – 5
ECC821	1. MEMS Technology
ECC822	2. Natural Language Processing
ECC823	3. 3-D Printing and Design
ECC824	4. Advanced Algorithms

Professional Elective Course – 6

	Professional Elective Course-6
ECC831	1. Advanced Networking Technologies
ECC832	2. Multimedia and Virtual Reality
ECC833	3. Quantum Computing
ECC834	4. System Security

Open Elective Course (OE)

Every student is required to take one **Open Elective** Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in both the semesters.

	Open Elective -2 (Common for all branches will be notified)
OEC8401	Project Management
OEC8402	Finance Management
OEC8403	Entrepreneurship Development and Management
OEC8404	Human Resource Management
OEC8405	Professional Ethics and CSR
OEC8406	Research Methodology
OEC8407	IPR and Patenting
OEC8408	Digital Business Management
OEC8409	Environmental Management

R-2025- B.E (Sem-VIII) Electronics and Computer Science

SEM VIII



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC801	Robotics	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC801	Robotics	20	20	40	60	2.5	--	--	100

Rationale:

The purpose of robotics is to design, build, and use robots to perform tasks that are difficult, dangerous, or repetitive for humans, ultimately aiming to improve efficiency, safety, and quality of life.

Course Objectives:

To introduce robot types, components, joints, coordinates, and specifications.

1. To explain mathematical models and transformations for robot positioning.
2. To study inverse kinematics and analyze robot workspaces.
3. To understand motion trajectories in joint and Cartesian space.
4. To explore robotic task planning and motion under uncertainty.
5. To study vision techniques and robot programming languages.



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Course Outcomes:

After successful completion of the course students will be able to:

1. *Identify* various types, components, and coordinate systems of robots.
2. *Apply* dot and cross products and *compute* arm equations using transformation matrices.
3. *Solve* inverse kinematics problems and *analyze* workspace limitations of robotic manipulators.
4. *Design* and *evaluate* joint-space and Cartesian-space trajectories for robotic motions.
5. *Simulate* path planning and *compare* different planning algorithms under uncertainty.
6. *Implement* basic vision techniques and *differentiate* among robot programming languages and control software.

Prerequisite: Applied Mathematics III, Applied Mathematics IV, Controls and Instrumentation

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	2D/3D coordinate transformations, Vectors and matrices, Open-loop and closed-loop control, Basic image processing	02	
I	Fundamentals of Robotics	Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Specification Notations, Applications.	04	CO1
II	Direct Kinematics	Dot and Cross Products, Co-ordinate frames, Rotations, Homogeneous Co-	07	CO2



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R-2025- B.E(SEM VIII) Electronics & Computer Science

		ordinates, Link Co-ordinates, Arm Equation (3 axis and 4 axis Robots)		
III	Inverse Kinematics and Work Space Analysis	General properties of solutions, Tool Configuration, Inverse kinematics of 3 axis, 4 axis and 5 axis Robots, Work Space Analysis of 3 axis and 4 axis Robots, Work Envelope.	07	CO3
IV	Trajectory planning	Basics of Trajectory planning , Joint-space trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion	04	CO4
V	Task Planning	Task level programming, Uncertainty, Configuration Space, Gross motion Planning; Grasp planning, Fine-motion Planning, Simulation of Planer motion, Source and goal scenes, BUG 1, BUG 2 and Tangent Bug Algorithms	07	CO5
VI	Robot Vision and Robot Languages	Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform. Robot language, Classification of Robot languages, Computer control and Robot software, Variable Assembly Language system and language	08	CO6



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Text Books:

1. Robert Shilling, “Fundamentals of Robotics - Analysis and control, Prentice Hall of India, 2009
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

References:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006
3. Mikell P. Groover et.al, ”Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008
5. S. R. Deb and Sankha Deb, “Robotics Technology and Flexible Automation” , Second Edition. TMH



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC821	MEMS Technology	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pr act / Or al	Total
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT 1	IAT 2	Total					
ECC821	MEMS Technology	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To provide knowledge of MEMS fabrication steps.
2. To provide knowledge of MEMS Materials with respect to applications.
3. To demonstrate the use of semiconductor-based fabrication processes for sensors and actuators
4. To provide an understanding of basic design and operation of MEMS sensors, actuators and passive structures.

Course Outcomes:



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After successful completion of the course students will be able to:

1. Understand the different MEMS devices, working principles.
2. Understand MEMS materials and their properties.
3. Develop different concepts of MEMS sensors and actuators for real-world applications
4. Understand the rudiments of Micro-fabrication techniques
5. Understand Construction, working applications and fabrications steps of MEMS devices.
6. To understand reliability of MEMS devices after fabrication process.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to MEMS	1.1 Introduction to MEMS and Micro Electronics Technologies.	04	CO1
		1.2 MEMS in Real world applications such as Air-Bag, DMD, Pressure Sensors, MEMS Challenges, MEMS Sensors in Internet of Things (IoT), Bio-medical applications		
II	MEMS Materials and Their Properties	2.1 Use of Si, SiO ₂ , SiN, SiC, Cr, Au, Al, Ti, SU8, PMMA, Pt in building MEMS applications.	07	CO2
		2.2 Material properties such as Young modulus, Poisson's ratio, density, piezo resistive coefficients, TCR, Thermal Conductivity, Thermoelectricity.		
III	MEMS Sensors and Actuators	3.1 Types MEMS Sensing (Capacitive, Piezo electric Piezo resistive)	08	CO3
		3.2 Micro Actuation Techniques (Thermal, Piezo electric, Electro static), Shape Memory Alloys, Micro Grippers, Micro Gears, Micro Motors, Micro Valves, Micro Pumps.		
IV		4.1 MEMS Processes & Process parameters: Bulk & Surface Micromachining, High Aspect	08	CO4



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	MEMS Fabrication Processes	Ratio MEMS (LIGA) .		
		4.2 X-Ray Lithography, Photolithography, PVD, Wet etching, Dry etching, Plasma etching, DRIE, Etch Stop Techniques, Die, Wire & Wafer Bonding, Dicing, Packaging.		
V	MEMS Devices	5.1 Construction and working and applications of basic Cantilever structure, Micro heaters, Accelerometers, Pressure Sensor , Micromirrors in DMD, Inkjet printer ,Steps involved in fabrication of above devices.	09	CO5
VI	MEMS Reliability	6.1 Reliability and various failure mechanisms for MEMS. 6.2 Reliability curve.	03	CO6
	MEMS Reliability	6.1 Reliability and various failure mechanisms for MEMS. 6.2 Reliability curve.		
Total			39	

Text Books:

1. An Introduction to Micro-Electromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc.
2. Micro-system Design - by S. Senturia; Publisher: Springer.
3. Introduction to Electromechanical system design –by James J Allen. Taylor & Francis Group, LLC publication

Reference Books:

1. Fundamentals of Micro-fabrication - by M. Madou; Publisher: CRC Press; 2nd edition.
2. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill4.

Online References:



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Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117105082
2.	https://archive.nptel.ac.in/courses/108/108/108108113/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC822	Natural Language Processing	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC822	Natural Language Processing	20	20	40	60	2.5	--	--	100

Rationale:

Natural Language Processing (NLP) is a vital area of artificial intelligence that enables computers to understand and interact with human language. This subject equips students with the skills to develop applications like chatbots, translators, and sentiment analyzers, combining knowledge from linguistics, computer science, and machine learning. As NLP is widely used in industries such as tech, healthcare, and finance, learning it boosts employability and prepares students for advanced AI work. The course also promotes innovation and helps address real-world challenges in communication and information processing.



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Course Objectives:

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. To design and implement applications based on natural language processing

Course Outcomes:

1. Have a broad understanding of the field of natural language processing.
2. Understand the mathematical and linguistic preliminaries necessary for various processes in NLP
3. Be able to Design, implement and test algorithms for NLP problems
4. Perform Word-Level, Syntax-Level and Semantic-Level Analysis
5. Develop basic understanding of Pragmatics in NLP
6. Be able to apply NLP techniques to design real world NLP applications

Prerequisite:

Python, mathematics (calculus, linear algebra, probability, and statistics), and machine learning

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Python, mathematics (calculus, linear algebra, probability, and statistics), and machine learning		
I	Introduction to Natural Language Processing	The need of NLP. Generic NLP system, Levels of NLP 02 Stages in building a Natural Language Processing System. Challenges and ambiguities in NLP Design	6	CO1



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II	Mathematical and Linguistic Preliminaries	Probability Theory, Conditional Probability and Independence, Bayes Rule, Random Variables, Probability Distributions, Statistics, Counting, Frequency, Mean and Variance 04 English Grammar, Parts of Speech, Phrase Structures	6	CO2
III	Word Level Analysis	Tokenization, Segmentation, Lemmatization, Edit Distance, Collocations, Porter Stemmer, N-gram Language Model 04 Morphological Analysis, Derivational and Reflectional Morphology	6	CO3
IV	Syntax-Analysis	Tag set for English, Penn Tree bank, Introduction to Parts of Speech Tagging (POST) 02 Markov Processes, Hidden Markov Models (HMM) 02 Parts of Speech Tagging using Hidden Markov Models, Viterbi Algorithm	8	CO4
V	Semantic Analysis	Lexical Semantics, ambiguous words, word senses, Relations between senses: synonym, antonym, reversives, hyponym, hypernym, meronym, structured polysemy, metonymy, zeugma Introduction to WordNet, gloss, synset, sense relations in WordNet. Cosine distance between documents. Word sense disambiguation.	8	CO5
VI	Pragmatics and applications of NLP	Reference resolution: Discourse model, Reference Phenomenon, Syntactic and Semantic Constraints on co reference	5	CO6



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		Applications of NLP: Categorization, Summarization, Sentiment Analysis, Named Entity Recognition, Machine Translation, Information Retrieval, Question Answer System		
--	--	--	--	--

Text Books:

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing II Second Edition, Prentice Hall.
2. Christopher D. Manning & Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press.

References:

1. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
2. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor), The Handbook of Computational

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2.	https://www.coursera.org/specializations/natural-language-processing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC823	3-D Printing and Design	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC823	3-D Printing and Design	20	20	40	60	2.5	--	--	100

Rationale:

With the rising influence of digital manufacturing, **3D Printing and Design** serves as a bridge between creativity and engineering. It enables rapid prototyping, sustainable manufacturing, and innovation across industries—from healthcare and aerospace to art and education.

Course Objectives:

1. Understand the fundamentals and evolution of 3D printing technology.
2. Develop 3D models using appropriate design software.
3. Evaluate different 3D printing processes and materials.
4. Analyze the application of 3D printing in industrial and social contexts.
5. Apply principles of sustainable design using additive manufacturing.
6. Promote entrepreneurial thinking through product design challenges.



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Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Explain the evolution of additive manufacturing and differentiate between subtractive and additive processes, highlighting their relevance to global industry trends.
- 2) Compare various 3D printing technologies (FDM, SLA, SLS, MJF, etc.) based on resolution, materials, and cost, and evaluate their suitability for real-world applications.
- 3) Use CAD tools to create printable 3D models by applying design guidelines and troubleshooting techniques for successful print preparation.
- 4) Identify and select appropriate materials based on application requirements, environmental impact, and sustainability considerations.
- 5) Analyze the impact of 3D printing across sectors like healthcare, aerospace, and construction, including ethical and social implications through real-world case studies.
- 6) Apply design thinking to 3D printing-based product development and explore entrepreneurial opportunities within the scope of Atmanirbhar Bharat and digital manufacturing.

Prerequisite: Engineering Drawing, Basic Computer Literacy and CAD tools, Basics of Materials Science

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to 3D Printing	Definition and Evolution of Additive Manufacturing Subtractive vs Additive Manufacturing Overview of 3D Printing Technologies Global trends and relevance to Industry	8	CO1
II	Types of 3D Printing Technologies	FDM (Fused Deposition Modeling) SLA (Stereolithography) SLS (Selective Laser Sintering) Inkjet, Binder Jetting, Multi Jet Fusion (MJF)	6	CO2



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		Comparison of processes based on resolution, cost, and materials		
III	CAD Modeling and Design for 3D Printing	Introduction to 3D modeling tools (TinkerCAD, Fusion 360, SolidWorks) Design guidelines for 3D printing STL generation, slicing and print preparation Troubleshooting design issues	6	CO3
IV	Materials and Sustainability in 3D Printing	Thermoplastics (PLA, ABS), Resins, Composites, Metals Sustainable material choices (bioplastics, recycled filaments) Material selection based on application and environmental impact Lifecycle and waste management	7	CO4
V	Applications and Real-World Case Studies	Biomedical devices (prosthetics, dental models) Aerospace, automotive, construction, education	5	CO5
VI	Innovation, Entrepreneurship and Industry Use-Cases	Prototyping to production Design Thinking in 3D product innovation Entrepreneurship opportunities in 3D printing startups Policies and future of digital manufacturing in India (Atmanirbhar Bharat)	7	CO6

Text Books:

1. Chua Chee Kai, Kah Fai Leong, Chu Sing Lim – *"Rapid Prototyping: Principles and Applications"*, World Scientific Publishing, 5th Edition.
2. Andreas Gebhardt, Jan-Steffen Hötter – *"Additive Manufacturing: 3D Printing for Prototyping and Manufacturing"*, Hanser Publications.
3. Joan Horvath, Rich Cameron – *"3D Printing with Autodesk 123D, Tinkercad, and MakerBot"*, Apress.
4. Ian Gibson, David Rosen, Brent Stucker – *"Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing"*, Springer.



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References:

- 1) Ben Redwood, Filemon Schöffner, Brian Garret – *"The 3D Printing Handbook: Technologies, Design and Applications"*, 3D Hubs.
- 2) Andreas Bastian – *"Design for Additive Manufacturing: Concepts and Applications"*, MIT Additive Manufacturing Center (Online Resource).
- 3) Lior Shamir (Ed.) – *"Biomedical Applications of 3D Printing"*, MDPI – Open Access Scientific Journal (Selected Articles).
- 4) Savio Chauhan, Manish Kumar – *"3D Printing and Additive Manufacturing Technologies"*, Springer India.

Online References:

Sr. No.	Website Name
1.	MDPI.com – Open-access scientific books and journals on additive manufacturing
2.	<u>mitpress.mit.edu</u> – MIT Press open-source books (e.g., <i>Open-Source Lab</i>)
3.	<u>worldscientific.com</u> – Publisher of foundational textbooks in 3D printing
4.	<u>alison.com</u> – Free certification courses on 3D printing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC824	Advanced Algorithms	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC824	Advanced Algorithms	20	20	40	60	2.5	--	--	100

Rationale:

The study of advanced algorithms equips students with the tools to design efficient, scalable solutions for complex computational problems beyond the scope of basic techniques.

Course Objectives:

1. To provide mathematical approaches for Analysis of Algorithms
2. To understand and solve problems using various algorithmic approaches
3. To analyse algorithms using various methods



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Course Outcomes:

At the end of the course learner will be able to

1. Analyze the running time and space complexity of algorithms.
2. Describe, apply and analyze the complexity of divide and conquer, greedy and dynamic programming strategy.
3. Identify appropriate data structures and design techniques for different problems
4. Differentiate polynomial and non-deterministic polynomial algorithms.
5. Analyze various algorithms.

Prerequisite: Data structure concepts, Discrete structure

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to analysis of algorithm	Mathematical background for algorithm analysis, Growth of function – Big –Oh, Omega, Theta notation, Complexity derivations, Solving recurrences using Substitution Method, Recursion tree method and Master method Complexity Classes: P, NP, NP Hard, NP Complete .Amortised Analysis -Aggregate Method, Accounting Method, Potential Method	07	CO1
II	Divide and Conquer approach	General method, Binary Search, Merge Sort, Quick Sort, Randomized quicksort, and Min-max algorithm	06	CO2



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III	Greedy Algorithms	General Method, Knapsack Problem, Huffman's Codes , Minimum Spanning Tree, Kruskal's Algorithm , Prim's Algorithm , Dijkstra's Algorithm	06	CO3
IV	Dynamic Programming Approach	General Method, Making coin change, Principle of optimality, Knapsack Problem, Matrix Chain Multiplication, Activity Selection Problem, Longest common subsequence, All pair shortest path algorithm	08	CO4
V	Maximum Flow	Flow networks, Ford Fulkerson method, Max bipartite matching , Push relabel algorithm , The relabel to front algorithm	06	CO5
VI	Classical Problems in Algorithms	Travelling Salesman problem, Subset Sum Problem, Matrix Multiplication, 15 puzzle , N-queens problem	06	CO5
Total			39	

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
3. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009
4. R.K. Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and



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Applications”, PrenticeHall Englewood Cliffs, NJ 1993.

References:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online References:

Sr. No.	Website Name
1.	NPTEL course: https://nptel.ac.in/courses/106105164
2.	Coursera link: https://www.coursera.org/specializations/algorithms



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC831	Advanced Networking Technologies	03	--	-	03	--	-	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC831	Advanced Networking Technologies	20	20	40	60	2.5	—	—	100

Rationale:

Advanced networking technologies are crucial for modern digital infrastructure, enabling efficient communication, enhanced security, and innovative applications across various industries. They drive digital transformation by facilitating data-driven technologies like IoT, AI, and cloud computing, supporting reliable, high-performance communication.

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These technologies are not just about connectivity; they are about enabling new business models, improving user experiences, and ensuring robust security.

Course Objectives:

1. Understand the characteristic features of Various Wireless networks.
2. Understand the characteristic features of ATM networks.
3. Introduce the need for network security and safeguards.

Course Outcomes:

After successful completion of the course students will be able to:

1. Appreciate the need for Wireless networks and study the IEEE 802.11 Standards
2. Comprehend the significance of Asynchronous Transfer Mode(ATM).
3. Analyze the importance of Optical networking.
4. Demonstrate knowledge of network design and security and management.
5. Understand the concept of multimedia networks.
6. Comprehend the significance of Network Design.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Wireless LAN and WAN Technologies	Introduction to Wireless networks : Infrastructure networks, Ad-hoc networks, IEEE 802.11 architecture and services ,Medium Access Control sub-layers,CSMA/CA, Physical Layer, 802.11,Security considerations Asynchronous Transfer Mode (ATM): Architecture, ATM logical connections, ATM	08	CO1



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		cells , ATM Functional Layers, Congestion control and Quality of service		
II	Optical Networking	SONET : SONET/SDH, Architecture, Signal, SONET devices, connections, SONET layers, SONET frames, STS Multiplexing, SONET Networks WDM, DWDM: Frame format, DWDM architecture ,Optical Amplifier , Optical cross connect Performance and design considerations.	06	CO2
III	Routing in the Internet	Intra and inter domain Routing, Unicast Routing Protocols: RIP, OSPF, BGP Multicast Routing Protocols ,Drawbacks of traditional Routing methods	08	CO3
IV	Network Security	Security goal, Security threats, security safeguards, firewall types and design, IP TABLES Internet Security: Network Layer Security, Transport Layer Security, Application Layer Security	08	CO4
V	Multimedia Information and Networking	Compression Fundamentals, Digital Representation, Compression techniques, Multimedia Communication across networks, RTP, RTSP, SIP,H..323	06	CO5
VI	Network Design	3 tier Network design layers: Application layer, Access layer. Backbone layers, Ubiquitous computing and Hierarchical computing	03	CO6
Total			39	



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Text Books:

1. Behrouz A. Forouzan, "Data communication and networking ", McGraw Hill Education, Fourth Edition.
2. J F. Kurose & KW. Ross: Computer Networking- A Top-down Approach featuring the Internet, 3rd edition,
3. Darren L. Spohn , "Data Network Design" , McGraw Hill Education ,Third edition
4. William Stallings, "Data and Computer communications", Pearson Education, 10th Edition

Reference Books:

1. K. R. Rao et al: Multimedia Communication Systems, Prentice-Hall of India,.
2. Deven Shah , Ambavade, "Advanced Communication Networking"
3. Behrouz A Forouzan , "TCP /IP Protocol Suite" , Tata McGraw Hill Education ,4th edition

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106243
2.	https://onlinecourses.nptel.ac.in/noc23_cs35/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC832	Multimedia System and Virtual reality	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC832	Multimedia System and Virtual reality	20	20	40	60	2.5	--	--	100

Rationale

The Multimedia Systems and Virtual Reality subject is relevant because it equips students with the skills to design and develop interactive, immersive experiences using multimedia technologies. This field is rapidly growing, finding applications in diverse areas like education, entertainment, and training. Virtual reality, in particular, offers unique learning opportunities through simulation and immersive engagement, enhancing knowledge retention and engagement.

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Course Objectives:

1. To introduce students about basic fundamentals and key aspects of the multimedia system.
2. To provide knowledge of compression techniques of different multimedia components.
3. To discuss the multimedia authoring tools and security in multimedia systems.
4. To comprehend and analyse the fundamentals of virtual reality systems.
5. To learn different pipeline and modelling techniques in virtual reality.
6. To understand various programming languages in virtual reality.

Course Outcomes:

1. Understand the basics of multimedia and multimedia system architecture.
2. Analyze file formats and compression algorithms for different multimedia components.
3. Understand multimedia authoring systems and apply security techniques in multimedia environments.
4. Define the fundamentals of virtual reality and its related technologies.
5. Understand typical rendering pipeline and modelling techniques.
6. Design an application with the principles of virtual reality.

Prerequisite: Computer Fundamentals, Graphics, Communication Theory, ISO-OSI Model, Java Classes

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		Definition of Multimedia, Characteristics of Multimedia System, History of Multimedia System, Difference between Multimedia and Hypermedia, Objects and Elements of Multimedia, Applications of Multimedia. Multimedia System Architecture: Workstation Architecture, IMA Architectural Framework, Network	05	CO1

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		Architecture for Multimedia Systems, Types of Medium (Perception Media, Representation Media, Presentation Media, Storage Media, Transmission Media, Information Exchange Media), Interaction Techniques.		
II	Multimedia Types, File Formats and Compression Techniques	Digital Image: Representation (2D format, resolution), Types of Images (monochrome, gray, color), File formats like BMP, JPG, Compression Techniques: fundamentals (coding, interpixel and psychovisual redundancies), Types –lossless and lossy, Lossless Compression; Algorithms– Shannon-Fano, CCITT Group 4 2D, Lossy Compression Algorithm – JPEG. Digital Audio: Computer representation of sound, File Formats – WAV, MPEG Audio, Compression: PCM, DM, DPCM. Digital Video: Digitization of Video, types of video signals (component, composite and S-video), File Formats: MPEG Video, H.261, Compression: MPEG Early stopping, Data Augmentation, Adding noise to input and output.	10	CO2
III	Multimedia Authoring and Security	Authoring System: Overview, Introduction to Authoring Tools, Features of Authoring Tools, Design Issue of Multimedia Authoring, Types of Authoring Systems. Digital Watermarking: Concept, Visible and Invisible Watermarks, Watermarking Classification (Spatial Domain, Transform Domain, Feature Domain), Digital Watermarking Applications. Steganography: Concept and Types Image Authentication: Issues and Digital Signature Based Image Authentication.	06	CO3
IV	Introduction to Virtual Reality	Definition of Virtual Reality (VR), Classical Components of VR System, Important Factors in a VR System, Types of VR Systems, VR Advantages, VR Input Output Devices, Applications of VR System.	4	CO4
V	VR Rendering Pipeline	Graphical Rendering Pipeline, Haptic Rendering Pipeline, OpenGL Rendering Pipeline, Geometric Modelling,	06	CO5

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	and Modelling	Kinematic Modelling, Physical Modelling, Behavior Modelling		
VI	VR Programm ing	VRML, Extensible 3D (X3D), Java 3D, OpenGL	06	CO6
Total			39	

Text Books:

1. Prabhat K. Andleigh&KiranThakrar, "Multimedia System Design", Pearson, 2015.
2. Rajesh K. Maurya, "Computer Graphics with Virtual Reality Systems", 3rd Edition, Wiley, 2018.
3. K.R.Rao,D.Milovanovic, Multimedia Communication Systems: Techniques, Standards and Networks, Pearson, 2012.
4. Koegel Buford, "Multimedia Systems", Pearson, 2002.

References:

1. Steinmetz Ralf and NahrstedtKlara, "Multimedia: Computing, Communications and Applications", Pearson, 2008.
2. AtulPuri, "Multimedia Systems, Standards, and Networks", 1st Edition, CRC Press, 2000.
3. Frank Y. Shih, "Multimedia Security: Watermarking, Steganography and Forensics", CRC Press, 2013.
4. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd Edition, Wiley, 2003.
5. John Vince, "Virtual Reality Systems", Pearson, 2002.

Online references:

Sr. No.	Website Name
1.	Multimedia Systems: https://nptel.ac.in/courses/117105083

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2.	Virtual Reality: https://nptel.ac.in/courses/106106138
3.	Virtual Reality Specialization: https://www.coursera.org/specializations/virtual-reality

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC833	Quantum Computing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC833	Quantum Computing	20	20	40	60	2.5	--	--	100

Rationale

Quantum Computing introduces students to a new computing paradigm based on quantum mechanics, offering solutions to problems beyond the reach of classical systems. The subject covers key concepts like qubits, superposition, entanglement, and quantum algorithms, with hands-on experience using quantum simulators and platforms. It prepares students for emerging careers and research in fields such as cryptography, optimization, and AI, fostering interdisciplinary learning and innovation.

Course Objectives:

1. To understand basics of quantum computing
2. To understand mathematics required for quantum computing.
3. To understand building blocks of quantum computing.



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4. To understand quantum algorithms.
5. To understand quantum hardware principles.
6. To understand tools for quantum computing. To introduce students about basic fundamentals and key aspects of the multimedia system.

Course Outcomes:

1. Explain basic concepts of quantum computing
2. Explain mathematical fundamentals required for quantum computing.
3. Explain building blocks of quantum computing through architecture and programming models.
4. Explain quantum algorithms.
5. Explain quantum hardware building principles.
6. Explain usage of tools for quantum computing. Understand the basics of multimedia and multimedia system architecture.

Prerequisite: Digital System Design Engineering ,Mathematics-III ,Data Structures and Algorithm

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Quantum Computing	Motivation for studying Quantum Computing Origin of Quantum Computing Quantum Computer vs. Classical Computer Introduction to Quantum mechanics Overview of major concepts in Quantum Computing Qubits and multi-qubits states Bloch Sphere representation Quantum Superposition Quantum Entanglement Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)	7	CO1



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II	Mathematical Foundations for Quantum Computing	Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.	05	CO2
III	Building Blocks for Quantum Program	Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubits States Quantum - superposition of qubits (valid and invalid superposition) Quantum Entanglement Useful states from quantum algorithmic perspective e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit No Cloning Theorem and Teleportation Programming model for a Quantum Computing Program Steps performed on classical computer Steps performed on Quantum Computer Moving data between bits and qubits.	08	CO3
IV	Quantum Algorithms and Error correction	Quantum Algorithms Shor's Algorithm Grover's Algorithm Deutsch's Algorithm Deutsch -Jozsa Algorithm Quantum error correction using repetition codes 3 qubit codes Shor's 9 qubit error correction Code	06	CO4
V	Quantum Hardware	Ion Trap Qubits The DiVincenzo Criteria Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor Quantum Mechanics of a Free Rotor: A Poor Person's Atomic Model: Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, Light-Induced Rotor-Phonon Interactions, University of Mumbai (B.E. Electronics and Computer Science) Page 103 of 140 Trapped Ion Qubits, Mølmer-Sørensen Coupling .	10	CO5



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		Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits Quantum computing with spins: Quantum inverter realized with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate.		
VI	OSS Toolkits for implementing Quantum program	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM)	03	CO6
Total			39	

Text Books:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley, 2008
3. Vladimir Silva, Practical Quantum Computing for Developers, 2018
4. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
5. Supriyo Bandopadhyay and Marc Cahy, "Introduction to Spintronics", CRC Press, 2008.

References:

1. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
2. La Guardia, Giuliano Gladioli "Quantum Error correction codes" Springer,

Online references:

Sr. No.	Website Name
1.	https://qiskit.org/textbook-beta/
2.	https://nptel.ac.in/courses/106106232
3.	https://onlinecourses.nptel.ac.in/noc21_cs103/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC834	System Security	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC834	System Security	20	20	40	60	2.5	--	--	100

Rationale:

The rationale of system security is to protect information systems and the data they contain from unauthorized access, use, disclosure, disruption, modification, or destruction. It's a crucial practice for maintaining the confidentiality, integrity, and availability of sensitive information and ensuring the proper functioning of systems.

Course Objectives:

1. To understand the fundamentals of system security.
2. To explore the working principles and utilities of various crypto algorithms including Secret key Cryptography and public key algorithms
3. To understand the various controls available for protection against internet attacks, including integrity check, firewalls, intruder detection systems.
4. To understand, and evaluate different attacks on Open Web Applications and Web services
5. To describe the mechanisms used to provide security in different infrastructure

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and networks.

6. To perform Security Auditing and Analysis

Course Outcomes:

1. Understand the concept of vulnerabilities, attacks and protection mechanisms.
2. Understand the working of various crypto algorithms.
3. Analyze various controls available for protection against internet attacks.
4. Evaluate different attacks on Open Web Applications and Web services
5. Analyze mechanisms used to provide security in different infrastructure and networks
6. Perform security monitoring and testing of system

Prerequisite:

Computer Networks

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Networks		
I	The Need for System Security	1.1 Risks, Threats, and Vulnerabilities, Tenets of Information Systems Security (Confidentiality, Integrity, Availability) 1.2 Malicious Attack Birthday Attacks, Brute-Force Password Attacks, Dictionary Password Attacks, IP Address Spoofing Hijacking, Replay Attacks, Man-in-the-Middle Attacks Masquerading, Eavesdropping, Social	4	CO1

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		Engineering, Phreaking, Phishing, Pharming		
II	Cryptography	2.1 Cryptography: Overview of Cryptography: What is cryptography, encryption and decryption techniques, Symmetric and asymmetric key cryptography: AES, DES, RSA, Knapsack crypto system.	6	CO2
III	Network Security	3.1 Firewall: Need of Firewall, types of firewall- Packet Filters, Stateful Packet Filters, Application Gateways, Circuit gateways. Firewall Policies, Configuration, limitations, DMZ, VPN. 3.2 Intrusion Detection System Vulnerability Assessment, Misuse detection, Anomaly Detection, Network Based IDS, Host-Based IDS, Honeypots 3.3 Kerberos: Working, AS, TGS, SS 3.4 IP Security-Overview, Protocols- AH, ESP, Modes-transport and Tunnel. 3.5 Public key infrastructure Introduction, Certificates, (PKI): Certificate Authority, authority, Registration 3.6 X.509/PKIX certificate format. 3.7 Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3	9	CO3
IV	Web Security	4.1 Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross Site Request Forgery, Session Hijacking and	7	CO4

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		Management, Secure Electronic Transaction, Email Attacks, DNS Attacks, Web Service Security.		
V	Infrastructure Security	5.1 Physical Security: Managerial, Technical And Physical Controls, Environmental Exposures And Controls, Physical Access Controls 5.2 Wireless network Security: IEEE 802.11xWireless LAN Security, Wireless Intrusion Detection System (WIDS) 5.3 Mobile Security: Security Threats, Device Security, Cloud Security: Cloud Security Risks and Countermeasures, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth 5.4 IOT Security: IoT Concepts, IoT Attacks, IoT Hacking Methodology, IoT Hacking Tools, IoT Countermeasures	9	CO5
VI	Security Auditing and Analysis	How to define your audit plan? What auditing benchmarks are? How to collect audit data? Which post-audit activities you need to perform? How to perform security monitoring? Which types of log information you should capture? How to verify security controls? How to monitor and test your security systems?	4	CO6

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Text Books:

- 1 Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education .
3. Fundamentals of Information system security, Third Edition, David Kim, Michael G. Solomon, Jones & Bartlett Learning
4. Network Security and Cryptography, Bernard Menezes, Cengage Learning
5. Network Security Bible, Eric Cole, Second Edition, Wiley

References:

1. Web Application Hackers Handbook by Wiley.
2. Information Security The Complete Reference, 2nd Edition, Mark Rhodes-Ousley, McGraw Hill Education
3. Computer Security, Dieter Gollman, Third Edition, Wiley
4. CCNA Security Study Guide, Tim Boyle, Wiley
5. Introduction to Computer Security, Matt Bishop, Pearson.
6. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs88/preview

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL805	Robotics lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ECL805	Robotics lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the mechanical structure and degrees of freedom of robotic arms.
- 2 To derive and compute the position of the end-effector using forward kinematics.
- 3 To differentiate between joint-space and Cartesian-space trajectories.
- 4 To understand and implement template matching in object detection.
- 5 To implement basic iterative control logic using software.
- 6 To integrate kinematics, trajectory planning, and vision for solving a real-world task.

Lab Outcomes:

1. Demonstrate the working principles of 4-axis and 5-axis robotic arms.

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2. Solve forward and inverse kinematics problems for robotic manipulators.
3. Implement joint-space and Cartesian-space trajectory planning.
4. Apply computer vision techniques such as template matching and segmentation for robotic perception.
5. Analyze the role of iterative processing in robot control algorithms.
6. Design and develop a mini-project using robotic and perception systems.

List of Experiments.

Sr No	List of Experiments	LO mapping	Hrs
01	Study/Demo of 4 axis robotic arm	LO1	02
02	Study/Demo of 5 axis robotic arm	LO1	
03	Forward kinematic	LO2	
04	Inverse kinematic	LO2	
05	Joint-space trajectory	LO3	
06	Cartesian-space trajectory	LO3	
07	Template matching	LO4	
08	Iterative processing	LO5	
09	Segmentation	LO4	
10	Mini project	LO6	



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Sr No	List of Assignments / Tutorials	Hrs
01	Study of Robot Types, Kinematics, and Workspace Analysis	02
02	Trajectory Planning, Task Execution, and Vision-Based Control in Robotics	02

Text Books:

1. Robert Shilling, “Fundamentals of Robotics - Analysis and control, Prentice Hall of India, 2009
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

References:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006
3. Mikell P. Groover et.al, ”Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008
5. S. R. Deb and Sankha Deb, “Robotics Technology and Flexible Automation” , Second Edition. TMH

Assessment:

Term Work: Term work consists of performing minimum 6 experiments covering entire syllabus of Robotics, one mini project and two assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL861	MEMS Technology Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ECL861	MEMS Technology Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Understand the fundamental principles of MEMS-based devices through simulation of mechanical, thermal, and electrical behavior.
2. Model cantilever beams, pressure sensors, accelerometers, and actuators using simulation tools such as COMSOL Multiphysics or ANSYS.
3. Simulate the behavior of smart materials like Shape Memory Alloys (SMA) and Piezoelectric materials in sensor and actuator applications.
4. Perform thermal and structural analysis of MEMS-based thermal actuators.
5. Analyze and interpret experimental results from hardware-based MEMS setups.
6. Investigate recent advances in MEMS technology through case studies and literature reviews.

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Lab Outcomes:

By the end of this course, students will be able to:

1. Demonstrate modeling and simulation of a cantilever beam and identify its resonance behavior. (Apply)
2. Simulate pressure sensors and analyze sensitivity under varying environmental conditions. (Analyze)
3. Design and validate the performance of MEMS-based accelerometers using simulation tools. (Create)
4. Evaluate thermal behavior and displacement of MEMS thermal actuators. (Evaluate)
5. Conduct hardware testing of MEMS devices and interpret sensor response. (Apply, Analyze)
6. Prepare a case study report on a recent advancement or innovation in MEMS technology. (Create, Evaluate)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Modeling and simulation of cantilever .	2
02	Modeling and simulation of pressure sensor .	2
03	Modeling and simulation of accelerometer .	
04	Modeling and simulation of thermal actuator. .	2
05	Modeling and simulation of SMA .	2
06	Modeling and simulation of Piezoelectric sensor. .	2
07	Hardware experiment on MEMS devices.	2
08	Hardware experiment on MEMS devices	2

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09	Case study on advance topic.	2
10	Case study of recent development in the subject.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Case study on any MEMS device	2
02	Review paper writing on advance topic.	2

Text Books:

1. An Introduction to Micro-Electromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc.
2. Micro-system Design - by S. Senturia; Publisher: Springer.
3. Introduction to Electromechanical system design –by James J Allen. Taylor & Francis Group, LLC publication

Reference Books:

1. Fundamentals of Micro-fabrication - by M. Madou; Publisher: CRC Press; 2nd edition.
2. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill4.

Online Resources:

Sr. No.	Website Name
1.	Refer to review papers in IEEE Journal of Microelectromechanical Systems.

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

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Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL 862	Natural Language Processing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ECL862	Natural Language Processing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To implement text preprocessing techniques such as tokenization, filtration, script validation, stop word removal, and stemming.
2. To analyze the morphological structure of words using Add-Delete tables for better understanding of root word derivation.
3. To understand and apply statistical language modeling techniques using N-gram models.

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4. To implement Parts of Speech (POS) tagging using rule-based and statistical approaches.
5. To compute emission and transition probabilities and apply the Hidden Markov Model (HMM) for POS tagging.
6. To develop and evaluate models for Chunking and Named Entity Recognition (NER) using tagged corpora.

Lab Outcomes:

1. Apply standard NLP preprocessing methods including tokenization, stop word removal, and stemming.
2. Validate and clean input text using script normalization techniques and understand their importance in multilingual NLP.
3. Construct and use Add-Delete tables for morphological analysis and root word extraction.
4. Build and evaluate N-gram language models and use them for predictive text generation and probability estimation.
5. Implement POS tagging using HMM and Viterbi decoding by calculating emission and transition probabilities.
6. Identify syntactic patterns using chunking and extract named entities using NER techniques.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Preprocessing of text (Tokenization, Filtration)	2
02	Preprocessing of text (Script Validation)	2
03	Preprocessing of text (Stop Word Removal, Stemming)	2
04	Understanding the morphology of a word by the use of the Add-Delete table.	2



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05	N-gram model	2
06	POS tagging	2
07	Calculation of emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	2
08	Find POS tags of words in a sentence using Viterbi decoding.	2
09	Chunking	2
10	Named Entity Recognition	2

Text Books:

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing | Second Edition, Prentice Hall.
2. Christopher D. Manning & Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press.

References:

1. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
2. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor), The Handbook of Computational

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2.	https://www.coursera.org/specializations/natural-language-processing

Assessment:

Term Work: Term Work shall consist of at least 8 practical's based on the above list. Also, Term work Journal must include at least 2 assignments.



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Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL863	3-D Printing and Design Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ECL863	3-D Printing and Design Lab	--	--	--	--	25	25	50

Rational:

The 3D Printing and Design Lab offers practical exposure to digital modeling and additive manufacturing processes. It enables students to design, prototype, and fabricate components using CAD tools and 3D printers. This hands-on experience fosters innovation and prepares learners for careers in product design, engineering, and rapid prototyping.

Lab Objectives:

1. Understand the operational workflow of various 3D printing technologies.
2. Develop digital 3D models using CAD tools.
3. Slice 3D models and configure printer settings for optimal output.



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4. Fabricate physical prototypes from digital designs.
5. Evaluate printed models for dimensional accuracy and structural integrity.
6. Integrate design thinking principles to address real-world and SDG-aligned problems.

Lab Outcomes:

On successful completion of the course learner will be able to:

1. Identify components and working of various types of 3D printers
2. Create CAD models for 3D printing using design software
3. Slice and simulate digital designs with correct printer settings
4. Operate a 3D printer and fabricate a physical model
5. Test and evaluate printed models for quality and errors
6. Apply design thinking to solve sustainable development problems

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of different 3D printing technologies and their working principles	
02	Introduction to 3D Printer hardware and software (FDM/Resin printer setup)	
03	Create basic CAD models using Tinkercad / Fusion 360 / FreeCAD	
04	Design a parametric model using OpenSCAD	
05	Import CAD model into slicer (Ultimaker Cura/PrusaSlicer), generate G-code	
06	Calibrate and operate a 3D printer to print a basic mechanical part	
07	Print a 3D model from STL file (e.g., keychain or mobile holder)	
08	Design and fabricate a sustainable product prototype (e.g., water-saving tap nozzle, prosthetic part)	



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09	Troubleshoot 3D print failures (layer shifting, under/over extrusion, warping)	
10	Dimensional accuracy and tolerance check on printed models using calipers	

Sr No	List of Assignments / Tutorials	Hrs
01	ASSIGNMENT 1: 1. Write a comparative report on FDM vs SLA vs SLS printing techniques. (SDG 9 – Industry Innovation) 2. Case study: How 3D printing contributed to COVID-19 medical supplies. (SDG 3 – Good Health & Wellbeing)	3
02	ASSIGNMENT 2: 1. Prepare a research note on sustainable materials for 3D printing. (SDG 12 – Responsible Consumption) 2. Design a 3D-printed product to solve a real-world problem in rural India. 3. Analyze the cost of in-house 3D printing vs outsourced rapid prototyping.	3

Text Books:

1. Chua Chee Kai, Kah Fai Leong, Chu Sing Lim – "Rapid Prototyping: Principles and Applications", World Scientific Publishing.
2. Ian Gibson, David Rosen, Brent Stucker – "Additive Manufacturing Technologies", Springer.
3. Ben Redwood, Filemon Schöffner, Brian Garrett – "The 3D Printing Handbook", 3D Hubs.

References:

- 1) Ben Redwood, Filemon Schöffner, Brian Garret – "The 3D Printing Handbook: Technologies, Design and Applications", 3D Hubs.
- 2) Andreas Bastian – "Design for Additive Manufacturing: Concepts and Applications", MIT Additive Manufacturing Center (Online Resource).



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Online Resources:

Sr. No.	Website Name
1.	Free CAD Software: www.tinkercad.com
2.	Free Courses: nptel.ac.in

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL864	Advanced Algorithms Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ECL 864	Advanced Algorithms Lab	--	--	--	--	25	25	50

Lab Objectives:

1. **Understand and implement advanced algorithmic techniques** such as Divide and Conquer, Greedy Algorithms, Dynamic Programming, and Backtracking.

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2. **Analyze the time and space complexity** of algorithms using theoretical and empirical methods.
3. **Solve real-world computational problems** by applying appropriate algorithmic strategies.
4. **Develop proficiency in writing efficient, optimized code** for complex algorithmic problems.
5. **Explore graph algorithms** such as shortest path, minimum spanning tree, and maximum flow in practical scenarios.

Lab Outcomes:

1. Understand the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
4. Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.



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List of Experiments.

Sr No	List of Experiments	Hrs
01	Implementation of Merge and Quick sort using divide and conquer approach	
02	Implementation of Fractional Knapsack	
03	Implementation of Dijkstra's algorithms	
04	Implementation of 0/1 Knapsack using dynamic programming	
05	Implementation of Longest Common Subsequence	
06	Implementation of Floyd's Warshall's algorithm	
07	Implementation of Ford Fulkerson algorithm	
08	Implementation of Maximum Bipartite matching algorithm	
09	Implementation of n-queen using backtracking	
10	Implementation of sum of subsets algorithm	
11	Implementation of 15 puzzle problem	
12	Implementation of Travelling salesman's problem	

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
3. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009
4. R.K. Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and

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Applications”, PrenticeHall Englewood Cliffs, NJ 1993.

References:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online Resources:

Sr. No.	Website Name
1.	NPTEL course: https://nptel.ac.in/courses/106105164
2.	Coursera link: https://www.coursera.org/specializations/algorithms

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL807	Major Project – II	--	8 [#]	--	--	4	--	4

Indicates workload of Learner (Not Faculty)

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		IAT 1	IAT 2	Avg.					
ECL807	Major Project – II	--	--	--	--	50	100	--	150

Subject Code	Subject Name	Credits
ECL807	Major Project – II	4
Course Objectives	The course is aimed 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.	

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Course Outcomes	On successful completion of course learner/student will be able to: 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyze the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. 9. Demonstrate project management principles during project work.
------------------------	--

Guidelines for Major Project

- Students should form groups with minimum 2(two) and not more than 4 (four)
- Students should do survey and identify needs, which shall be converted into problem statement for major project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Student shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of major project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during major project activity; however, focus shall be on self-learning.

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- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the major Projects.

Guidelines for Assessment of

Major Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in the semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - o Marks awarded by guide/supervisor based on log book : 30
 - o Marks awarded by review committee : 30
 - o Quality of Project report : 40

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Review/progress monitoring committee may consider following points for assessment.

- In VIII semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in _____ an _____ earlier _____ semester.
- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Assessment criteria of Major Project-II

Major Project-II shall be assessed based on following criteria;

1. Cost effectiveness and Societal impact
2. Full functioning of working model as per stated requirements
3. Effective use of skill sets
4. Effective use of standard engineering norms
5. Contribution of an individual's as member or leader
6. Clarity in written and oral communication



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Guidelines for Assessment of Major Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Major 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 organizations 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.

Major Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individuals as member or leader
8. Clarity in written and oral communication

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Open Elective Course (OE)

Every student is required to take one **Open Elective** Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

OE84WW	Open Elective -2 (Common for all branches will be notified)
OE8401	Project Management
OE8402	Finance Management
OE8403	Entrepreneurship Development and Management
OE8404	Human Resource Management
OE8405	Professional Ethics and CSR
OE8406	Research Methodology
OE8407	IPR and Patenting
OE8408	Digital Business Management
OE8409	Environmental Management

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Course Code	Course Name	Credits
OE8401	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge Areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &	6



	performing), team dynamics.	
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. Project Contracting Project procurement management, contracting and outsourcing,	8
06	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6



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REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9th Ed.

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Course Code	Course Name	Credits
OE8402	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06



02	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities	10
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of	05



	Optimal Capital Structure	
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

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2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.



Course Code	Course Name	Credits
OE8403	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09



03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

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1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises,



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9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in



Course Code	Course Name	Credits
OE8404	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5



02	Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness. High performing teams, Team Roles, cross functional and self-directed team.	7
03	Organizational Structure & Design Structure, size, technology, Environment of organization. Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace. Tactics and strategies.	6
04	Human resource Planning Recruitment and Selection process, Job-enrichment, Empowerment - Job- Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
05	Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
	HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM	



06	Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10
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2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications



Course Code	Course Name	Credits
OE8405	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05



05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

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1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.



Course Code	Course Name	Credits
OE8406	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research Issues and Problems in Research Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research Basic Research Applied Research Descriptive Research Analytical Research Empirical Research Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: • Identification and Selection of Research Problem • Formulation of Research Problem	08



	• Review of Literature • Formulation of Hypothesis • Formulation of research Design • Sample Design • Data Collection • Data Analysis • Hypothesis testing and Interpretation of Data Preparation of Research Report	
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	04

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education



Course Code	Course Name	Credits
OE8407	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07



03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non- patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	07



REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
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13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

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Course Code	Course Name	Credits
OE8408	Digital Business Management	03

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and pervasive computing	06



	EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e- commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	
3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
4	Managing E-Business- Managing Knowledge, Management skills for e- business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy- E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	08

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1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014



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5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective - DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en)OECD Publishing



Course Code	Course Name	Credits
OE8409	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man- made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03



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2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G.Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015