Department of Electronics and Communication Engineering

Bachelor of Technology
in
Electronics and Communication Engineering

Curriculum and Syllabus
IIITUGECE22

2022-2023

SCHOOL OF ELECTRONICS
Indian Institute of Information Technology Una
Himachal Pradesh

B. TECH. CURRICULUM

ACADEMIC YEAR: 2022 – 23

SCHOOL OF ELECTRONICS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IIITUGECE22

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA

SALOH, UNA, HIMACHAL PRADESH

PERSONAL DETAILS

NAME OF THE STUDENT	**:**
PARENT/ GUARDIAN	**:**
ROLL NUMBER	**:**
BATCH	**:**
RESIDENTIAL ADDRESS	**:**
CONTACT NUMBER	**:**
E-MAIL	**:**
BLOOD GROUP	**:**
AADHAR CARD NO.	**:**

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HISTORY OF SCHOOL OF ELECTRONICS

PROGRAM	DESCRIPTION
UG in B.Tech. (Electronics and Communication Engineering)	• Started with 30 seats in 2014 • Intake increased to 66 in 2020

INSTITUTE VISION AND MISSION

INSTITUTE VISION

To build a vibrant multicultural learning environment with value based academic principles and to achieve excellence in teaching and research and to contribute effectively and responsibly to the national and global community.

INSTITUTE MISSION

M1:	To provide quality education to the students with practical orientation.
M2:	To collaborate with industries and research institutions to solve socially relevant problems.
M3:	To inspire students to become responsible citizens and competent professionals with ethical values.

SCHOOL OF ELECTRONICS: VISION AND MISSION

SCHOOL VISION

To impart up-to-date technical knowledge of electronics and communication engineering and equip the students to solve socially relevant global problems.

INSTITUTE MISSION

M1:	To educate the students with theoretical and practical knowledge by imparting quality education.
M2:	To increase research activities in emerging areas through continuous interaction with research organizations and industries.
M3:	To encourage students to entrepreneurship, teamwork, and professional ethics in solving real world problems.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1:	**Technical Competence:** To enable the graduates with the competence of technical skills, entrepreneurship abilities or research attitude for a successful career in electronics and communication engineering.
PEO2:	**Professionalism:** To collaborate with industries and research institutions to solve socially relevant problems.
PEO3:	**Life-long Learning** To inspire students to become responsible citizens and competent professionals with ethical values.

PEO TO MISSION MAPPING

	M1	M2	M3
PEO1	3	3	2
PEO2	2	2	3
PEO3	3	2	3

PEO Statements	Mission Statements	Mapping Level	Justification
PEO1	**M1**	**3**	Mapped strongly as the students will gain technical knowledge in the field of electronics and communication engineering that will enable them to have successful careers.
	M2	**3**	Mapped strongly as, with the interaction with the research organizations and industries, students will be exposed to state-of-art offerings in the field of ECE and will be motivated to pursue successful professional lives.
	M3	**2**	Mapped moderately as students will work on real-life problems as a part of their careers keeping in view the various ethical concerns.

PEO2	**M1**	**2**	Mapped moderately as the graduates will practice the various ethical and social responsibilities in their professional lives.
	M2	**2**	Mapped moderately as the graduates will practice the various ethical and social responsibilities in their professional lives by being exposed to the working of the organizations.
	M3	**3**	Mapped strongly as the graduates will be practicing the various ethical practices in their field of employment while solving various societal problems.
PEO3	**M1**	**3**	Mapped strongly as the graduates will be requiring state-of-art technical knowhow for lifelong learning.
	M2	**2**	Mapped moderately as graduates will be required to keep themselves updated with the latest technologies to be successful in their professional careers.
	M3	**3**	Mapped strongly as the graduates will be requiring strong technical and ethical know how to be successful entrepreneurs while solving socially relevant problems.

PROGRAM SPECIFIC OBJECTIVES

PSO1:	To solve problems and develop innovative solutions pertaining to cyber physical systems, next generation communication systems, artificial intelligence and high-speed networks.
PSO2:	To identify processes and components for the design and development of eco-friendly and energy efficient embedded and VLSI systems.
PSO3:	To apply the fundamentals of mathematics, basic sciences and electronics and communication engineering to develop ingenious solutions in multidisciplinary fields using the ethical practices.

PO/PSO TO PEO MAPPING

PO's		PEO1	PEO2	PEO3
PO1	Engineering Knowledge	3	1	3
PO2	Problem Analysis	3	1	3
PO3	Design/Development of solutions	3	2	3
PO4	Conduct investigations of complex problems	3	1	3
PO5	Modern tool usage	3	2	3
PO6	The engineer and society	1	3	1
PO7	Environment and sustainability	1	2	3
PO8	Ethics	2	3	3
PO9	Individual and Teamwork	3	3	2
PO10	Communication	2	3	3
PO11	Project management and finance	1	2	2
PO12	Lifelong Learning	3	2	3
PSO1	To solve problems and develop innovative solutions pertaining to cyber physical systems, next generation communication systems, artificial intelligence and high-speed networks.	3	2	3
PSO2	To identify processes and components for the design and development of eco-friendly and energy efficient embedded and VLSI systems.	2	3	2
PSO3	To apply the fundamentals of mathematics, basic sciences and electronics and communication engineering to develop ingenious solutions in multidisciplinary fields using the ethical practices.	1	2	3

DESIGN OF CURRICULUM

The B.Tech. Curriculum has been designed conforming to the recommendations of the Senate and guidelines of AICTE, including NEP 2020.

CONFORMANCE TO NEP 2020

I. MULTIPLE EXIT OPTIONS

Sl. No.	Exit Description	Exit Point	Degree/Certificate offered	Goal
1.	First Exit	After completion of First year.	Certificate in ECE	The student should be employable as Technical Assistant (ECE) in any industry/organization.
2.	Second Exit	After completion of Second year.	Diploma in ECE	The student should be employable as Technician (ECE) in any industry/organization.
3.	Third Exit	After completion of Third year.	BS in ECE	The student should be employable as Technical Supervisor (ECE) in any industry/organization.
4.	Normal Exit	After completion of Fourth year.	B. Tech. in ECE	The student should be employable as Engineer (ECE) in any relevant industry/organization.

II. MULTIPLE EXIT OPTIONS

Sl. No.	Entry Descriptions	Entry Point	Eligibility
1.	Normal (First) Entry	I-Sem. of the program	100% through JoSAA/ CSAB based on JEE main entrance.
2.	Second Entry	III-Sem. of the program	The successful completion of first year with certificate in ECE from our institute.
3.	Third Entry	V-Sem. of the program	The successful completion of diploma in ECE from our institute.
4.	Fourth Entry	VII-Sem. of the program	The successful completion of BS in ECE from our institute.

III. No. of maximum exits: one other than normal.

IV. No. of maximum entry: one other than normal.

V. Maximum gap between exit and entry: two years (integral only).

VI. Academic Bank of Credits will be maintained

It is mandatory for the student to register for four theory and three lab courses from I to V semester. The student should undergo industrial training/ internship for a minimum period of five months during the VI semester. In the VII semester, student will register for four theory courses and a lab course, while in the VIII semester three theory courses are mandatory. Project Work will be carried out in the V, VII, and VIII semesters.

Design of curriculum consists of the following components of study:

GENERAL INSTITUTE REQUIREMENT (GIR)

This group of courses consists of Mathematics, Physics, Chemistry, Biology, Professional Communication, Basic Environmental Science and Engineering, Humanities, Signals and Systems, and Computer Programming. Students may choose a management elective subject out of total four subjects mentioned in the curriculum.

PROGRAM CORE (PC)

The PC consists of 9 courses which comprise of both theory and lab components and 2 lab courses specifically for programming. The PC comprises a total number of 49 credits (31 Theories + 18 Labs). All the PC courses will be covered in first two years which covers almost the GATE syllabus.

PROGRAM ELECTIVE (PE)

The total number of 6 PE will be offered in V, VII, and VIII semesters. Students will have to choose one out of two subjects as per their choice. The PE consists of six theory courses out of which three courses comprise labs. The PE comprises a total number of 24 credits (18 Theories + 6 Labs).

STREAM ELECTIVE (SE)

The Institute offers common SE to all the departments. School of Electronics is offering two streams i.e., Cyber Physical Systems and Intelligent Systems. Moreover, Applications, Artificial Intelligence and Machine Learning, Database and Networking, and Security streams are offered by the School of Computing. A total number of 30 subjects will be offered in V, VII, and VIII semesters. The subjects are grouped into six streams and further, each elective comprises five number of subjects, one from each stream. Students will have to choose one out of six subjects as per their choice.

INTERNSHIP (IN)

The curriculum has the support for internship in the adjoining V semester for a minimum period of five months in any of the reputed Industries/ Academic Institutes/ R&D Organizations. Students may identify the industries considering their career choice. Evaluation will be conducted as per the Clause 10.2 of Academic Rules. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or foreign universities are also permitted in lieu of industrial training.

PRACTICUM (PM)

This is a semester project work included in I to IV semester, having 3 credits in each semester. It consists of a practical problem or a project based on the combination of different labs studied in a corresponding semester.

PROJECT WORK (PW)

The PW is designed as a single project for a total duration of three semesters, involving detailed literature survey, implementation plan, and experimentation plan. The percentage of overall project work should be approximately 15 and 35 in V and VII semester respectively. Remaining 50% of the work has to be completed or demonstrated in VIII semester. Evaluation will be conducted as per the Clause 10.3 of Academic Rules.

ONLINE COURSES (OC)

a) Honours Online Courses

This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc,. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded grade must be submitted for the award of suitable letter grade in this course.

b) Optional Online Courses

This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfil the eligibility criteria for Honors can opt for Optional Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc,. In Optional course the

credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

L–T–P–C NOTATION

L-T-P-C ⇒ Lecture – Tutorial – Practicum/Practical – Credits

Credit structure of each course is given in L-T-P-C form (e.g., 2–1–0–3). The numbers corresponding to L, T and P denote the contact hours per week for Lecture, Tutorial and Practical/Practicum respectively, and that of C denotes the total number of credits for that course in a semester.

GRADING CRITERIA

1. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades. All assessment of a course will be done on the basis of marks.
2. The students shall be placed in any of the bands with letter grades: 'S', 'A', 'B', 'C', 'D', 'E' and 'I' with the credit points of '10', '9', '8', '7', '6', '5', '0', respectively.
3. The cut-off mark for completion of a course shall be calculated as $\frac{\overline{X}}{2}$ where $\overline{X}$ is the mean of the class. Students scoring marks above the cut-off mark shall be appropriately placed in top six bands typically 10, 15, 25, 25, 15, 10 percentages respectively. Students scoring less than cut-off mark shall be placed in lower most band ('I').
4. Teachers can adopt any one of the following logical methods to decide the grades: (a) Normalized curve, (b) Z-score, and (c) Gap theory.

General Institute Requirements (GIR)

S. No.	Course Name
1	Engineering Mathematics
2	Engineering Physics *
3	Engineering Chemistry *
4	Introduction to Biotechnology
5	Professional Communication*
6	Basic Environmental Science and Engineering
7	Humanities
8	Basics of Programming in C *
9	Signals and Systems*
10	Electronics/ Computer/ IT Workshop
11	Internship
12	Project Work
13	Technical Clubs/ Sports/ Cultural/ Yoga/ NCC/ NSS
14	Industrial/ Expert Lectures

Program Core Subjects (PC)

S. No.	Course Name
1	Electrical Circuits and Networks*
2	Electronic Devices and Circuits*
3	Digital Circuits and Systems*
4	Electromagnetic Field Theory
5	Communication Systems*
6	Microwave Engineering*
7	Control Systems*
8	Microprocessors and Microcontrollers*
9	Linear Integrated Circuits*
10	Introduction to Python
11	Advanced Python Programming

*** Includes Lab**

CURRICULUM COMPONENTS

S. NO.	COURSE COMPONENT	TOTAL CREDITS	CURRICULUM CONTENT (% OF CREDITS)
1	GIR Theory	32	20
2	PC Theory	31	19
3	PE Theory	18	11
4	GIR Lab	12	08
5	PC Lab	14	09
6	PE Lab	06	04
7	SE	15	10
8	IN	00	00
9	PW	18	11
10	PM	12	08
11	OC (Honours/Optional)	12	07

The curriculum supports approximately 60% of Theory and 40% of Lab including PW and PM. Online courses are optional.

B.TECH. (ECE) – CURRICULUM (IIITUGECE22)

SEMESTER-WISE CURRICULUM

I SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	MAC121	Mathematics - I	3	1	0	4
2	PHC122	Electricity, Magnetism, and Quantum Mechanics	3	0	4	5
3	EVC103	Basic Environmental Science and Engineering	3	0	0	3
4	ECC104	Electrical Circuits and Networks	3	0	4	5
5	ENC125	Communication Skills	3	0	4	5
6	ECL106	Practicum-I	0	0	6	3
		TOTAL	**15**	**1**	**18**	**25**

II SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	MAC221	Mathematics - II	3	1	0	4
2	CYC222	Engineering Chemistry	2	0	4	4
3	BIC203	Introduction to Biotechnology	3	0	0	3
4	CSC204	Basics of Programming in C	3	0	4	5
5	ECC205	Signals and Systems	3	1	4	6
6	ECL206	Practicum-II	0	0	6	3
		TOTAL	**14**	**2**	**18**	**25**

III SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	ECC301	Electronic Devices and Circuits	3	0	4	5
2	ECC302	Digital Circuits and Systems	3	0	4	5
3	ECC303	Electromagnetic Field Theory	3	1	0	4
4	ECC304	Communication Systems	3	1	4	6
5	ECL305	Practicum-III	0	0	6	3
6	ECL306	Introduction to Python	0	0	4	2
		TOTAL	**12**	**2**	**22**	**25**

IV SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	ECC401	Microwave Engineering	3	0	4	5
2	ECC402	Control Systems	3	0	4	5
3	ECC403	Microprocessors and Microcontrollers	3	1	4	6
4	ECC404	Linear Integrated Circuits	3	0	4	5
5	ECL405	Practicum – IV	0	0	6	3
6	ECL406	Advanced Python Programming	0	0	4	2
		TOTAL	**12**	**1**	**26**	**26**

V SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	XXXXXX	Program Elective - I	3	0	4	5
2	XXXXXX	Program Elective - II	3	0	4	5
3	XXXXXX	Program Elective - III	3	0	0	3
4	XXXXXX	Stream Elective - I	3	0	0	3
5	ENL501	Professional Communication and Soft Skills	0	0	4	2
6	ECL502	Project Phase - I	0	0	6	3
7	ECO503	Honours Online Course - I*	5	1	0	3
		Optional Online Course - I*	5	1	0	0-3
		TOTAL	**12**	**0**	**18**	**21**

VI SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	ECL601	Internship	0	0	40	0
2	ECO602	Honours Online Course - II*	5	1	0	3
		Optional Online Course - II*	5	1	0	0-3
		TOTAL	**0**	**0**	**0**	**0**

VII SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	XXXXXX	Program Elective – IV	3	0	4	5
2	XXXXXX	Program Elective – V	3	0	0	3
3	XXXXXX	Program Elective – VI	3	0	0	3
4	XXXXXX	Stream Elective – II	3	0	0	3
5	HMC701	Professional Ethics	1	0	0	0
6	ECL702	Project Phase – II	0	0	12	6
7	ECO703	Honours Online Course - III*	5	1	0	3
		Optional Online Course - III*	5	1	0	0-3
		TOTAL	**12**	**0**	**16**	**20**

VIII SEMESTER

S. NO.	COURSE CODE	COURSE NAME	L	T	P	C
1	XXXXXX	Stream Elective - III	3	0	0	3
2	XXXXXX	Stream Elective - IV	3	0	0	3
3	XXXXXX	Stream Elective - V	3	0	0	3
4	HMEXX	Management Elective	3	0	0	3
5	ECL801	Project Phase - III	0	0	18	9
6	ECO802	Honours Online Course - IV*	5	1	0	3
		Optional Online Course - IV*	5	1	0	0-3
		TOTAL	**12**	**0**	**18**	**21**

***NPTEL/ SWAYAM/ MOOCs, etc.**

SUMMARY

SEMESTER	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	25	25	25	26	21	0	20	21	163

LIST OF PROGRAM ELECTIVES (PE)

S. NO.	COURSE NAME
1	Data Communication and Networks*
2	Artificial Neural Networks*
3	Digital Signal Processing*
4	Modelling and Testing of Digital Systems (VHDL)*
5	Communication Theory
6	Embedded Systems
7	Fibre Optic Communication*
8	VLSI Design*
9	Antenna and Wave Propagation
10	Application Specific Integrated Circuits (ASIC)
11	Nanoscience and Nanotechnology
12	Wireless Communication

SEMESTER-WISE PROGRAM ELECTIVES

V SEMESTER

S. NO.	PROGRAM ELECTIVE	COURSE CODE	COURSE NAME
1	I	ECPE11	Data Communication and Networks*
		ECPE12	Artificial Neural Networks*
2	II	ECPE21	Digital Signal Processing*
		ECPE22	Modelling and Testing of Digital Systems (VHDL)*
3	III	ECPE31	Communication Theory
		ECPE32	Embedded Systems

***Includes Lab**

VII SEMESTER

S. NO.	PROGRAM ELECTIVE	COURSE CODE	COURSE NAME
1	IV	ECPE41	Fibre Optic Communication*
		ECPE42	VLSI Design*
2	V	ECPE51	Antenna and Wave Propagation
		ECPE52	Application Specific Integrated Circuits (ASIC)
3	VI	ECPE61	Nanoscience and Nanotechnology
		ECPE62	Wireless Communication

***Includes Lab**

LIST OF STREAM ELECTIVES (SE)

S. NO.	COURSE NAME	DEPARTMENT
1	Applications	IT
2	Artificial Intelligence and Machine Learning	CSE
3	Database and Networking	CSE
4	Security	IT
5	Cyber Physical Systems	ECE
6	Intelligent Systems	ECE

STREAM – I
APPLICATIONS

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	ITSE11	Mobile Applications Development	Computer Networks
2	ITSE12	Cloud Computing	Computer Networks
3	ITSE13	Internet of Things	Computer Networks
4	ITSE14	Big Data Analytics	Database Management System
5	ITSE15	Computer Vision	Probability and Random Process, Linear Algebra, Digital Image Processing

STREAM – II
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	CSSE11	Machine Learning	Linear Algebra, Probability, Programming language (any high level)
2	CSSE12	Deep Learning	Linear Algebra, Probability, Programming language (any high level)
3	CSSE13	Artificial Intelligence	-
4	CSSE14	Soft Computing	Linear Algebra, Probability, Programming language (any high level), Algorithms
5	CSSE15	NLP with Deep Learning	Linear Algebra, Probability, Programming language (any high level)

STREAM – III
DATABASE AND NETWORKING

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	CSSE21	Relational Database Management Systems	Database Management System
2	CSSE22	Advanced Database Management Systems	Database Management System
3	CSSE23	Database Security	Advanced Database Management System, Computer Networks
4	CSSE24	Mobile Computing and Communication	Computer Networks
5	CSSE25	Wireless Sensor Networks	Computer Networks

STREAM – IV
SECURITY

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	ITSE21	Information Security	-
2	ITSE22	Principles of Cryptography	Discrete Structures
3	ITSE23	Network Security	Computer Networks
4	ITSE24	Applied Cryptography	Discrete Structures, Principle of Cryptography, Graph Theory
5	ITSE25	Cyber Physical Systems	-

STREAM – V
CYBER PHYSICAL SYSTEMS

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	ECSE11	Introduction to IoT	Data communication and networks, Communication systems, Communication theory, Embedded systems
2	ECSE12	Wireless Sensor Networks	Data communication and networks, Communication systems, Communication theory, Embedded systems
3	ECSE13	Industrial IoT	Introduction to IoT, Wireless Sensor Networks

4	ECSE14	Principles of Cyber Physical Systems	Introduction to IoT, Wireless Sensor Networks, Communication Theory, Control systems.
5	ECSE15	Communication in Cyber Physical Systems	Introduction to IoT, Wireless Sensor Networks, Communication theory, Control systems.

STREAM – VI
INTELLIGENT SYSTEMS

S. NO.	COURSE CODE	COURSE NAME	EXPECTED PRIOR STUDY
1	ECSE21	Mobile Robots	Linear Algebra, Control Systems, Embedded systems.
2	ECSE22	Machine Vision and Perception	Linear Algebra, Probability
3	ECSE23	Pattern Recognition and Computational Intelligence	Artificial neural networks, Probability, Linear algebra.
4	ECSE24	Autonomous Mobile Robots	Mobile Robots, Machine Vision and Perception, Control Systems, Embedded systems.
5	ECSE25	Reinforcement Learning	Artificial neural networks, Probability, Linear algebra.

SEMESTER-WISE STREAM ELECTIVES

V SEMESTER

STREAM ELECTIVE – I

S. NO.	COURSE CODE	COURSE NAME	STREAM
1	ITSE11	Mobile Applications Development	Applications
2	CSSE11	Machine Learning	Artificial Intelligence and Machine Learning
3	CSSE21	Relational Database Management Systems	Database and Networking
4	ITSE21	Information Security	Security
5	ECSE11	Introduction to IoT	Cyber Physical Systems
6	ECSE21	Mobile Robots	Intelligent Systems

VII SEMESTER

STREAM ELECTIVE – II

S. NO.	COURSE CODE	COURSE NAME	STREAM
1	ITSE12	Cloud Computing	Applications
2	CSSE12	Deep Learning	Artificial Intelligence and Machine Learning
3	CSSE22	Advanced Database Management Systems	Database and Networking
4	ITSE22	Principles of Cryptography	Security
5	ECSE12	Wireless Sensor Networks	Cyber Physical Systems
6	ECSE22	Machine Vision and Perception	Intelligent Systems

VIII SEMESTER

STREAM ELECTIVE – III

S. NO.	COURSE CODE	COURSE NAME	STREAM
1	ITSE13	Internet of Things	Applications
2	CSSE13	Artificial Intelligence	Artificial Intelligence and Machine Learning
3	CSSE23	Database Security	Database and Networking
4	ITSE23	Network Security	Security
5	ECSE13	Industrial IoT	Cyber Physical Systems
6	ECSE23	Pattern Recognition and Computational Intelligence	Intelligent Systems

STREAM ELECTIVE – IV

S. NO.	COURSE CODE	COURSE NAME	STREAM
1	ITSE14	Big Data Analytics	Applications
2	CSSE14	Soft Computing	Artificial Intelligence and Machine Learning
3	CSSE24	Mobile Computing and Communication	Database and Networking
4	ITSE24	Applied Cryptography	Security
5	ECSE14	Principles of Cyber Physical Systems	Cyber Physical Systems
6	ECSE24	Autonomous Mobile Robots	Intelligent Systems

STREAM ELECTIVE – V

S. NO.	COURSE CODE	COURSE NAME	STREAM
1	ITSE15	Computer Vision	Applications
2	CSSE15	Natural Language Processing	Artificial Intelligence and Machine Learning
3	CSSE25	Wireless Sensor Networks	Database nd Networking
4	ITSE25	Cyber-Physical Systems	Security
5	ECSE15	Communication in Cyber Physical Systems	Cyber Physical Systems
6	ECSE25	Reinforcement Learning	Intelligent Systems

LIST OF MANAGEMENT ELECTIVES

S. NO.	COURSE CODE	COURSE NAME
1	HME861	Organizational Behaviour
2	HME862	Entrepreneurship Development
3	HME863	E-commerce and Digital Marketing
4	HME864	Usability Analysis

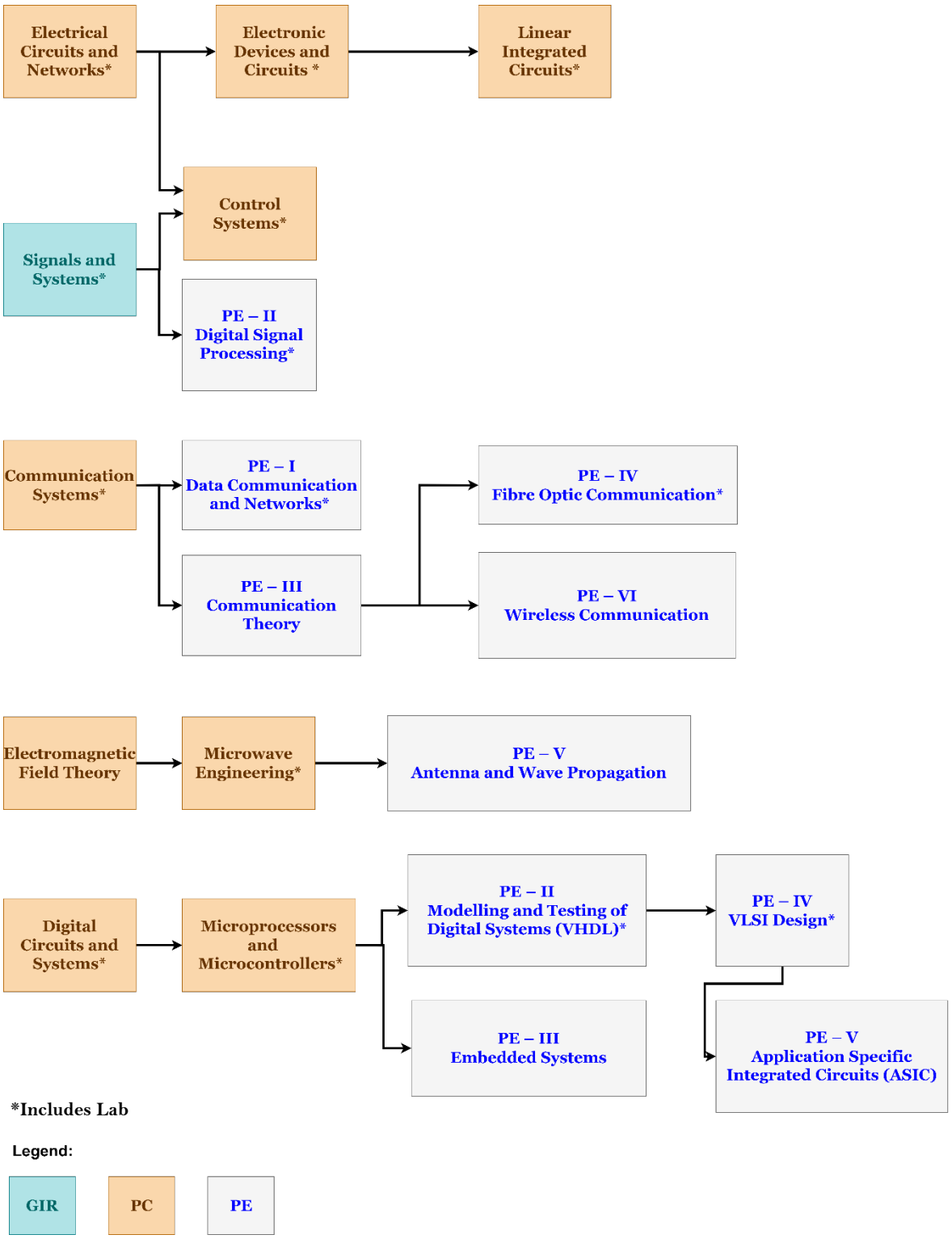
STUDY CHART

Sem. - I	Mathematics - I	Electricity, Magnetism, and Quantum Mechanics*	Basic Environmental Science and Engineering	Electrical Circuits and Networks*	Communication Skills	Practicum - I
Sem. - II	Mathematics - II	Engineering Chemistry*	Introduction to Biotechnology	Basics of Programming in C*	Signals and Systems*	Practicum - II
Sem. - III	Electronic Devices and Circuits *	Digital Circuits and Systems*	Electromagnetic Field Theory	Communication Systems*	Introduction to Python	Practicum - III
Sem. - IV	Microwave Engineering*	Control Systems*	Microprocessors and Microcontrollers*	Linear Integrated Circuits*	Adv. Python Programming	Practicum - IV
Sem. - V	Professional Communication and Soft Skills	PE – I Data Communication and Networks* / Artificial Neural Networks *	PE – II Digital Signal Processing* / Modelling and Testing of Digital Systems (VHDL)*	PE – III Communication Theory / Embedded Systems	SE - I	Project Phase-I
Sem. - VI	Internship					
Sem. - VII	PE – IV Fibre Optic Communication* / VLSI Design*	PE – V Antenna and Wave Propagation / Application Specific Integrated Circuits (ASIC)	PE – VI Nanoscience and Nanotechnology / Wireless Communication VI	SE - II	Professional Ethics	Project Phase-II
Sem. - VIII	SE - III	SE - IV	SE - V	Management Elective		Project Phase-III

*Includes Lab

Legend: GIR | PC | PE | SE | Internship | Practicum | Project

DEPENDENCY CHART



*Includes Lab

Legend:

GIR PC PE

FIRST SEMESTER

MAC121 MATHEMATICS – I

CREDITS: 04	GIR	LTPC: 3 – 1 – 0 – 4

COURSE OBJECTIVES

- To learn mathematical concepts and methods.
- To acquire fundamental knowledge.

COURSE CONTENTS

UNIT 1: MATRICES **08**

Matrices, Related matrices, Complex matrices, Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Consistency of a linear system of equations, Rouche's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

UNIT 2: INFINITE SERIES **08**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, Comparison test, D'A1embert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test, Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

UNIT 3: ELEMENTARY CALCULUS **08**

Zeno's Paradox, Limit, Continuity and Differentiability, Uniform continuity, Maxima and Minima, Mean value theorem, Partial Derivatives, Integration.

UNIT 4: VECTOR SPACES **08**

Vector spaces, Sub Spaces, Linear Dependences and Independences of Vectors, Span, Bases and Dimensions, Direct Sum.

UNIT 5: LINEAR TRANSFORMATIONS **08**

Linear Transformations, Linear Variety, Range Space and Rank, Null Space and Nullity, Homomorphism, Matrix of Linear Transformations, Matrix Representation of a linear transformation, Structure of the solutions of the matrix equation Ax = b, Change of bases.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate qualitative problems based on matrix analysis such as rank, Eigen values, and Eigen vectors etc.	(K2)
CO2	:	Test the convergence of the series by approximating complicated functions appearing in different engineering models.	(K4)
CO3	:	Simplify the problems on differentiation of functions of two variables and know about the maximization and minimization of these functions	(K4)
CO4	:	Make use of the concepts of vector analysis such as linear independence and dependence of vectors etc.	(K3)
CO5	:	Interpret the use of linear transformation in real world problems.	(K2)

TEXT BOOKS

1. Jain R.K., Iyengar S.R.K., "*Advanced Engineering Mathematics*", 5th Edition, Narosa Pub. House, 2016.
2. Ram, P., "*Engineering Mathematics through Applications*", 2nd Edition, CBS Publications, 2015.

REFERENCE BOOKS

1. K. Hoffman and R. Kunze, "*Linear Algebra*" Prentice Hall, 2008.
2. G. Strang, "*Linear Algebra and its Applications*", 4th Edition, Thomson, 2006.
3. Wilfred Kaplan, "*Advanced Calculus*", Pearson, 2003.
4. Wylie, C.R. and Barrett, L.C., "*Advanced Engineering Mathematics*", 6th Edition, McGraw-Hill Inc.US, 1995.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	-	-	-	-	-	-	-	-	-	-	-	-	10
COM*	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

***COM: COURSE OUTCOME MAPPING**

PHC122 ELECTRICITY, MAGNETISM AND QUANTUM MECHANICS

CREDITS: 05	GIR	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To impart knowledge about the limitations of Newtonian Mechanics and alternate formalism of Lagrange and Hamilton and the concept of special relativity and its applications to physical sciences and engineering.
- To study the basic principles of quantum mechanics: Learn how to solve the Schrödinger's equation and its applications.
- To understand the basic framework of solid-state physics.
- To recognize and classify the structures of Optical fibre and types.
- To apprise the students regarding the concepts of electrodynamics and Maxwell equations and use them in various situations

COURSE CONTENTS

UNIT 1: CLASSICAL MECHANICS **08**

i) Review: Newtonian Mechanics in Rectilinear Coordinate System, Motion in Plane Polar Coordinates, Conservation Principles, Inertial and Non-inertial Frames, Rigid Body Dynamics. Introductory ideas about Lagrangian and Hamiltonian and their simple applications.

ii) Special Theory of Relativity (STR). Michelson-Morley Experiment, Postulates of STR, Galilean Transformation, Lorentz Transformation, Simultaneity, Length Contraction, Time Dilation, Relativistic Addition of Velocities, Mass-Energy Equivalence, Energy-Momentum Relationships.

UNIT 2: MODERN PHYSICS **08**

i) Basics of Quantum Physics: Origin of Quantum Theory, Planck's Quantum Theory, Black Body Radiation, Photoelectric Effect, Compton Effect, Wave-Particle Duality: De Broglie Wavelength, Group and Phase Velocity, Heisenberg's uncertainty Principle, Double Slit Experiment, Schrödinger Equation, Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-Value Problem, Solution of Schrödinger Equation for simple boundary value problems, Reflection and Transmission Coefficients, Tunnelling, Particle in a three Dimensional Box, Degenerate States.

ii) Quantum Statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Density of States. Applications of B-E statistics: LASER (Spontaneous

and Stimulated Emissions & Absorption, Einstein's Coefficients, Population Inversion, LASER Systems: Ruby LASER, He-Ne LASER, Semiconductor LASER-applications), Bose-Einstein Condensation. Applications of F-D Statistics: Free Electron Model of electrons in metals. Concept of Fermi Energy. Elementary Ideas of Band Theory of Solids.

UNIT 3: PHYSICS OF MATERIALS **08**

i) Structure of Materials: Space Lattice and Unit Cells, Crystal System, Symmetry Operation, Miller Indices, Packing Fractions, Structure Determination using X-ray Diffraction, Bragg's Law.

ii) Semiconductor: Direct and indirect band gap semiconductors, Electron and Hole concentrations, Doping n-type, p-type, temperature variation of carrier concentration, Fermi level, Zener Diode, Tunnel Diodes, Photodiodes, Light Emitting Diodes. Hall Effect, Superconductors.

iii) Magnetic and Dielectric Properties of Materials: Origin of Magnetism, Dia, Para, Ferro, Anti-Ferro and Ferrimagnetism, Soft and Hard Magnetic Materials, Dielectric Properties.

UNIT 4: FIBER OPTICS **08**

Fermat's principle and Snell's law-optical fiber, Principle and construction, Acceptance cone, Numerical aperture, V-Number, Types of fibers, Fabrication: Double crucible technique, Fiber optic communication principle, Fiber optic sensors.

UNIT 5: LINEAR TRANSFORMATIONS **08**

i) Electrostatics: Coulomb's Law, Gauss's Law, proof of Gauss's Law, Electrostatic Field in Matter: Dielectric Polarization, polarizability and susceptibility, Types of Polarization, Claussius-Mossotti Equation.

ii) Magnetostatics: Lorentz Force, Equation of Continuity, Biot-Savart Law, Ampere's Law, Magnetostatic field in matter: Torques and forces on magnetic dipoles, Magnetization, Induction, Maxwell's Equations, Propagation of EM Waves in Free Space.

LIST OF EXPERIMENTS

1. To find the moment of inertia of a given flywheel.
2. To find the value of charge carrier concentration and Hall coefficient.
3. To determine the value of Planck's constant.
4. To find the value of wavelength of a given light source using Michelson Interferometer.

5. To find the value of wavelength of a given light source using Newton's rings.
6. To verify the Biot-Savart Law using the circular coil carrying current.
7. To find the resonance frequency in a series LCR circuit.
8. To find the resonance frequency in a parallel LCR circuit.
9. To determine the value of Stefan's constant using black body radiation.
10. To determine the value of e/m ratio.
11. To find the energy gap of a material of p-n junction.
12. To study the Rutherford scattering of alpha particles.
13. To determine the plateau and optimal operating voltage of a Geiger-Müller
14. To determine the wavelength of a given LASER source using Diffraction Grating.
15. To study the interaction of high energy photons with matter.
16. To find the value of time constant of an RC circuit.
17. To study the charging and discharging of a Capacitor.
18. To study the I-V characteristics of a Solar cell.
19. To study the polarization of light.
20. To study the B-H hysteresis curve.

Total Periods: 40+48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Identify the role of virtual work, Lagrange's and Hamilton's approach to the mechanics and develop skills to impart practical knowledge and apply the knowledge of Special Theory of Relativity.	(K3)
CO2	:	Describe and analyze the dynamics of systems that move under the influence of given potential, and to make use of the basics of Quantum Mechanics.	(K4)
CO3	:	Apply principles to determine crystal structure, thermal behavior of solids, dielectric, electric and magnetic behavior of solids, and develop skills to impart practical knowledge.	(K3)
CO4	:	Demonstrate optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	(K3)
CO5	:	Apply the concepts related to Faraday's law, induced emf and Maxwell's equations.	(K3)

TEXT BOOKS

1. Kleppner, D., and Kolenkow, R. J. "*An Introduction to Mechanics*", Tata McGraw-Hill, New Delhi, 2000.
2. Griffiths, David J. "*Introduction to Quantum Mechanics*,", 2nd Edition, Pearson Education Ltd, 2014.

REFERENCE BOOKS

1. Kittel, Charles "*Introduction to Solid State Physics*, 8th edition", John Wiley & Sons, Inc, USA, 2005.
2. Griffiths, David J. "*Introduction to Electrodynamics*" 3rd Edition Prentice-Hall of India, 2005
3. Goldstein, H., Poole, C. and Safko, J., "*Classical Mechanics*,", 2nd Edition Narosa, 1985.
4. Puri, R. K. and Babbar, V. K. "*Solid State Physics*", S. Chand & Co. Pvt. Ltd, New Delhi, 2000.
5. Beiser, Arthur "*Concepts of Modern Physics*", Tata McGraw-Hill, New Delhi, 1995.
6. Resnick, R. "*Introduction to Special Relativity*" John Wiley, Singapore, 2000.
7. Avadhanulu, M. N. and Kashirsagar, P. G. "*A Text Book of Engineering Physics*", S. Chand & Co. Pvt. Ltd, New Delhi, 2008.
8. Ida, Nathan "*Engineering Electromagnetics*", Springer, 2005.
9. Feynman, R. P., Leighton, R. B. and Sands, M. "*The Feynman Lectures on Physics*, Vol. I" Narosa Publishing House, 1998.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	3	-	-	-	-	-	-	-	2	-	-	2
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
CO5	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Score	11	4	-	11	-	-	-	-	-	-	-	2	-	-	10
COM	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

EVC103 BASIC ENVIRONMENTAL SCIENCE AND ENGINEERING

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the principles of renewable energy systems.
- To explore the environmental impact of various energy sources.
- To comprehend the effects of different pollutants.
- To know the impacts of environmental biodiversity in our daily life.
- To understand the recent sustainable environmental engineering practices.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO NON-CONVENTIONAL ENERGY SOURCES 08

Present Energy resources in India and its sustainability, Different type of conventional Power Plant, Energy Demand Scenario in India, Advantage and Disadvantage of conventional Power Plants, Conventional vs non-conventional power generation, Environment issues of various power plants, Industrial and transport emissions and impacts.

UNIT 2: ENVIRONMENTAL IMPACT OF VARIOUS ENERGY SOURCES 08

Basics of Solar Energy, Solar thermal energy, Solar photovoltaic-advantages and disadvantages, Power and energy from wind turbines, India's wind energy potential, Types of wind turbines-Off Shore Wind energy, Fossil fuels energy, Biomass energy, Geothermal energy, Ocean energy, Chemical energy sources, Thermonuclear fusion energy.

UNIT 3: INTRODUCTION TO ENVIRONMENT AND POLLUTION 08

Introduction to the Environment: Physical environment; biotic environment; biotic and abiotic interactions, Environmental pollution (water, air, soil and noise): Sources, effects, control, Air quality standards, International Standards for Drinking Water, Greenhouse gases effect, Acid rain.

UNIT 4: IMPACT OF ORGANISMS ON THE ENVIRONMENT 08

History (scientists and discoveries), Classification and nomenclature of microorganisms, Structural organization and multiplication of Microbes, Microscopic examination of microorganisms: light, fluorescent, dark field, phase

contrast, and electron microscopy, Stains and staining techniques, Microbial nutrition and growth, Control of microorganisms.

UNIT 5: APPLICATIONS OF ENVIRONMENTAL TECHNOLOGY **08**

Aerobic wastewater treatment, Anaerobic wastewater treatment, Bioremediation of contaminated land and water, Biofertilizers, Biopesticides, Biosensors.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Classify the environmental impact of various energy sources.	(K2)
CO2	:	Select a solution based on the energy source.	(K3)
CO3	:	Explain the various aspects of several pollutants.	(K2)
CO4	:	Examine the biodiversity through analytical tools.	(K4)
CO5	:	Apply scientific solutions to preserve water and land from contaminations.	(K3)

TEXT BOOKS

1. Khan, B.H., "*Non-Conventional Energy Resources*," 3rd Edition, The McGraw Hill Education, 2017.
2. Rai, G. D., "*Non-conventional Energy Sources*," 6th Edition, Khanna Publishers, 2018.
3. Balasubramanian D., Bryce, C.F.A., Jayaraman K., Green J., and Dharmalingam K., *Concepts in Biotechnology*, 6th Edition. Hyderabad: Universities Press, 2005.
4. Pelczar M.J., Chan E.C.S., Krieg N. R., *Microbiology*, 6th Edition. McGraw Hill, India, 2018.
5. Thakur I.S., *Environmental Biotechnology*: Basic Concepts and applications, 2nd Edition, I.K. International Publishing House Pvt. Ltd., 2019.

REFERENCE BOOKS

1. Sargsyan G., Bhatia M., Banerjee S.G., Raghunathan K., and Soni R., *Unleashing the Potential of Renewable Energy in India*, World Bank Report, 2011.
2. Everett, G., Boyle, S., Peake, and Ramag J., *Energy Systems and Sustainability. Power for a sustainable future*. 2nd Edition, Oxford University Press, 2011.
3. Wang L.K., Tay J.H., Tay S.T.L., and Hung Y.T. *Environmental Bioengineering*, 1st Edition, Humana Press, 2010.
4. Evans G.G., and Furlong J., *Environmental Biotechnology: Theory and Application*, 2nd Edition, Wiley, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	-	-	2	-
CO2	3	2	2	1	1	-	2	-	-	-	-	2	-	2	2
CO3	-	2	-	-	-	2	2	3	-	-	-	-	-	-	2
CO4	-	-	2	2	1	-	2	-	-	-	-	-	-	-	2
CO5	3	-	2	2	1	2	2	3	-	-	-	2	-	-	2
Score	9	6	6	5	3	4	10	6	-	-	-	4	-	4	8
COM	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**-**	**-**	**-**	**2**	**-**	**2**	**2**

ECC104 ELECTRICAL CIRCUITS AND NETWORKS

CREDITS: 05	GIR	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To learn various techniques for solving electrical circuits.
- To learn the steps for different network theorems used in simplifying any network.
- To study two port networks in terms of various parameters.
- To construct the pole zero diagram for the transfer function of any network.
- To develop a network in different forms as per the given desired transfer function.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO NETWORKS **08**

KCL, KVL, Node and Mesh analysis, Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and topological equation for nodal voltage, Duality.

UNIT 2: NETWORK THEOREMS **08**

Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

UNIT 3: TWO PORT NETWORKS **08**

Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications.

UNIT 4: NETWORK FUNCTIONS **08**

Concepts of complex frequency, Transform impedance, Networks function of one port and two port networks, concepts of poles and zeros, property of driving point and transfer function.

UNIT 5: PASSIVE NETWORK SYNTHESIS **08**

Introduction, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Elements of circuit synthesis, Foster and Cauer forms of LC Networks, Synthesis of RC and RL networks.

List of Experiments

1. Verification of Kirchhoff's current law and voltage law.
2. Verification of mesh analysis and nodal analysis
3. Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave.
4. Verification of superposition theorem and reciprocity theorem.
5. Verification of maximum power transfer theorem and Thevenin's theorem
6. Verification of Norton's theorem and compensation theorem
7. Verification of series resonance and parallel resonance
8. Verification of self-inductance and mutual inductance
9. Verification of Tellegin's theorem for two networks of the same topology.
10. Determination of transient response of current in RL and RC circuits with step voltage input.
11. Determination of transient response of current in RLC circuit with step voltage input for under damp, critically damp and over damp cases
12. Determination of frequency response of current in RLC circuit with sinusoidal ac input
13. Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.
14. Above experiments are to be simulated through PSPICE.

Total Periods: 40 + 48 = 88

Course Outcomes

After the completion of this course, students will be able to:

CO1	:	Explain the concepts of KCL, KVL, Node analysis, Mesh analysis, and Graph Theory for solving any electrical circuit.	(K2)
CO2	:	Apply different network theorems to find the current and voltage in every branch of a given circuit.	(K3)
CO3	:	Make use of appropriate parameters for the analysis of a two-port network.	(K3)
CO4	:	Infer the stability of the network with the use of pole zero diagram.	(K2)
CO5	:	Develop any electrical circuit for the given transfer function.	(K3)

Text Books

1. Valkenberg, V., "*Network Analysis*", 3rd Edition, Pearson Education, 2015.
2. Hayt, W. H. and Kemmerly, J, "*Engineering Circuit* Analysis", 8th Edition, McGraw-Hill Education, 2013.

Reference Book

1. Sudhakar, A. and Palli, S. S., "*Circuits and Networks: Analysis and Synthesis*", McGraw-Hill Education, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	6	15	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

ECN125 COMMUNICATION SKILLS

CREDITS: 05	GIR	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To identify, rectify, and overcome mother tongue influence and sensitize usage of native English speech sounds, word accent, intonation and rhythm.
- To develop awareness about different forms of professional communication & social behaviour.
- To empower students with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

COURSE CONTENTS

UNIT 1: THE PROCESS OF COMMUNICATION 08

- Grammar Refresh: Synonyms and Antonyms, Homophones, Homonyms and Homographs, Tenses, Active Voice and Passive Voice, Idioms and Phrasal Verbs, Reported Speech.
- Introduction to Communication, Communication Models, Noise in Communication, Nonverbal Communication, Channels of communication, Technical Communication, Downward-Upward Communication, Internal-External Communication, Horizontal-Diagonal Communication, Written vs. oral Communication, Conversational problems of second language users, Difference between conversation and other speech events.
- How to write Accurately, Briefly, Clearly. Precis writing.
- How to Read, Introduction to Comprehension Skills, Skills to improve Comprehension Skills.
- Telephonic Communication, Templates for Telephonic Conversation, Do's and Don'ts of Telephonic Communication, Leaving a message.

UNIT 2: JOB APPLICATIONS AND INTERVIEWS 08

- Format of Resume and Cover Letter, How to make a great Resume, How to write a Covering Letter to Resume.
- Preparing for an Interview, Self-Introduction in Interview, Select Questions and how to answer them, Mock Interview.
- What is Group Discussion, How to ace you GD, Do's and Don'ts of GD, Mock GD.

UNIT 3: MANAGING ORGANIZATIONAL STRUCTURE 08

- Organizational Roles, Leadership and Management, Ad Hoc Committee, Roles and Responsibilities of Committee & its members.
- Eustress & Distress, Regulating stress.
- Simulated Conversation Template.
- Drafting Formal/Corporate Emails.

UNIT 4: TAKING NOTES AND PREPARING MINUTES 08

- Planning a Meeting, Roles of the members, Meeting Etiquettes, How to draft Notice of a Meeting, How to draft Agenda of a Meeting, How to draft Minutes of a Meeting.
- Elements of Report Writing, Procedure & Guidelines, Types and Format.
- Taking notes, Note-taking skill: essential components.

UNIT 5: PRESENTATION SKILLS AND NEGOTIATION SKILLS 08

- Parts of a Presentation Delivery, Starting a Presentation Delivery, Introduction: Hooking the Audience, Body of a Presentation Delivery, Structuring a Presentation Delivery, Conclusion of a Presentation, How to tackle Q&A from Audience, Podium Panic, Body Language, Do's and Don'ts of PD, Mock PD.
- Types of Corporate Conversations, Negotiation, Mediation & Arbitration, Resolving arguments, Models of Negotiation Process, Types of Negotiation, Skills of a Negotiator, Steps of the Negotiation Process, Skills to improve Negotiation Process.

LIST OF EXPERIMENTS

1. Introduction to Phonetics, Phonetic alphabet.
2. Introduction to Speech Sounds: Vowels & Consonants.
3. Structure of Syllables.
4. Extempore, Public Speaking.
5. Words and Phrasal Stress.
6. Stress and Rhythm.
7. Rhythms from Mainland.
8. Mock Telephonic Conversation.
9. Resume and Presentation Skills.
10. Group Discussion.
11. Interview Skills.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Develop skills of comprehension, writing and speaking in professional English and learn strategies to enhance independent language learning.	(K3)
CO2	:	Use the appropriate template, language and body language for group discussions, interviews and public speaking.	(K3)
CO3	:	Explain and apply the nuances of English professional communication in an organisation.	(K3)
CO4	:	Plan and execute Meetings, and draft minutes, reports and relevant documents.	(K3)
CO5	:	Develop public speaking skills essential for presentation deliveries, negotiations and corporate communications.	(K3)

TEXT BOOKS

1. Rizvi, M. A., "*Effective Technical Communication*", 2nd edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., "*Developing Communication Skills*", 2nd edition, Laxmi Publications, 2009.

REFERENCE BOOKS

1. Bhatacharya, I., "*An Approach to Communication Skills*", Dhanpat Rai & Co., 2007.
2. Evans, D., "*Decision maker*", Cambridge University Press, 1997.
3. Thorpe, E., and Thorpe, S., "*Objective English*", Pearson Education, New Delhi, 2007.
4. Fisher, D., "*Communication in Organizations*", Jaico Publishing House, 2004.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
Score	-	-	-	-	-	-	-	-	3	11	-	-	-	-	3
COM	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

ECL106 PRACTICUM - I

CREDITS: 03	GIR	LTPC: 0 – 0 – 6 – 3

COURSE OBJECTIVES

- To develop a reverse engineering attitude for improvement in the existing utility products.
- To learn the fundamentals of basic electrical engineering.
- To learn the fundamentals of basic electronics engineering.
- To learn the engineering of electro-mechanical devices.
- To construct interdisciplinary working models.

COURSE CONTENTS

UNIT 1: REVERSE ENGINEERING IN UTILITY PRODUCTS **18**

Case study of water immersion rod, room heater, multi-point extension cord, electric iron, hair dryer, hair trimmer, hair straightener, air blower, electric fan, mobile/laptop charger, battery eliminator etc.

UNIT 2: FUNDAMENTALS OF BASIC ELECTRICAL ENGINEERING **12**

Apply the basic concepts of electrical engineering to routine appliances of daily use.

UNIT 3: FUNDAMENTALS OF BASIC ELECTRONICS ENGINEERING **12**

Apply the basic concepts of electronics engineering to routine appliances of daily use.

UNIT 4: ENGINEERING OF ELECTRO-MECHANICAL DEVICES **12**

Apply the basic concepts of mechanical engineering to routine appliances of daily use.

UNIT 5: CONSTRUCTING INTERDISCIPLINARY WORKING MODELS **18**

Developing the interdisciplinary working models and adding a feature for improving the performance of existing available products.

Total Periods: 72

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Apply the knowledge of reverse engineering to solve problems.	(K3)
CO2	:	Apply the mathematical and scientific concepts to an engineering product.	(K3)
CO3	:	Application of fundamentals of engineering on a product in real time.	(K3)
CO4	:	Analyse a product to find the scope of improvements.	(K4)
CO5	:	Improve the performance of existing products by adding a feature to it.	(K6)

TEXT BOOKS

1. Marco Lino Calderón Saldierna, "*A collection of resources for the Study of Educational Reverse Engineering Activities in Engineering Design Education"*, Universitat Politècnica de Catalunya, 2016.
2. Alexandru C.Telea, "*Reverse Engineering: Recent advances and applications"*, IntechOpen, 2012.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	2	-	-	3	-	-	-	2	-
CO2	2	2	3	-	3	-	2	-	-	2	3	3	2	-	2
CO3	2	2	3	3	3	-	3	-	-	-	-	3	2	-	2
CO4	2	2	3	3	2	-	-	-	-	-	2	3	2	-	2
CO5	2	2	3	-	3	-	-	-	-	-	-	-	2	2	-
Score	10	10	13	7	12	2	7	-	-	5	5	9	8	4	6
COM	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**2**	**2**	**2**

SECOND SEMESTER

MAC221 MATHEMATICS - II

CREDITS: 04	GIR	LTPC: 3 – 1 – 0 – 4

COURSE OBJECTIVES

- To learn mathematical concepts and methods.
- To acquire fundamental knowledge.

COURSE CONTENTS

UNIT 1: ORDINARY DIFFERENTIAL EQUATIONS **08**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

UNIT 2: INTEGRAL TRANSFORMS **08**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

UNIT 3: FOURIER SERIES **08**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

UNIT 4: FOURIER TRANSFORMATIONS **08**

Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems, Differential Equations in Electric Circuits.

UNIT 5: PROBABILITY AND DISTRIBUTION **08**

Introduction to Random Variables and Probability, Conditional Probability, Probability density function, Discrete and continuous distribution, Mean, Medium,

Mode and Standard Deviations of Standard Distributions, Central Limit Theorem, Generating Functions, Correlation and Regression Analysis, Independent Trials, Baye's Rule, Bernoulli Trials, Binomial, Gaussian, Rayleigh, Exponential, Geometrical and Uniform Distributions and their Density Functions.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Analyze and solve system of differential equations which are arising in real world problems.	(K4)
CO2	:	Apply Laplace transform technique to solve boundary value problems.	(K3)
CO3	:	Verify the solution of the partial differential equations through Fourier analysis and compare them with harmonic analysis.	(K4)
CO4	:	Apply the Fourier transform to evaluate integral equations.	(K3)
CO5	:	Interpret the theory of probability and random variables for which correlation and regression analysis can be done.	(K2)

TEXT BOOKS

1. Ram, P., "*Engineering Mathematics through Applications*", 2nd Edition, CBS Publications, 2015.
2. Kreyszig, E., "*Advanced Engineering Mathematics*", 10th Edition, Wiley, 2015.

REFERENCE BOOK

1. Veerarajan, T., "*Probability, Statistics and Random. Processes*", 3rd Edition, McGraw- Hill Education, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	-	-	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

CYC222 ENGINEERING CHEMISTRY

CREDITS: 04	GIR	LTPC: 2 – 0 – 4 – 4

COURSE OBJECTIVES

- To learn about hard-soft water and solve problems based on hardness estimation.
- To comprehend the structure, properties, synthesis and applications of polymers.
- To investigate engineering materials such as nanomaterials, fuels and lubricants.
- To understand the structure and properties of compounds using IR, UV, NMR, Thermal analysis and chromatography.
- To acquire skills to perform laboratory experiments, demonstrate safe and proper use of standard chemistry glassware and equipment's.

COURSE CONTENTS

UNIT 1: WATER AND ITS TREATMENT **06**

Sources, Hard and Soft Water, Estimation of Hardness by EDTA Method, Softening of Water, Boiler Feed Water, Treatment Methods, Specifications for Drinking Water, BIS and WHO Standards, Desalination Processes.

UNIT 2: POLYMER AND COMPOSITES **06**

Introduction, Functionality, Classification, Mechanism of Polymerization, Molecular Weight, Structure Property Relationship, Moulding Techniques, Synthesis, Properties and Application of Commercially Important Polymers, Conducting Polymers, Introduction to Composites, Classification, Constituents, Advantages and Applications.

UNIT 3: ENGINEERING MATERIALS **06**

Introduction to Nano-Chemistry, Synthesis, Characteristics and Applications of Carbon Nanostructures; Fuels- Classification, Types Of Coal, Determination of Calorific Value of Solid Fuels, Bomb Calorimeter, Theoretical Oxygen, Proximate and Ultimate Analysis of Coal, Manufacture of Metallurgical Coke, Flue Gas Analysis, Lubricants-Definition, Theories, Characteristics, Additives to Lubricants, Solid Lubricants.

UNIT 4: CHARACTERIZATION TECHNIQUES **06**

Introduction to Spectroscopy, UV-Visible Spectroscopy, Principle, Instrumentation and Application, IR Spectroscopy: Principle and Applications, NMR, Principle, Instrumentation, Applications Of NMR, Thermal Method-Instrumentation,

Fundamental Principles and Applications of TGA, DTA and DSC; Introduction to Chromatographic Techniques.

LIST OF EXPERIMENTS

1. ***Volumetric analysis (Titrations):***
   a) To determine the total hardness of the given hard water using EDTA titration method.
   b) To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method.
   c) To determine the strength of given solution of Mohr's salt.
   d) To estimate amount of chlorine present in given sample of bleaching powder.
   e) To determine free residual chlorine in sample water by iodometric titration; To determine the Cu present in given brass sample by iodometrically.
   f) To determine the iron content in the given salt by using external indicator.
2. ***Colorimetric analysis:***
   a) To determine free residual chlorine content in given water sample.
   b) To estimate ferric ions in aqueous solution using thiocyanate solution.
   c) To find out the concentration of given KMnO4 solution spectrophotometrically.
   d) To estimate the amount of ferrous iron present in the given sample of cement by colorimetry using ammonium thiocyanate as the reagent.
   e) To determine the concentration of Cr in unknown solution of K2Cr2O7 using calibration curve method.
3. ***Physical Chemistry:***
   a) To determine the strength of an acid by pH –metric method.
   b) To determine the strength of hydrochloric acid solution by titrating against sodium hydroxide solution conductometrically.
   c) To identify given unknown liquid by surface tension measurement using Stalagmometer.
   d) To identify given unknown liquid by viscosity using Ostwald viscometer.
   e) To determine the viscosity coefficient of the given polymer PEG and find out the composition of unknown solution.
   f) To separate the mixture of amino acids by thin layer chromatography.
4. ***Lubricant analysis:***
   a) To determine the flash point and fire point of given lubricant using Abel's/Pensky Martin closed cup apparatus.
   b) To determine the acid value of a given oil/fat sample.
5. ***Organic synthesis:***
   a) To prepare polymer of Bakelite.

b) To prepare urea formaldehyde resin.

c) To prepare a pure sample of Aspirin.

Total Periods: 24+48 = 72

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Distinguish between hard / soft water and solve the day today problems associated with it.	(K3)
CO2	:	Explain the properties, structure, synthesis and applications of Polymers in engineering fields.	(K2)
CO3	:	Identify the different engineering materials and explain its usefulness in technological advancement.	(K3)
CO4	:	Analyse the structures of known and unknown compounds using different characterization techniques.	(K4)
CO5	:	Apply the concepts of Engineering Chemistry to real-world situations.	(K3)

TEXT BOOKS

1. Vairam, S., "*Engineering Chemistry- A textbook of chemistry for engineers*", Wiley India Pvt. Ltd., 2018.
2. Palanna, O. G., "*Engineering Chemistry*", Tata McGraw-Hill Publishing Company Ltd., 2017.

REFERENCE BOOKS

1. Poole, J.R, Charles, P., and Frank J. owens., "*Introduction to nanotechnology*", John Wiley & Sons, 2009.
2. Pavia, D.L., Lampman, G.M., Kriz, G.S., "*Introduction to spectroscopy: a guide for students of organic chemistry*", Philadelphia: W.B. Saunders Co., 1979.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	2	2	-	-	-	-	-	-	-	2
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	2	-	-	-	-	-	-	--	-	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
Score	15	10	-	15	-	4	2	-	-	-	-	-	-	-	4
COM	**3**	**2**	**-**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

BIC203 INTRODUCTION TO BIOTECHNOLOGY

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of biotechnology.
- To get familiarised with various routinely used biotechnological techniques.
- To know the applications of biotechnology in our daily life.
- To comprehend the environmental biotechnology processes for a sustainable environment.
- To learn the biotechnological regulations and bioethics.

COURSE CONTENTS

UNIT 1: BASIC CONCEPT OF BIOTECHNOLOGY 08

Old and modern biotechnology: History of biotechnological developments with major milestones, Biotechnology tree, Types of biotechnology, Biotechnology workforce, Biotechnology and pharmaceutical companies and their products, Organization structure of a biotechnology company, Quality assurance and quality control.

Basics of molecular biotechnology: Review of cell structure, Biomolecules, Chromosome structure, Genes and genomes, DNA replication, DNA transcription, Genetic code, Translation, Post translation modification, Regulation of gene expression, Mutation, Causes and Consequences, Epigenome.

UNIT 2: DNA AND PROTEIN BIOTECHNOLOGY 08

Recombinant DNA technology: DNA technology basics, Restriction enzymes, DNA cloning vectors, Genomics and cDNA libraries, Library screening, PCR, Cloning PCR products, DNA technology application to genomics, Next-generation sequencing, Gene microarrays, Genomics and bioinformatics, DNA database. Introduction to proteins and their products: Protein structure, Protein production, Upstream processing, Downstream processing, Analytical techniques, Chromatography, and Electrophoresis, Post-purification analysis methods, Proteomics.

UNIT 3: MICROBIAL, PLANT, AND ANIMAL BIOTECHNOLOGY 08

Microbial biotechnology: Structure of microbes, Microorganism as tools, Microbial applications, Food products, Fermenting microbes, Therapeutic proteins, Antimicrobial drug, Vaccines types and production, Microbial genomes, Microbes for making biofuels, Microbial diagnostics, Combating bioterrorism.

Plant biotechnology: Plant tissue culture, Plant transgenics methods, Applications of plant biotechnology, Vaccines, Genetic pesticides, Herbicide resistance, Enhanced nutrition, Biofuels, Health and environmental concerns.

Animal Biotechnology: Regulations in animal research, Alternatives to the use of animals, Animal cloning, Transgenic animals and techniques, Applications of animal biotechnology, Enhanced agricultural production, Transgenic animals as bioreactors, Knockouts animals, Human antibodies in animals.

UNIT 4: ENVIRONMENTAL AND MEDICAL BIOTECHNOLOGY 08

Environmental biotechnology: Bioremediation basics, Chemicals in the environment, Fundamentals of clean-up reactions, Aerobic and anaerobic biodegradation, Bioremediation genomics programs, Phytoremediation, Clean-up sites and strategies, Genetically engineered strains for environmental remediation, Biosensors, Environmental disasters, Case studies in bioremediation, Challenges for bioremediation.

Medical biotechnology: Detecting and diagnosing human disease conditions, Medical products and applications, Gene therapy, Regenerative medicine, Organ transplantation, Cellular therapeutics, Tissue engineering, Stem cell technology.

UNIT 5: BIOTECHNOLOGY REGULATIONS AND ETHICS 08

Biotechnology regulations: Regulatory framework, U.S. department of agriculture, Animal and plant health inspection service, Environmental protection agency, Food and drug administration, Legislation and regulation, Patents and patent filing process, international biotechnology regulation.

Biotechnology ethics: Approaches to ethical decision making, Ethics in biotechnological processes, Cells and products, GM crops, Animal husbandry or Animal tinkering, Synthetic genomes and synthetic biology, Regenerative medicine and personhood, Spare embryos for research versus Creating embryos for research, Gene doping, Debates on humans or other animals cloning for any reason, Economics, Role of science, and communication.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate understanding of the biological system.	(K2)
CO2	:	Solve the protein, and DNA sequences.	(K3)
CO3	:	Identify the protein production system in bacteria, plants, and animals.	(K3)

CO4 : Apply bio-engineering processes to meet the environmental and societal needs. (K3)

CO5 : Identify the ethical aspects of bioengineering fields. (K3)

TEXT BOOK

1. Thieman W. J. and Palladino M. A., "*Introduction to Biotechnology*", Pearson New International Edition, 3rd Edition, 2014.

REFERENCE BOOKS

1. Renneberg R., Demin A. L. and Papoport, T., "*Biotechnology for Beginners*", Academic Press, Annotated Edition, 2007.
2. Colin R. and Bjorn K., "*Basic Biotechnology*" Cambridge University Press, 3rd Edition, 2006.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	2	2	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	2	-	-	-	-	-	-	-	2
CO4	-	-	2	-	1	2	2	-	-	-	-	-	-	2	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Score	6	4	5	1	4	4	4	2	-	-	-	-	-	2	6
COM	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

CSC204 BASICS OF PROGRAMMING IN C

CREDITS: 05	GIR	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To learn algorithmic problem-solving techniques.
- To learn the fundamentals of C programming.
- To compose programs in C using conditions, iterations and decompose a problem into functions.
- To construct programs in C using array, functions and pointers.
- To develop programs using advanced concepts like structure, file handling.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO COMPUTERS, PROBLEM SOLVING TOOLS 08

Computer Organization, Characteristics, Hardware and Software, Modes of operation, Types of programming languages, developing a program, Algorithms, Characteristics, Flowcharts, Principles of Structured programming, Sequential, selective structures, Repetitive structures, Bounded, Unbounded and Infinite iterations ,Examples for each.

UNIT 2: INTRODUCTION TO C PROGRAMMING 08

C character set, Identifiers and Keywords, Data types, Constants, Variables, Declarations, Expressions, Statements, Symbolic constants, Operators, Library functions, Data input and output: Single character input and output, entering input data, writing output data, gets and puts functions.

UNIT 3: CONTROL STATEMENTS, ARRAY AND POINTERS 08

Control statements, branching, if-else, looping, while do-while for, Nested control structures, switch statement, break statement, continue statement, comma operator, goto statement, Modular Programming, Functions and Procedures, Examples, Parameter passing methods, Arrays, defining an array, processing an array, Multidimensional arrays, Pointers, Variable definitions and initialization, Pointer operators, Pointer expressions and arithmetic, Pointers and one-dimensional arrays.

UNIT 4: FUNCTIONS, STRING HANDLING 08

Functions, Defining a function, Accessing a function, Function prototypes, Passing arguments to a function, Passing arrays to a function, Passing pointers to a function, Recursion. String Handling, Introduction to Strings, Sample Program, Standard String Library Functions, Array of String.

UNIT 5: STRUCTURES, UNIONS AND FILE HANDLING **08**

Structures and Unions, Declaring and Instantiating Structures, Structures as Parameter and Pointer to Structures, Enumerated Data Types, Union, Bit Fields, File Processing, Concept of Files, File Opening in Various Modes and Closing of a File, reading from a File, Writing onto a File.

LIST OF EXPERIMENTS

1. Implementation of basics of C programming.
2. Implementation of concepts of conditional statements in C programming.
3. Implementation of concepts of control statements in C programming.
4. Implementation of concepts of array and pointers in C programming.
5. Implementation of concepts of functions in C programming.
6. Implementation of concepts of strings handling functions in C programming.
7. Implementation of concepts of structures and union in C programming.
8. Implementation of concepts of file handling in C programming.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the computer fundamentals and design an algorithm, flowchart and pseudo code for a given problem.	(K2)
CO2	:	Explain the basics and different constructs used in C programming.	(K2)
CO3	:	Apply the concepts of control structures, arrays, pointers to implement various algorithms and practice the skill of algorithmic thinking.	(K3)
CO4	:	Apply the concepts of functions and string handling using C programming.	(K3)
CO5	:	Apply the concepts of structures, unions and file handling in C programming.	(K3)
CO6	:	Develop various applications with Effective utilization of different concepts in C programming.	(K5)

TEXT BOOKS

1. Paul D., and Harvey D., "*C How to Program*", Prentice Hall London, 8th Edition, 2015.
2. Kernighan B. W. and Dennis R. M., "*The C Programming Language*", 2nd Edition Prentice Hall, 2012.

REFERENCE BOOKS

1. Dromey R.G, "*How to solve it by Computer"*, 4th Reprint, Pearson Education, 2007.
2. Kanetka Y., "*Let us C"*, BPB Publication.
3. Hanly J.R. and Koffman E.B., "*Problem Solving and Program Design in C"*, 6th Edition, Pearson Education, 2009.
4. Byron S Gottfried, "*Programming with C, Schaum's Outlines"*, 2nd Edition, Tata McGraw-Hill, 2016.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO^	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
Score	18	12	6	15	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

ECC205 SIGNALS AND SYSTEMS

CREDITS: 06	GIR	LTPC: 3 – 1 – 4 – 6

COURSE OBJECTIVES

- To learn various types of signals and their properties.
- To learn different types of systems with their properties.
- To compose periodic signals in different forms of Fourier series.
- To analyse the using Fourier Transform.
- To get familiar with the concepts of Laplace Transform.

COURSE CONTENTS

UNIT 1: SIGNALS **08**

Signal Classification (Analog-Digital, Energy-Power, Even-Odd, Periodic-Aperiodic, Deterministic-Random etc.), Standard Signals (Unit Step, Unit Impulse, Ramp, Exponential, Sinusoids), Transformations of the Independent Variable (Shifting, Scaling, Reversal), Discrete Exponential Functions and Their Properties, Discrete Unit Step and Impulse Signals and Their Properties.

UNIT 2: SYSTEMS **08**

System Classifications (Linearity, Time Invariance, Memory, Analog/Digital, Continuous /Discrete Time, Causality), Discrete Time Convolution, Continuous Time Convolution, System Properties via the Impulse Response (Causality, Memory, Stability, Invertibility, Unit Step Response).

UNIT 3: FOURIER SERIES OF PERIODIC FUNCTION **08**

History of Fourier Series, Euler to Fourier, Response of LTI Systems to Complex Exponentials and Fourier Series Representation of Continuous Time Periodic Signals, Fourier Series Representation of sawtooth, square and triangular Waves, Gibbs Phenomena, Properties of Fourier Series and Examples, Convergence of Fourier Series, Fourier Series and LTI Systems, Filtering.

UNIT 4: FOURIER TRANSFORM **08**

Introduction of the Continuous Time Fourier Transform by Taking the Limit of a Periodic Signal (i.e., Making it Aperiodic), Fourier Transforms of Periodic Signals, Properties of Continuous Time Fourier Transforms, Convolution Property of Fourier Transforms, Brief Introduction to Sampling Theorem.

UNIT 5: LAPLACE TRANSFORM **08**

Introduction to Laplace Transform; Region of Convergence, Inverse Laplace Transform, Properties of Laplace transforms, initial/final Value Theorems, Laplace Transforms and LTI systems, causality/stability, Laplace Transforms and Block System Diagrams, Unilateral Laplace Transform and Initial Value Problems.

LIST OF EXPERIMENTS

1. Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.
2. Find the Fourier transform of a square pulse. Plot its amplitude and phase spectrum.
3. Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.
4. Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.
5. Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.
6. Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
7. Write a program to find the autocorrelation and cross correlation of sequences.
8. Plot the histogram and the probability function for any sequence. Compute the mean and variance of any random signal.
9. Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.
10. Compute the autocorrelation of any sequence.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain different types of signals and their properties.	(K2)
CO2	:	Apply different conditions such as Causality, memory requirement, stability, and invertibility for checking the type of the system.	(K3)
CO3	:	Estimate the periodic signals in different forms of Fourier series.	(K5)
CO4	:	Determine the Fourier Transform of signals for finding their response at different frequencies.	(K5)
CO5	:	Analyse the unstable systems using Laplace transform.	(K4)

TEXT BOOKS

1. Oppenheim, A. V., Willsky, A. S., and Nawab, S. H., "*Signals and Systems*," 2nd Edition, Pearson Education, 2015.
2. Lathi, B. P., "*Principles of Linear Systems and Signals*," 2nd Edition, Oxford, 2009.

REFERENCE BOOK

1. Haykin, S., "*Signals and Systems*," 2nd Edition, Wiley, 2008.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	3	3	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	-	3	-	-	-	-	-	-	-	-	3	-	2
Score	15	12	6	15	-	-	-	-	-	-	-	-	6	-	10
COM	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECL206 PRACTICUM - II

CREDITS: 03	GIR	LTPC: 0 – 0 – 6 – 3

COURSE OBJECTIVES

- To introduce Matlab/Simulink software as an engineering tool for numerical computations and simulations.
- To equip the students with a deeper understanding of basic principles of Physics in aerodynamics and communication systems.
- To study the basics of Python programming.
- To expose the students and gain more knowledge about interfacing of devices with Arduino.
- Ability to analyse and apply the knowledge to solve the problems in electrical, computer and electronics engineering.

COURSE CONTENTS

UNIT 1: BASICS OF MATLAB/SIMULINK 18

A. MATLAB Basics
   a. Introduction to MATLAB and its programming
   b. Arithmetic and logical operations
   c. Handling matrix
   d. Common MATLAB functions
   e. Plotting

B. MATLAB editor

C. Solving RC, RL, RLC networks

D. Solution of network problems (Solution of linear differential equations)

E. Introduction to SIMULINK
   a. Creating a Simulink model
   b. Simulink solution of differential equation
   c. Storing/saving data
   d. Observing variables during simulation

F. Modelling of half wave rectifiers in MATLAB/SIMULINK with different types of filters.

G. Modelling of full wave rectifiers in MATLAB/SIMULINK with different types of filters.

H. Arrays and its significance in MATLAB

I. Vector handling and its application

J. Flow controls and functions

K. Data visualisation and its interpretation

UNIT 2: BASICS OF COMPUTER PROGRAMMING **18**

A. Study and implement Basic Linux Commands. What is Linux File System? Getting familiar with Linux Commands related to Creating, Moving, Removing and Listing Files/Directories including various flags.

B. Linux Ownership and File Permissions. Getting familiar with Setting/Removing Linux File/Directory Permissions, finding patterns in a File/string, Shell Script: Implementing basic programs in Shell.

C. To create and set up a virtual machine using Virtual Box. To form communication between Virtual machines in various modes and accessing Internet in each virtual machine formed. Getting familiar with the basic commands of networking.

D. Study basics of Python Programming. Execute basic operations: read a csv/data file; display the content of a file; data visualisation (plot various graphs).

UNIT 3: BASICS OF ARDUINO TECHNOLOGY **18**

A. Interfacing of LED with Arduino.

B. Interfacing of Buzzer with Arduino.

C. Interfacing of Ultra-sonic sensor with Arduino.

D. Interfacing of LCD with Arduino.

E. Interfacing of Seven Segment display with Arduino.

F. Interfacing of DC Stepper motor with Arduino.

G. Arduino based Mini Project.

UNIT 4: BASIC PRINCIPLES OF 3-D PRINTING AND PCB DESIGN **18**

A. Study of 3-D printing tools and software.

B. Design of prototypes using 3-D printer.

C. Study of PCB design software.

D. Design of custom PCB using PCB design software.

UNIT 5: ENGINEERING APPLICATIONS

Application of Matlab/Simulink, Python, arduino technology, make block mBot to various domains of electrical, computer and electronics engineering.

Total Periods: 72

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Ability to analyse the performance of electrical systems through simulation results.	(K3)
CO2	:	Develop and visualise the models with basic programs in Python.	(K3)
CO3	:	Experiment with Arduino and the various interfaced Input/Output devices.	(K3)
CO4	:	Examine the functionality of the 3D printing and PCB design.	(K4)
CO5	:	Constructing a solution for the estimation and designing of the Electronic or Electrical system and Computational tool using the Matlab, Python or Arduino interfacing.	(K6)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	-	2	-	-	3	3	3	-	-	2
CO2	3	2	3	3	2	-	-	-	-	3	-	3	-	-	-
CO3	3	2	3	3	2	-	2	-	-	3	-	3	3	2	2
CO4	3	2	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	3	2	-	-	-	-	-	3	3	3	2	3
Score	15	10	14	15	10	-	4	-	-	9	6	12	6	6	7
COM	**3**	**2**	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**3**	**3**	**3**	**3**	**2**	**3**

THIRD SEMESTER

ECC301 ELECTRONIC DEVICES AND CIRCUITS

CREDITS: 05	PC	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To familiarize with the semiconductor properties and formation of PN Junction diode and its characteristics.
- To study the operation and applications of BJT and FET.
- To describe the functionality of power semiconductor devices.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO SEMICONDUCTORS DEVICES 08

Semiconductors, Conductor and Insulators, Fermi Level, Energy Band Gap of Semiconductor, Conductivity and Mobility, Intrinsic and Extrinsic Semiconductor, Direct and Indirect Bandgap Semiconductor. Semiconductor Diodes, Current Components in Semiconductors, Poisson and Continuity Equations, PN Junction, VI Characteristics of a PN Junction Diode, Diode Resistance and Capacitance.

UNIT 2: RECTIFIERS AND SPECIAL PURPOSE DIODES 08

Rectifiers, Half Wave and Full Wave, Clippers, Single and Two Level, Clampers, Analysis with Ideal and Practical Diodes, Special Purpose Diodes, Zener Diode, Tunnel Diode and Varactor Diode, LED, Photo Diode, Schottky Diode.

UNIT 3: BIPOLAR JUNCTION TRANSISTOR 08

Transistors, Construction, Operation, Characteristics, Parameters, Transistor as an Amplifier at Low Frequency, Hybrid Model and re-Model of BJT, Analysis of Amplifier using Hybrid Model and re Model, Amplifier Types, CE, CB, CC, DC Operating Point, Biasing Circuits-Fixed Bias, Emitter Bias, Voltage Divider Bias, Bias Stabilization.

UNIT 4: FIELD-EFFECT TRANSISTORS 08

Junction FET, Construction, Operation, Characteristics, Parameters, Biasing of JFET, JFET as an Amplifier, Common Source and Common Drain. FET as a VVR. Construction and Operation of N-Channel and P-Channel MOSFET, Enhancement and Depletion Type MOSFET, Characteristics, Threshold Voltage, Channel Length

Modulation, Comparison of N-Channel and P- Channel MOSFETs, Comparison of MOSFET with JFET, Applications of MOSFETs in CMOS Circuits.

UNIT 5: POWER SEMICONDUCTOR DEVICES **08**

Power Semiconductor Devices, Construction, Principle of Operation, Characteristics and Applications of UJT, PNPN Diode, SCR, LASCR, DIAC, TRIAC, GTO Thyristors, Power BJT, Power MOSFET, DMOS, VMOS.

LIST OF EXPERIMENTS

1. A Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency.
2. V-I characteristics of PN Junction and Zener diodes, and determining its DC and AC resistance.
3. Study on half-wave and full-wave rectifier circuits without and with capacitor filter.
4. Study on clipper and clamper circuits.
5. I-V characteristic of an n-p-n and p-n-p transistors, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
6. Study BJT fixed bias, self-bias, and voltage divider bias configurations.
7. Transfer and Drain Characteristics of JFET (Find gm, rd and μ from characteristics).
8. Study FET fixed bias, self-bias configurations.
9. Differential Amplifier using Bipolar Junction Transistors.
10. Study of MOSFET in common source configuration.
11. Study of SCR characteristics.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Describe the basics of semiconductor physics and working principle of PN Junction diode.	(K2)
CO2	:	Apply the working principle of special semiconductor devices.	(K3)
CO3	:	Analyze the Bipolar Junction Transistor characteristics and the biasing techniques.	(K4)
CO4	:	Analyze the Field Effect Transistor characteristics and its applications.	(K4)
CO5	:	Explain the construction and working principle of power semiconductor devices.	(K2)

TEXT BOOKS

1. Milliman, J., Halkias, C., and Jit, S., "*Electronics Devices and Circuits*", 2nd Edition, McGraw Hill Education, 2008.
2. Streetman, B. G., & Banerjee, S., "*Solid State Electronic Devices*", 7th Edition, Upper Saddle River: Pearson/Prentice Hall, 2016.

REFERENCE BOOKS

1. Neamen, D. A., "*Semiconductor physics and devices: basic principles*", 4th edition, McGraw-Hill, 2003.
2. Sedra, A. S., Smith, K. C., Carusone, T. C., and Gaudet, V. *Microelectronic Circuits*. Vol. 4. New York: Oxford University Press, 2004.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	-	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	3	1	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	-	1	-	-	-	-	-	-	-	-	-	2
Score	15	14	9	6	2	-	-	-	-	-	-	-	-	-	10
COM	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

ECC302 DIGITAL CIRCUITS AND SYSTEMS

CREDITS: 05	PC	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- Describe the basic principles of digital circuits and solve logic expressions and circuits using Boolean laws and K-map.
- To impart knowledge for design and implementation of combinational logic circuits.
- To impart knowledge for design and implementation of sequential logic circuits.
- Classify and comprehend the working principle of logic family and data converters.
- To learn basics of Verilog HDL for system modelling.

COURSE CONTENTS

UNIT 1: NUMBER SYSTEM AND LOGIC GATES **08**

Introduction to Various Number Systems and their Conversion, Binary Arithmetic (Addition, Subtraction, Multiplication and Division), BCD Codes, Excess-3 Code, Gray Code, Hamming Code, Error Detection and Correction. Boolean Algebra and Logic Gates: Basic Logic Operations, Basic Identities, Algebraic Laws, Useful Boolean Identities, Canonical Logic Forms, Algebraic Reductions, Complete Logic Sets, Karnaugh Maps.

UNIT 2: COMBINATIONAL LOGIC NETWORKS **08**

Concept of a Digital Component, BCD Validity Detector, Binary Adders, Subtractors, Multiplexers, Demultiplexers, Line Decoders and Encoders, Binary Multiplication, Binary Comparators, Transmission Gate Logic.

UNIT 3: SEQUENTIAL LOGIC NETWORKS **08**

Concept of a Sequential Network, Latches, Clock and Synchronization, Flip-Flops, Design of Synchronous & Asynchronous Sequential circuits. Shift registers: Principle of 4-bit shift registers. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO registers, Introduction to state machine.

UNIT 4: LOGIC FAMILIES AND DATA CONVERTERS **08**

Digital Logic Gates, Various Logic Families: RTL, DTL, TTL and ECL, MOS and CMOS. D/A converter: weighted resistor type, R-2R Ladder type, A/D Converters: Flash type, Successive Approximation type, Single Slope, Dual Slope.

UNIT 5: FIRST CONCEPTS IN VERILOG HDL **08**

Defining Modules in Verilog HDL; Gate, Data Flow and (Behavioural) Structural Modelling, Learning Verilog HDL. CMOS Logic Circuits: NOT Function in CMOS, Complex Logic Gates in CMOS.

LIST OF EXPERIMENTS

1. Introduction of Digital Logic Gates: Investigate logic behavior of NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.
2. Gate-level minimization: Two level and multi-level implementation of Boolean functions.
3. Combinational Circuits design assemble and test: adders and subtractors.
4. Code Converter: BCD to Excess-3 code converter, gray code to binary converter, binary to gray code converter.
5. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
6. Design of multiplexers and de-multiplexers.
7. Design of encoders and decoders.
8. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce an 8-bit product.
9. Parallel adder and accumulator: design, implement and test.
10. Flip-Flop: assemble, test and investigate operation of S-R, D & J-K flip-flops.
11. Counters: Design, assemble and test various Asynchronous and Synchronous binary counter with parallel load.
12. Shift Registers: Design and investigate the operation of all types of shift registers with parallel load.
13. Design of Combinational circuits using the Verilog HDL module.
14. Design of Sequential circuits using the Verilog HDL module.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Describe the different number systems, solve logic expressions and circuits using Boolean laws and K-map.	(K2)
CO2	:	Develop competence in combinational Logic problem formulation and logic optimization.	(K3)
CO3	:	Develop competence in analysis of synchronous and asynchronous sequential circuits.	(K3)
CO4	:	Compare different types of logic families and data converters which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.	(K4)
CO5	:	Demonstrate knowledge of Verilog HDL for system Modeling.	(K2)

TEXT BOOKS

1. Floyd T. L., "*Digital Fundamentals*" 11th Edition Pearson International Education, 2017.
2. Mano, M. M. and Ciletti, M. D. "*Digital Design: With an Introduction to the Verilog HDL*" 5th Edition, Pearson Education, 2013.

REFERENCE BOOKS

1. Palnitkar, S., "*Verilog HDL: A Guide to Digital Design and Synthesis*," Prentice Hall, 1996.
2. Perry, D. L. "*VHDL: Programming by Example* ", 4th Edition, McGraw-Hill, 2002.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	9	15	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

ECC303 ELECTROMAGNETIC FIELD THEORY

CREDITS: 04	PC	LTPC: 3 – 1 – 0 – 4

COURSE OBJECTIVES

- To learn fundamentals of vector algebra.
- To study concepts of Electrostatics and Magnetostatics.
- To impart knowledge on Maxwell equations and their applications.
- To study how electromagnetic waves propagate in a medium.
- To study fundamentals of transmission lines and its various characteristics.

COURSE CONTENTS

UNIT 1: VECTOR ALGEBRA **08**

Introduction, Scalar fields, Vector fields; Cartesian coordinate system, cylindrical coordinate system, Spherical coordinate system, Transformation from Cylindrical to Spherical Coordinates, Gradient of a Scalar function, Divergence of a vector field, Circulation of a vector and Curl.

UNIT 2: ELECTROSTATICS AND MAGNETOSTATICS **08**

Electrostatics, Coulomb's Law, Electric fields of point charges, Gauss's Law and applications, Electric potential, Poisson's and Laplace equations, Method of Images, Multipole Expansion, Electrostatic fields in matter, Dielectrics and electric polarization, Capacitors with dielectric substrates, Magnetostatics: Magnetic fields of steady currents, Biot-Savart's and Ampere's Laws, Magnetic vector potential; Magnetic properties of matter, Faraday's Law.

UNIT 3: MAXWELL'S EQUATIONS **08**

Equation of continuity for time varying fields. Inconsistency of Amperes law, Maxwell's equations and their physical interpretation, Maxwell's Equations in Differential form and Integral form, Interface Conditions for Electromagnetic field, Time-harmonic representation of Maxwell's equations, Source-free equations.

UNIT 4: ELECTROMAGNETIC WAVES AND PROPAGATION **08**

The Electromagnetic wave equation and its solution, Time-dependent wave equation, Time-Harmonic wave equation, One-Dimensional Wave equation in Free-space and perfect dielectrics; Poynting theorem and electromagnetic power, Complex Poynting vector, Propagation of Plane waves in different materials, Polarization of Plane waves, Normal Incidence on a general dielectric interface, Oblique incidence on dielectric interface for perpendicular and parallel polarization, Brewster's Angle.

UNIT 5: TRANSMISSION LINES **08**

Distributed parameters, Time-domain transmission Line Equations, Types of transmission lines, Finite Transmission lines, Load reflection coefficient, Line

impedance and generalized reflection coefficient, Standing wave ratio; Power relations on a generalized transmission line, The Smith chart, Impedance Matching, Stub Matching, Quarter wave transformer matching.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of vector algebra and apply those in the study of electromagnetic field theory.	(K2)
CO2	:	Analyze the principles of electrostatics and magnetostatics with the help of different laws.	(K4)
CO3	:	Analyze the inconsistency in Ampere's law and formulate Maxwell's equations in differential and integral forms.	(K4)
CO4	:	Identify how electromagnetic waves propagate in any material medium.	(K3)
CO5	:	Analyze the principle of flow of V/I waves in a transmission line and study concept of impedance matching.	(K4)

TEXT BOOKS

1. Griffiths, D. J., "*Introduction to Electrodynamics*", 4th Edition, Cambridge University Press, 2020.
2. Nathan, I., "*Engineering Electromagnetics*", 2nd Edition, Springer India, 2005.

REFERENCE BOOKS

1. Verma, H.C., "*Classical Electromagnetism*", 1st Edition, Bharati Bhawan Publishers, 2022.
2. Guru, B. and Hiziroglu, H., "*Electromagnetic field theory Fundamentals*", Cambridge University Press, 2005.
3. Jordon, E. C. and Balmain, K. G., "*Electromagnetic waves and Radiating System*", 2nd Edition, Prentice Hall New Delhi, 2007.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
Score	15	11	2	15	10	2	3	3	2	15	-	15	9	-	10
COM	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**0**	**3**	**3**	**0**	**2**

ECC304 COMMUNICATION SYSTEMS

CREDITS: 06	PC	LTPC: 3 – 1 – 4 – 6

COURSE OBJECTIVES

- To study the detailed description of communication system and multiplexing methods.
- To understand the concepts of analog modulation and demodulation techniques with performance of AM, FM and PM schemes.
- To understand the design characteristics of analog communication transmitter and receiver systems.
- To introduce the concepts of various digital signal communication principles and their transmission methods and evaluate the performance of PCM, DPCM and DM.
- To study digital modulation and demodulation methods with performance of ASK, FSK, PSK, QAM.
- To understand different multiplexing domain techniques.

COURSE CONTENTS

UNIT 1: FUNDAMENTALS OF COMMUNICATION SYSTEM **08**

Communication Systems: Introduction, Block Diagrams of Analog and Digital Communication System, Merits & Demerits of Analog and Digital Systems. Overview of modulation and demodulation techniques.

UNIT 2: ANALOG MODULATION AND DEMODULATION **08**

Theory of Amplitude Modulation, Double Side Band (DSB), Single Side Band (SSB), Independent Side Band (ISB), Vestigial Side Band (VSB); AM Generation: Square law Diode Modulation, Balanced Modulator, Ring Modulator. AM Detectors; Envelope Detector, Generation of Frequency Modulation (FM) by Direct methods and Indirect Methods, The Armstrong Method, FM Stereo Transmission. Direct Methods of Frequency Demodulation; Slope Detector, Indirect methods of FM Demodulation; FM Detector using PLL and Stereo FM Multiplex Reception, Spectra of FM Signals, Narrow Band and Wide Band FM, Phase modulator and demodulator circuits.

UNIT 3: ANALOG TRANSMITTER AND RECEIVERS **08**

Pre-emphasis and De-emphasis, Tuned Radio Frequency (TRF) Receiver, Super-heterodyne receiver; RF Amplifiers Characteristics-Sensitivity, Selectivity, Image Frequency Rejection, Automatic gain Control, Foster-Seely or Phase Discrimination

UNIT 4: DIGITAL COMMUNICATION PRINCIPLES **08**

Basic principle of Analog to Digital, Need, Sampling process, Aliasing Problem, Uniform and Non-uniform quantization, Line Coding & its properties, Baseband

transmission: Pulse code modulation (PCM), Attributes of various PCM waveforms, Differential and adaptive PCM, Noise considerations in PCM, Delta modulation and demodulation, slope overload, Adaptive and Sigma Delta Modulation.

UNIT 5: DIGITAL MODULATION AND DEMODULATION **08**

Generation and detection of coherent & non-coherent Amplitude, Frequency & Phase Shift Keying (ASK, FSK, PSK), Quadrature modulation techniques, Minimum Shift Keying (MSK), M-ary FSK, Probability of error and comparison of various digital modulation techniques, Coherent reception of ASK, PSK and FSK, Non-Coherent reception of ASK, FSK, PSK and QPSK, Introduction to Multiplexing Techniques: TDM, FDM, CDM.

LIST OF EXPERIMENTS

1. To study Amplitude Modulation/demodulation using a transistor, depth of modulation, and observe the diagonal peak clipping effect of AM.
2. Frequency Modulation using Voltage Controlled Oscillator.
3. Generation of DSB-SC, SSB, and VSB.
4. Study of Phase Lock Loop (PLL) and detection of FM Signal using PLL.
5. Study functioning of Super-heterodyne AM Receiver, and study the limiter circuit and IF filter frequency response, study of the effect of image frequency.
6. Measurement of Sensitivity, Selectivity, and Fidelity of radio receivers.
7. Study of PAM, PPM, and PPM.
8. Study of line coding techniques.
9. Study of sampling theorem.
10. Study of pulse code modulation and demodulation.
11. Study of delta modulation and demodulation, the effect of slope overload.
12. Study pulse data coding techniques for NRZ and RZ formats.
13. Study of ASK, PSK, FSK, QPSK, MSK and QAM modulator and demodulator.
14. Study of multiplexing technique such as CDMA.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Understand the fundamental principles and working of analog and digital communication systems.	(K2)
CO2	:	Analyze and compare different analog modulation and demodulation schemes for their efficiency and bandwidth.	(K4)

CO3	:	Attain in-depth knowledge of transmitter and receiver design and performance parameters.	(K3)
CO4	:	Apply concepts of digital principles in baseband transmission and designing communication systems.	(K3)
CO5	:	Associate different digital modulation schemes to compute the bit error performance and illustrate various multiplexing techniques.	(K2)

TEXT BOOKS

1. Haykin S., "*Communications Systems*", John Wiley and Sons, 2001.
2. B. P. Lathi, "*Modern Digital and Analog Communication Systems*," 4th Edition, Oxford, 2011.

REFERENCE BOOKS

1. Tomasi, W., "*Advanced Electronic Communications systems*" 6th Edition, Pearson Publishers, 2015.
2. Taub H. and Schilling D.L., "*Prnciples of Communication Systems*", Tata McGraw Hill, 2001.
3. Sklar, B., "*Digital Communication - Fundamentals and Applications*", 2nd Edition, Prentice-Hall India, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
Score	15	11	2	15	10	2	3	3	2	15	-	15	9	-	10
COM	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**0**	**3**	**3**	**0**	**2**

ECL305 PRACTICUM - III

CREDITS: 03	PC	LTPC: 0 – 0 – 6 – 3

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate a sound technical knowledge of the selected domain	(K2)
CO2	:	Survey research studies and demonstrate a solution of a complex engineering problem	(K6)
CO3	:	Experiment with state-of-the-art methods and analyze the available solutions	(K4)
CO4	:	Construct and implement the proposed solution utilizing the systematic approach	(K6)
CO5	:	Evaluate results using various performance metrics and compare it with the available solutions	(K5)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	-	3	3	-	3	-	-	3
CO2	3	3	1	3	-	-	-	-	3	3	3	3	3	3	3
CO3	3	3	-	3	-	-	-	-	3	3	3	3	3	3	3
CO4	3	3	2	3	1	2	3	-	3	3	3	3	3	3	3
CO5	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	2	5	6	3	15	15	12	15	12	12	15
COM	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

ECL306 INTRODUCTION TO PYTHON

CREDITS: 02	PC	LTPC: 0 – 0 – 4 – 2

COURSE OBJECTIVE

- The objectives of this lab are to become familiar with the interactive and script modes in Python, and to learn the basics of input, processing, and output in Python.

LIST OF EXPERIMENTS

1. Introduction to python programming and python datatypes.
2. Python program to convert decimal number to binary and vice-versa.
3. Python program to print the grades according to the marks.
4. Python program to calculate the sum of first n numbers.
5. Python program to find the sum of square of first n numbers.
6. Python Program to check the given number is prime or not.
7. Python Program to check the given numbers are twin primes or not.
8. Python program to find the intersection and union of two lists.
9. Python program to transpose a given matrix.
10. Python program to remove the "*i*" th occurrence of the given word in a list where words repeat.
11. Python program to check if a substring is present in a given string.
12. Python program to map two lists into a dictionary.
13. Python program to count the frequency of words in a string using a dictionary.
14. Python program to create a dictionary with key as first character and value as words starting with that character.
15. Python program to find the length of a list using the concept recursion.
16. Python program to read a file and modify the first letter of every word in the file.

Total Periods: 48

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Understand computer architecture and data representations (variables, representation of numbers and character strings).	(K2)
CO2	:	Administer basic algorithmic problem-solving techniques (decision structures, loops, functions).	(K3)
CO3	:	Develop and understand the concepts of lists and dictionaries used in programming.	(K3)
CO4	:	Develop, document, implement and test solutions to programming problems.	(K3)
CO5	:	Identify and repair coding errors in a program.	(K2)

TEXT BOOK

1. Downey, Allen. “Think python” *O'Reilly Media*, Inc., 2012.
2. Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers, “*How to Think Like a Computer Scientist: Learning with Python 3*”, 3rd Edition, 2015.

REFERENCE BOOK

1. Shein, Esther. "*Python for beginners*" Communications of the ACM 58.3 (2015): 19-21.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	6	15	-	-	-	-	-	-	-	-	-	-	8
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

FOURTH SEMESTER

ECC401 MICROWAVE ENGINEERING

CREDITS: 05	PC	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To learn fundamentals of microwaves.
- To represent microwave network using scattering matrix.
- To impart knowledge on microwave waveguides and components.
- To study design consideration and principle of operation of microwave tubes.
- To study various microwave semiconductor devices and their applications.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO MICROWAVES **08**

History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves, Mathematical model of Microwave Transmission, Microwave Propagation (Friis Free space propagation model), Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT 2: MICROWAVE NETWORK ANALYSIS **08**

Equivalent voltages and currents, concept of impedance, impedance and admittance matrices of microwave junctions, scattering matrix representation of microwave networks, ABCD parameters, excitation techniques for waveguides.

UNIT 3: MICROWAVE WAVEGUIDES AND COMPONENTS **08**

Analysis of Parallel plane waveguides, Rectangular waveguides and Circular waveguides, Rectangular cavity resonator, Microwave Hybrid circuits, Waveguide Tees, Magic tees, Rat-race circuits, Directional coupler, Circulators and Isolators, Wilkinson power divider.

UNIT 4: MICROWAVE TUBES **08**

Design considerations for microwave tubes, current status of microwave tubes, principle of operation of multi- cavity and reflex klystron, magnetron and traveling wave tube, Applications of Microwave tubes, Effect of microwaves on human body.

UNIT 5: MICROWAVE SEMICONDUCTOR DEVICES **08**

Operation and circuit applications of Gunn diode, IMPATT diode, PIN Diode, and Schottky barrier diode; Microwave BJT, MESFET, HEMT and their applications.

LIST OF EXPERIMENTS

1. To study I-V characteristics of Gunn diode.
2. To study the output power and frequency as a function of voltage characteristic of Gunn diode.
3. To study square wave modulation through Pin diode.
4. To study the characteristics of Reflex Klystron Tube.
5. Measurement of Directional Coupler parameters.
6. To study characteristics of Isolator and Circulator.
7. To study characteristics of Waveguide Tees.
8. Measurement of Frequency and Wavelength.
9. Measurement of Impedance.
10. Antenna Measurements.
11. Low, medium and high VSWR measurements.
12. To study the variable attenuator.
13. To study voice communication using Microwave test bench.
14. To study the square law behavior of microwave crystal detector.
15. To design Microstrip patch antenna using CST microwave studio.
16. To design Vivaldi antenna using CST microwave studio.
17. To design Anti-Podal Vivaldi antenna using CST microwave studio.
18. To design a Frequency selective surface for X-band using CST microwave studio.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of microwave engineering and outline the losses associated with microwave transmission.	(K2)
CO2	:	Analyze the operating principles of various microwave devices and recognize their usability in microwave network analysis.	(K4)
CO3	:	Analyze the basic mechanism behind the wave propagation in waveguides.	(K4)
CO4	:	Identify the effect of microwaves on different parts of human body and study operating principles of microwave tubes.	(K3)
CO5	:	Assess the methods used for generation and amplification of microwave power.	(K5)

TEXT BOOKS

1. Liao. S. Y., "*Microwave Device and Circuits*", 3rd Edition, Pearson Education, 2000.
2. Pozar, D. M., "*Microwave Engineering*", 4th Edition, Wiley, 2013.

REFERENCE BOOKS

1. Collin, R. E., "*Foundations for Microwave Engineering*", 2nd Edition, Wiley, 2007.
2. Das, A. and Das, S. K., "*Microwave Engineering*", 3rd Edition, McGraw Hill Education, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	2	3	2	-	-	-	3	3	-	3	-	-	-
Score	15	11	4	15	10	2	3	3	5	15	-	15	6	-	8
COM	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**0**	**3**	**3**	**0**	**2**

ECC402 CONTROL SYSTEMS

CREDITS: 05	PC	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To acquire the knowledge of the dynamic modelling of the systems and their representations.
- To analyse the time domain behaviour of the control systems.
- To analyse the open and closed loop stability.
- To analyse the frequency domain behaviours and design control systems using different classical control theory.
- To understand the concept of state variable analysis.

COURSE CONTENTS

UNIT 1: BASIC CONCEPTS **08**

Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Mathematical modelling of electrical, Mechanical and thermal systems, Analogies, Block diagrams and signal flow graphs, Control System Components.

UNIT 2: TIME DOMAIN ANALYSIS **08**

Importance of time response in transient and steady state analysis, typical test input signals, transient response of the first order and second order system, time response specifications, dominant closed loop poles of higher order systems, steady state error and error coefficients, PID control-Analytical design for P, PI, PID control systems.

UNIT 3: STABILITY **08**

Concepts of absolute and relative stability, pole zero location, Routh Hurwitz criteria. Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT 4: FREQUENCY DOMAIN ANALYSIS AND COMPENSATOR DESIGN **08**

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot — Polar Plot-Nyquist Plots. Design of compensators using Bode plots, lead compensation, lag compensation, lag-lead compensation.

UNIT 5: STATE VARIABLE ANALYSIS **08**

Concept of State, State variables & state models, State space representation of linear continuous time systems, State models for linear continuous time systems, State

variables and linear discrete time systems, Solution of state equations, Concept of controllability &observability.

LIST OF EXPERIMENTS

1. Modelling and simulating plant dynamics using Matlab/Simulink.
2. Estimation of step/ramp/impulse response of 1st and 2nd order systems.
3. Time domain analysis of 1st and 2nd order systems
4. Frequency domain analysis of 1st and 2nd order systems using graphical methods.
5. Stability analysis of linear systems.
6. Design of P, PI, PD and PID controllers for 1st and 2nd order systems using classical control methods.
7. Design and Tune Feedback Compensators using Control System Designer Application.
8. Design of control system using Root Locus.
9. State space analysis.
10. Modelling and analysis of non-linear systems.
11. Design of full state feedback compensator.
12. Design of LQR controller.
13. Model order reduction of higher order system.
14. Design of fuzzy control system for linear systems.
15. Optimal design of controllers using optimization methods.

Total Periods:40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain and distinguish between open and closed control systems.	(K2)
CO2	:	Compute the transfer function of the mathematical model of a given physical system.	(K3)
CO3	:	Distinguish the various type of control system hardware and their functionality.	(K2)
CO4	:	Analyze and measure the response and stability of the closed and open loop systems.	(K5)
CO5	:	Design various kinds of controllers and compensators and then compare their performance.	(K6)

TEXT BOOKS

1. Nagrath, I. J. and Gopal, M., "*Control System Engineering*," 7th Edition, New Age International, 2021.
2. Nise, Norman S., "*Control Systems Engineering*" 8th Edition, John Wiley & Sons, 2019.

REFERENCE BOOKS

1. Warwick, K., "*An Introduction to Control Systems*", 2nd Edition, World Scientific Publishing, 1996.
2. Åström, K. J. and Murray, R.M. "*Feedback systems. An Introduction for Scientists and Engineers*". 2008.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	-	-	-	-	-	-	-	3	-	-
CO2	2	2	2	3	2	-	-	-	-	-	-	-	3	-	3
CO3	2	2	2	3	-	-	-	-	-	-	-	-	3	-	-
CO4	2	3	3	3	2	-	-	-	3	3	-	2	3	-	3
CO5	2	3	3	3	2	-	-	-	3	3	-	3	3	-	3
Score	10	12	12	13	6	-	-	-	6	6	-	5	15	-	9
COM	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**3**

ECC403 MICROPROCESSORS AND MICROCONTROLLERS

CREDITS: 06	PC	LTPC: 3 – 1 – 4 – 6

COURSE OBJECTIVES

- To study the architecture of 8086 microprocessor and 8051 microcontrollers.
- To learn the development of assembly language programming of 8086 and 8051.
- To learn the design aspects of I/O and memory interfacing circuits of 8086 and 8051.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO MICROPROCESSOR **08**

Evolution of microprocessors, technological trends in microprocessor development, The Intel family tree, applications of Microprocessors. Introduction to 16-Bit microprocessor architecture: 8086 Block diagram, 8086 pin diagram, Addressing modes, 8086 minimum mode, maximum mode. 8086 CPU Read/ Write timing diagrams in minimum and maximum mode, coprocessor, closely coupled and loosely Coupled configurations.

UNIT 2: 8086 INSTRUCTION SET **08**

Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; assembler directives, assembly language programming, linking and relocation, stacks, procedures, macros, interrupts and interrupt service routines.

UNIT 3: I/O INTERFACING **08**

Serial communication interface, Parallel communication interface, Programmable timer/counter, Keyboard /display controller, Interrupt controller, DMA controller, Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT 4: MICROCONTROLLER **08**

Architecture of 8051, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

UNIT 5: INTERFACING MICROCONTROLLER **08**

Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, 8255 Interfacing, External Memory Interface, Stepper Motor and waveform generation.

List Of Experiments

1. Programs for 64-bit arithmetic operations for 8086 (using various addressing modes).
2. Program for sorting an array for 8086.
3. Program to find the factorial of a given number.
4. Programs for searching a number or character in a string for 8086.
5. Programs for string manipulation for 8086.
6. Programs for digital clock design using 8086, Interfacing ADC and DAC to 8086.
7. Parallel communication between two microprocessors kits using 8255.
8. Serial communications between two microprocessors kits using 8251.
9. Programming using arithmetic, logical and bit manipulation instructions of 8051.
10. Interfacing and programming 8086 to control stepper motor.
11. Program and verify timer/counter in 8051.
12. Program and verify interrupt handling in 8051.
13. UART operation in 8051, communication between 8051 kit and PC.
14. Interfacing LCD to 8051.
15. Interfacing matrix/keyboard to 8051.
16. Data transfer from peripheral to memory through DMA controller 8237/8257.
17. LED blinking, Interfacing ADC to 8051.
18. Interfacing keyboard and LCD to 8051.
19. Interfacing & programming for the fastest finger.
20. LED blinking model-I, LED blinking model-II.
21. Interfacing to 8051 and programming to control stepper motor.

Total Periods: 40 + 48 = 88

Course Outcomes

After the completion of this course, students will be able to:

CO1	:	Describe the internal organization/architecture of 8086 microprocessor and 8051 microcontrollers.	(K2)
CO2	:	Apply programming techniques in developing the assembly language program for microprocessor applications.	(K3)
CO3	:	Understand various types of interfacing devices with other peripherals.	(K2)
CO4	:	Apply programming techniques in developing the assembly language program for microcontroller applications.	(K3)
CO5	:	Analyse Microprocessor and Microcontroller based systems.	(K4)

TEXT BOOKS

1. Liu, Y. C. and Gibson, G. A., "*Microcomputer Systems - The 8086/8088 Family: Architecture, Programming and Design*", 2nd Edition, Prentice Hall of India, 2011.
2. Mazidi, M. A., Mazidi, J. G., and McKinlay, R. D., "*The 8051 Microcontroller and Embedded systems*", 2nd Edition, Pearson Education, 2011.

REFERENCE BOOKS

1. Brey, B. B., "*Intel Microprocessors*", 8th Edition, Pearson Education, 2013.
2. Ayala, K. J., "*The 8051 microcontroller - Architecture, Programming and Applications*", 2nd Edition, Thomson Delmar Learning.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	3	-	2	3	3	-	-	-	-	-	2	-
Score	15	15	15	10	-	2	3	3	-	-	-	-	-	4	-
COM	**3**	**3**	**3**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

ECC404 LINEAR INTEGRATED CIRCUITS

CREDITS: 05	PC	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To learn the fundamentals of multistage and differential amplifiers.
- To study basics of operational amplifiers.
- To learn general linear applications of Op-Amp.
- To impart knowledge on active filters and oscillators.
- To study special IC applications using Op-Amp.

COURSE CONTENTS

UNIT 1: MULTISTAGE AND DIFFERENTIAL AMPLIFIERS 08

BJT Amplifiers (CC, CE, CB), Multistage Amplifiers, Types of multistage couplings. Feedback Amplifier; Concept of feedback, Analysis of various configurations of feedback in amplifiers; Current mirror and current sources, Current sources as active loads, BJT Differential amplifier with active loads.

UNIT 2: BASICS OF OPERATIONAL AMPLIFIERS 08

Introduction to operational amplifiers, Interpretation of data sheets and characteristics of an Op-Amp, The ideal Op-Amp, Equivalent circuit of Op-Amp, Ideal Voltage Transfer curve, Open-loop Op-Amp configurations, Characteristics of practical Op-Amp; Input offset voltage, Input bias current, Input offset current, Power supply rejection ratio, Common mode rejection ratio, Frequency response of an Op-Amp.

UNIT 3: GENERAL LINEAR APPLICATIONS OF OP-AMP 08

The peaking amplifier, Summing, Scaling and Averaging amplifiers, Voltage Follower, Differential input and Differential output amplifier, V-to-I with Floating load and Grounded load, I-to-V converters, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier.

UNIT 4: ACTIVE FILTERS AND OSCILLATORS USING OP-AMP 08

Active filters, First-order and second order Butterworth filters; Low pass and High pass, Band pass filters, Band-reject filters, All-pass filter, Oscillators; Principles, Types, Phase shift oscillator, Wein Bridge oscillator, Basic Comparator, Schmitt Trigger, Zero-crossing detector, Astable Multivibrator and Monostable Multivibrator (using op-amp).

UNIT 5: SPECIAL FUNCTION IC APPLICATIONS **08**

The 555 Timer; as a monostable multivibrator, as a astable multivibrator, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator, Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters, Phase-Locked loops.

LIST OF EXPERIMENTS

1. Design and testing of inverting and non-inverting operational amplifiers.
2. To verify the function of an operational amplifier as an adder and subtractor.
3. To demonstrate the integrator and differentiator circuits using Op-amp.
4. Design and testing Instrumentation amplifier.
5. Design and testing active low-pass, high-pass, band-pass and band-stop filters.
6. Design and testing of astable and mono-stable multi-vibrators using Op-amp.
7. Design and testing Schmitt Trigger and Comparator using Op-amp.
8. Design, Build and Test a Square wave and triangular wave generators using op-amp.
9. To study the operation of IC 565 as PLL.
10. Study of Multiplier IC.
11. To study the output characteristics of half-wave and full-wave rectifier using op-amp.
12. Above experiments are to be Simulated using SPICE.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Infer the DC and AC characteristics of amplifiers and explain their effect on the output.	(K2)
CO2	:	Explain the working of general-purpose OP-AMP and study its frequency response.	(K2)
CO3	:	Design the general linear applications of an OP-AMP.	(K6)
CO4	:	Examine the functionality of various active filters and oscillators.	(K4)
CO5	:	Design application specific ICs such as Voltage regulators, PLL and determine their applications in modern day communication systems.	(K6)

TEXT BOOKS

1. Gayakwad, R. A., "*OP-AMP and Linear Integrated Circuits*", 4th Edition, Pearson Education, 2015.
2. Franco, S., "*Design with Operational Amplifiers and Analog Integrated Circuits*", 4th Edition, McGraw-Hill education, 2016.

REFERENCE BOOK

1. Choudhary, D. R. and Jain, S. B., "*Linear Integrated Circuits*", 5th Edition, New Age International, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	3	3	-	-	2	-	-	-	-	3	-	3	-	-	2
CO3	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
CO4	3	2	2	3	2	-	-	-	-	3	-	3	-	-	2
CO5	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
Score	15	13	8	9	10	-	-	-	6	15	-	15	6	4	10
COM	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**2**	**3**

ECL405 PRACTICUM – IV

CREDITS: 03	PC	LTPC: 0 – 0 – 6 – 3

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate a sound technical knowledge of the selected domain.	(K2)
CO2	:	Survey research studies and demonstrate a solution of a complex engineering problem.	(K6)
CO3	:	Experiment with state-of-the-art methods and analyze the available solutions.	(K4)
CO4	:	Construct and implement the proposed solution utilizing the systematic approach.	(K6)
CO5	:	Evaluate results using various performance metrics and compare it with the available solutions.	(K5)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	-	3	3	-	3	-	-	3
CO2	3	3	1	3	-	-	-	-	3	3	3	3	3	3	3
CO3	3	3	-	3	-	-	-	-	3	3	3	3	3	3	3
CO4	3	3	2	3	1	2	3		3	3	3	3	3	3	3
CO5	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	2	5	6	3	15	15	12	15	12	12	15
COM	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

ECL406 ADVANCED PYTHON PROGRAMMING

CREDITS: 02	PC	LTPC: 0 – 0 – 4 – 2

COURSE OBJECTIVES

- To introduce methods of data input and other operations using Python.
- To provide an exposure to more advanced programming methods, such as object-oriented programming.

LIST OF EXPERIMENTS*

1. Write a program to read a $n \times n$ matrix and find the transpose.
2. Write a program to perform addition, subtraction of two $n \times n$ matrices.
3. Write a program to perform multiplication of two $n \times n$ matrices.
4. Write a program to check whether two given $n \times n$ matrices are identical or not.
5. Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding. Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance between two balls centers) $\leq$ (sum of their radii) then (they are colliding).
6. Write a function nearly_equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b. (Do not use any built-in function.)
7. Install packages requests, flask and explore using (pip).
8. Write a Python program that imports requests and fetch content from wiki page.
9. Write a Python program to generate a series of unique random numbers by using random module.
10. Create a class ATM and define ATM operations to create account, deposit, check_balance, withdraw and delete account. Use constructor to initialize members.
11. Make a class Employee with a name and salary. Make a class Manager inherit from Employee. Add an instance variable, named department. Write a method that prints manager's name, department and salary. Make a class Executive inherit from Manager. Write a method that prints the string "Executive" followed by the information stored in the Manager super class object.
12. A hospital wants to create a database regarding its indoor patients. The information to store includes a) Name of the patient b) Date of admission c) Disease d) Date of discharge. Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about to store the age of the patients. List the information about all the paediatric patients (less than twelve years in age).
13. Write a python program to read the file contents and do the following operations
    - Print each word of a file in reverse order.

- Print each line of a file in reverse order:
  - *Sample Input*: Python Programming
  - *Sample Output*: Programming Python
- Display the content of a without whitespaces.

14. Write a Python program to store N student's records containing name, roll number and branch. Print the given branch student's details only.

**Do not use any built-in function.*

Total Periods: 48

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the basic concepts of Python programming.	(K2)
CO2	:	Apply the concepts of user defined functions.	(K3)
CO3	:	Illustrate the uses and applications of object-oriented concepts.	(K3)
CO4	:	Illustrate the use of the concepts of built-in Python libraries.	(K3)
CO5	:	Demonstrate the file handling using Python.	(K3)

TEXT BOOK

1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers, "*How to Think Like a Computer Scientist: Learning with Python 3*", 3rd Edition, 2015.

REFERENCE BOOKS

1. Michael H Goldwasser, David Letscher, "*Object Oriented Programming in Python*", 1st Edition, Prentice Hall, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, "*Let us Python*", 1st Edition, BPB publication, 2019.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	6	15	-	-	-	-	-	-	-	-	-	-	8
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

FIFTH SEMESTER

ENL501 PROFESSIONAL COMMUNICATION AND SOFT SKILLS

CREDITS: 02	PC	LTPC: 0 – 0 – 4– 2

COURSE OBJECTIVES

- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To develop awareness about different forms of professional communication & social behaviour.
- To hone the employability related communication skills of the students by empowering them with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO SOFT SKILLS AND PROFESSIONAL ETHICS 05

Aspects of Soft Skills, Effective Communication Skills, Personality Development- Importance of Professional Ethics.

UNIT 2: TEAM BUILDING 05

Understanding nature of team-mapping personal and professional goals of team members, working effectively in a team through building relations and interpersonal communication.

UNIT 3: ART OF NEGOTIATION 05

What is negotiation, Ways of negotiating, Understanding the power of language and non-verbal communication.

UNIT 4: ORGANISING MEETINGS 05

How to call a meeting, how to organize a meeting, how to design the agenda and prepare minutes of the meeting.

UNIT 5: PRESENTATION SKILLS 06

Researching for a presentation, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation.

UNIT 6: STRESS MANAGEMENT AND TIME MANAGEMENT 05

Kinds of stress, Identifying the right reasons of stress, How to handle the pressure, Techniques to cope with the stressful situation at a workplace, Goal setting, Understand the importance of time and How to prepare the time line.

UNIT 7: GROUP DISCUSSION AND PUBLIC SPEAKING **05**

Nature of discussion, Ways to form and present the arguments. Public speaking skills and being successful in it.

Total Periods: 36

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Develop awareness about personality development, social behaviour and professional ethics.	(K3)
CO2	:	Understand and recognise the importance of interpersonal skills and team dynamics, and strengthen individual expression in collaborative peer activities.	(K3)
CO3	:	Apply concepts of negotiation to a workplace situation and effectively plan a negotiation using appropriate verbal and nonverbal cues.	(K3)
CO4	:	Plan and execute Meetings, and draft minutes, reports and relevant documents.	(K3)
CO5	:	Develop coherence, cohesion and competence essential for presentation deliveries.	(K3)
CO6		Become more effective through stress management, time management, goal/target setting and self-motivation.	(K3)
CO7		Develop critical thinking, clarity of expression and proactive participation in group discussion.	(K3)

TEXT BOOKS

1. Rizvi, M. A., "*Effective Technical Communication*", 2nd Edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., "*Developing Communication Skills*", 2nd Edition, Laxmi Publications, 2009.

REFERENCE BOOKS

1. Dale, C., "*How to Win Friends and Influence People*", Simon & Schuster,1998.
2. Coleman, D., "*Emotional Intelligence*" Bantam Book, 2006.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO7	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Score	-	-	-	-	-	-	-	3	6	6	-	-	-	-	3
COM	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

ECL502 PROJECT PHASE – I

CREDITS: 03	PC	LTPC: 0 – 0 – 6 – 3

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate a sound technical knowledge of the selected project topic.	(K2)
CO2	:	Survey research studies, find research gaps, and formulate a complex engineering problem.	(K6)
CO3	:	Experiment with state-of-the-art methods and identify the available solutions.	(K4)
CO4	:	Analyze and compare the available solutions.	(K4)
CO5	:	Plan, propose and implement the proposed solution.	(K6)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	3	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	15	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

ECO503 HONORS ONLINE COURSE – I

CREDITS: 03	OC	LTPC: 5 – 1 – 0 – 3

- This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

ECO503 OPTIONAL ONLINE COURSE – I

CREDITS: 0 – 3	OC	LTPC: 5 – 1 – 0 – (0 – 3)

- This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students having SGPA<8.0 (Semester I to IV) are eligible for the Online Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

SIXTH SEMESTER

ECL601 INTERNSHIP

CREDITS: 00	PC	LTPC: 0 – 0 – 40– 0

- The curriculum has support for Industrial/Academic/R&D training for a minimum period of 5 months from December to May in any of the reputed industries/institutions. The students may identify the industry/institute suitable for them, considering their career choice. However, the institute may also offer its services. The evaluation will be as per the Clause 10.2 of *Academic Rules and Regulations.*

ECO602 HONORS ONLINE COURSE – II

CREDITS: 03	OC	LTPC: 5 – 1 – 0 – 3

- This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

ECO602 OPTIONAL ONLINE COURSE – II

CREDITS: 0 – 3	OC	LTPC: 5 – 1 – 0 – (0 – 3)

- This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students having SGPA<8.0 (Semester I to IV) are eligible for the Online Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

SEVENTH SEMESTER

HMC701 PROFESSIONAL ETHICS

CREDITS: 00	GIR	LTPC: 1 – 0 – 0– 0

COURSE OBJECTIVES

- To enable the students to create on awareness on Engineering Ethics and Human Values, to instil Moral and Social Values and loyalty and to appreciate the rights of others.

COURSE CONTENTS

UNIT 1: HUMAN VALUES **03**

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

UNIT 2: ENGINEERING ETHICS **03**

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.

UNIT 3: ENGINEERING AS SOCIAL EXPERIMENTATION **02**

Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

UNIT 4: SAFETY, RESPONSIBILITIES AND RIGHTS **04**

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Importance of Plagiarism, Discrimination.

UNIT 5: GLOBAL ISSUES **03**

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

Total Periods: 15

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Distinguish between ethical and non-ethical situations.	(K4)
CO2	:	Practice moral judgment effectively handling the conditions of dilemma.	(K3)
CO3	:	Develop cognitive skills in solving social problems and apply the code of ethics to social experimentation.	(K3)
CO4	:	Apply risk and safety measures in various engineering fields.	(K3)
CO5	:	Explain corporate social responsibility and understand the concern for ethical contribution for the global society.	(K2)

TEXT BOOKS

1. Govindarajan M., Natarajan S., Senthilkumar V.S., "*Engineering Ethics*", PHI, 2013.
2. Martin Mike W., Schinzinger Roland, "*Ethics in Engineering*", 4th Edition, Tata Mc Graw Hill, 2005.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Score	-	-	-	-	-	2	2	9	3	-	-	-	-	-	3
COM	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**

ECL702 PROJECT PHASE – II

CREDITS: 06	PC	LTPC: 0 – 0 – 12 – 6

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate a sound technical knowledge of the selected project topic.	(K2)
CO2	:	Survey research studies, find research gaps, and formulate a complex engineering problem.	(K6)
CO3	:	Experiment with state-of-the-art methods and identify the available solutions.	(K4)
CO4	:	Analyze and compare the available solutions.	(K4)
CO5	:	Plan, propose and implement the proposed solution.	(K6)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	3	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	15	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

ECO703 HONORS ONLINE COURSE – III

CREDITS: 03	OC	LTPC: 5 – 1 – 0 – 3

- This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

ECO703 OPTIONAL ONLINE COURSE – III

CREDITS: 0 – 3	OC	LTPC: 5 – 1 – 0 – (0 – 3)

- This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students having SGPA<8.0 (Semester I to IV) are eligible for the Online Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

EIGHTH SEMESTER

› ALL THE SUBJECTS ARE ELECTIVES

ECL801 PROJECT PHASE – III

CREDITS: 09	PC	LTPC: 0 – 0 – 18 – 9

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate a sound technical knowledge of the selected project topic.	(K2)
CO2	:	Survey research studies, find research gaps, and formulate a complex engineering problem.	(K6)
CO3	:	Experiment with state-of-the-art methods and identify the available solutions.	(K4)
CO4	:	Analyze and compare the available solutions.	(K4)
CO5	:	Plan, propose and implement the proposed solution.	(K6)

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	3	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	15	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

ECO802 HONORS ONLINE COURSE – IV

CREDITS: 03	OC	LTPC: 5 – 1 – 0 – 3

- This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

ECO802 OPTIONAL ONLINE COURSE – IV

CREDITS: 0 – 3	OC	LTPC: 5 – 1 – 0 – (0 – 3)

- This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students having SGPA<8.0 (Semester I to IV) are eligible for the Online Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

PROGRAM ELECTIVES

PROGRAM ELECTIVE - I

ECPE11 DATA COMMUNICATION AND NETWORKS

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To provide the fundamental concepts of computer networks, reference models and its functionalities.
- To explore the different types of signalling schemes and channel access techniques in physical layer
- To identify the key design issues of data link and network layer protocols.
- To evaluate the network performance using various services provided by transport and application layers.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO COMPUTER NETWORKS **08**

Network, Component and Categories, Topologies, Transmission Media, Reference Models: ISO/OSI Model and TCP/IP Model.

UNIT 2: PHYSICAL LAYER **08**

Digital and Analog Signals, Periodic Analog Signals, Transmission Impairments, Digital data transmission techniques, Analog data transmission techniques, Multiplexing and Spread Spectrum.

UNIT 3: DATA LINK LAYER **08**

Error Detection and Correction, Parity, LRC-CRC, Hamming Code, Flow Control and Error Control, Stop and wait, ARQ, Sliding window, HDLC, Multiple Access Protocols, IEEE 802.3 Ethernet.

UNIT 4: NETWORK LAYER **08**

Packet Switching and Datagram approach, IP addressing methods, Subnetting, Routing, Distance Vector Routing, Link State Routing, Broadcast and Multicast Routing.

UNIT 5: TRANSPORT AND APPLICATION LAYER **08**

Transport Services, UDP, TCP, Congestion Control, Quality of Services (QOS), Application Layer: Domain Name Space (DNS), Electronic Mail.

LIST OF EXPERIMENTS

1. Study of different typed of Networks Cable and Practically Implement the cross-wired cable and straight through cable using clamping tool.
2. Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.
3. Install and configure Network Devices: HUB, Switch and Routers.
4. Connect the Computers in Local Area Network.
5. Configure Host IP, Subnet Mask and Default Gateway in a System in LAN (TCP/IP Configuration).
6. Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.
7. Configure Internet connection and use IPCONFIG, PING / Tracer and Net stat utilities to debug the network issues.
8. Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network.
9. Router Configuration Using Packet Tracer.
10. Connection oriented Client server applications with TCP Assignment.
11. Connectionless Client server applications with UDP Assignment.
12. Study of Socket Programming and Client – Server Model.
13. Configure a Network Topology using packet tracer software.
14. Configure a Network using Distance Vector Routing Protocol.
15. Configure a Network using Link State Vector Routing Protocol.
16. To get the MAC or Physical address of the system using Address Resolution Protocol.
17. Simulate the Implementing Routing Protocols using border gateway protocol (BGP) .
18. Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Infer the layered protocol approach in computer networking.	(K2)
CO2	:	Explain and apply the fundamentals of signal processing in the physical layer of the computer networking.	(K3)
CO3	:	Make use of various error detection and correction services provided by the data link layer.	(K3)

CO4	:	Analyze the various addressing and routing services provided by the network layer and design network layer protocols..	(K4)
CO5	:	Infer and apply various services provided by the transport and the application layer.	(K3)

TEXT BOOKS

1. Foruzan, B. A., "*Data Communication and Networking*", 5th Edition, McGraw Hill Education, 2017.
2. Tanenbaum, A. S. and Wetherall, D. J., "*Computer Networks*", 5th Edition, Pearson Education, 2013.

REFERENCE BOOK

1. Stallings, W., "*Data and Computer Communication*", 10th Edition, Pearson Education, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	-	-	-	-	-	-	-	3	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	-	3	-	2
CO3	2	2	2	2	-	-	-	-	-	-	-	-	3	-	2
CO4	2	2	2	2	-	-	-	-	-	-	-	-	3	-	2
CO5	2	2	2	2	-	-	-	-	-	-	-	-	3	-	2
Score	10	10	10	9	-	-	-	-	-	-	-	-	15	-	10
COM	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

PROGRAM ELECTIVE - I

ECPE12 ARTIFICIAL NEURAL NETWORKS

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To study the basics of neural network architecture.
- The study the ANN architectures used for pattern classification.
- The study the ANN architectures used for pattern association.
- The study the competitive ANN.
- To study the BPN and real-life applications of ANN.

COURSE CONTENTS

UNIT 1: BASIC CONCEPTS **08**

Biological Neuron, Historical developments on NNs, Introduction of ANNs, Need and Applications of ANNs, Basic architecture, building blocks, common activation functions, McCulloch-Pitts Neuron and its implementation of various Boolean functions.

UNIT 2: NEURAL NETWORKS FOR PATTERN CLASSIFICATION **08**

General architecture and its building blocks, principle of linear separability, Hebb Net, algorithm and applications, Perceptron, architecture, algorithm, applications and convergence theorem, Adaline, architecture, algorithm and applications, Madaline, architecture and MRI and MRII algorithms.

UNIT 3: PATTERN ASSOCIATION **08**

Hebb Rule and Delta Rule for pattern association, Hetero associative memory networks, Auto-associative memory networks, Hopfield networks, Bidirectional Associative Memory networks.

UNIT 4: COMPETITIVE NEURAL NETWORKS AND ART NETWORKS **08**

Fixed weight competitive networks, MAXNET, Mexican hat and Hamming network, Kohonen self-organising maps, architecture, algorithm and applications, Learning vector quantization, architecture, algorithm and applications, Counter propagation networks, full CPN and forward only CPN, Adaptive resonance theory, motivation, architecture, ART1 and ART2 Networks, architecture, algorithm and applications.

UNIT 5: BACKPROPAGATION NEURAL NETWORKS AND REAL-LIFE APPLICATIONS **08**

Standard back propagation neural networks, architecture, algorithms and applications, Applications of neural networks in forecasting, signal processing,

control systems, Introduction to Deep neural networks and convolutional neural networks.

List Of Experiments

1. To implement various activation functions.
2. To implement perceptron neural network.
3. To implement feed forward neural network and compare performances of various learning rules.
4. To implement a Multi-layered feed forward neural network.
5. To solve the XOR problem.
6. To implement a Multi-layered feed forward neural network.
7. To solve the multi class classification problem.
8. Time series prediction using Adaline.
9. To implement SOM and compare its performance for three different datasets.
10. To implement LVQ on iris dataset for multi class classification.

Total Periods: 40 + 48 = 88

Course Outcomes

After the completion of this course, students will be able to:

CO1	:	Infer the architecture for artificial neural networks.	(K2)
CO2	:	Apply the training rules for single and multi-layer neural networks.	(K3)
CO3	:	Interpret the architecture and analyze the learning abilities of associative memory networks.	(K4)
CO4	:	Interpret the architecture and analyze the performance of competitive memory networks.	(K4)
CO5	:	Infer, analyze and evaluate the various real-life application that use neural networks.	(K5)

Text Books

1. Fausett, Laurene V. *Fundamentals of neural networks: architectures, algorithms and applications*. Pearson Education India, 2006.
2. Hagan, Martin T., Howard B. Demuth, and Mark Beale. *Neural network design*. PWS Publishing Co., 1997.

Reference Books

1. Rashid, Tariq. *Make your own neural network.* CreateSpace Independent Publishing Platform, 2016.
2. Hassoun, Mohamad H. *Fundamentals of artificial neural networks*. MIT press, 1995.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	1	-	-	-	3	-	2
CO2	2	2	2	3	2	-	-	-	3	3	-	2	3	-	3
CO3	2	2	2	3	2	-	-	-	3	3	-	2	3	-	3
CO4	2	2	3	3	2	-	-	-	3	3	-	2	3	-	3
CO5	2	2	3	3	2	-	-	-	3	3	-	2	3	-	3
Score	10	10	11	13	9	-	-	-	13	12		8	15	-	14
COM	**2**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**2**	**3**	**-**	**3**

PROGRAM ELECTIVE - II

ECPE21 DIGITAL SIGNAL PROCESSING

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To study the basics of Signal representation and discrete systems.
- To understand the analytical tools such as Fourier transforms, Discrete Fourier transforms, Fast Fourier Transforms and Z-Transforms required for digital signal processing.
- To understand the digital filters for digital signal processing.
- To design and realize various IIR and FIR.
- To understand the concept of multi-rate signal processing.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO SIGNALS, DISCRETE SYSTEMS AND PROCESSING METHODS **08**

Overview of the Frequency Analysis in continuous-time and discrete-time signals, Discrete Time Systems Described by Difference Equations, Implementation of Discrete Time systems, Correlation of Discrete Time Signals, Transform algorithms and their Properties, Fourier Transforms, Z-transforms, Discrete Fourier Transform, Discrete Time Fourier Transform, Computation of DFT and FFT, Circular Convolution, Linear Convolution using the DFT. Standards IEEE 265-1966, IEEE 1057-2007.

UNIT 2: DESIGN OF DIGITAL FILTERS **08**

Basic principles of Filters and Filtering. Different types of the filters, Problems associated with Passive filters, Difference between analog and digital filter design, Frequency Sampling techniques.

UNIT 3: DESIGN OF FIR DIGITAL FILTERS **08**

Symmetric and Anti-symmetric FIR filters, Linear phase concept, Design of ideal and practical FIR filter (LPF, HPF, BPF and BRF) with and without using Window functions, Comparison of window functions, Design of FIR filters using frequency sampling methods, Design of digital differentiator, Structure for realizing digital FIR filters, Finite Length Effect in FIR Filters.

UNIT 4: DESIGN OF IIR DIGITAL FILTERS **08**

Butterworth and Chebyshev approximation, Design of Butterworth (Type 1 and II) Low-pass filters using approximation of Derivative, Impulse invariance and Bilinear Transformation, Frequency warping effect, Pre-warping, Frequency transformation

in both analog and digital domain, Difference between IIR and FIR filters, Structure for realizing digital IIR filters, Finite Length Effect in IIR Filters.

UNIT 5: MULTI-RATE DIGITAL SIGNAL PROCESSING 08

Concept of multi-rate signal processing, Decimation and Interpolation, Up-sampling and Down-sampling in the Z-domain, FIR filter poly-phase structure, Filters for decimation and interpolation, multi-stage decimators and interpolators, Filter banks, Uniform DFT filter bank, Poly-phase realization of the uniform DFT filter bank, two channel QMF bank, FIR QMF banks with PR, Half-band filters, Different applications of the multi-rate signal processing.

LIST OF EXPERIMENTS

1. To generate basic signals like unit impulse, unit step, unit ramp signal and Exponential signals using MATLAB.
2. To generate continuous time sinusoidal signal, discrete time cosine signal.
3. To write a MATLAB code for verifying sampling theorem.
4. To write a MATLAB code to perform linear convolution upon two given discrete time signals.
5. To write a MATLAB code to perform circular convolution upon two given discrete time signals.
6. To write a MATLAB code to perform autocorrelation on a given signal and to verify its properties.
7. To write a MATLAB code to perform cross correlation and to verify its properties.
8. To write a MATLAB code to evaluate the Frequency response of the system.
9. To write a MATLAB code to evaluate the impulse response of the system.
10. To write the MATLAB code to find the DFT / IDFT of given signal.
11. To calculate the linear convolution of two sequences using DFT and IDFT.
12. To calculate the circular convolution of two sequences using DFT and IDFT.
13. To implement Fast Fourier Transform (FFT) of given sequence.
14. To verify Power Spectral Density.
15. To design and implement FIR Low pass filters using MATLAB commands.
16. To design and implement FIR High pass filters using MATLAB commands.
17. To verify Frequency response of analog IIR filter using MATLAB (LP/HP).
18. To generate the sinusoidal signal using filter.
19. To implementation of decimation of given sequence by factor M.
20. To implementation of interpolation for given sequence by factor L.
21. Plot the window function and normalized frequency response in dB of the Rectangular and Barlett window.

22. Plot the window function and normalized frequency response in dB of the Blackman and Hamming window.
23. To write a program to calculate Hilbert transform of a function.
24. To write a program to generate a Kaiser window. Use different values of M and α and generate at least three different windows.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Summarize the fundamentals of different signals and basic operations of Signal processing.	(K2)
CO2	:	Understand the handling of discrete/digital signals using MATLAB.	(K2)
CO3	:	Analyse the spectral parameter of window functions.	(K4)
CO4	:	Characterize IIR, and FIR filters for band pass, band stop, low pass and high pass filters.	(K3)
CO5	:	Classify the signal processing algorithm using the concept of multi-rate in MATLAB.	(K3)

TEXT BOOKS

1. Proakis, J. G. and Manolakis, D. G., "*Digital Signal Processing: Principles, Algorithms and Applications*", 4th Edition, Pearson education, 2014.
2. Mitra, S. K., "*Digital Signal Processing: A computer-based approach*", 4th Edition, McGraw Hill Education, 2013.

REFERENCE BOOKS

1. Tan, L. and Jiang, J., "*Digital Signal Processing: Fundamentals and Applications*", 2nd edition, Academic Press, 2013.
2. Oppenheim, A. V. and Schafer, R. W., "*Discrete-Time Signal Processing*", 3rd edition, Pearson Education, 2014.
3. Andreas Antoniou (2006), "*Digital Signal Processing*", Tata McGraw Hill, New Delhi.
4. Ifeachor and Jervis, "*Digital Signal Processing*", Pearson Education India.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	-	-	-	-	-	2	-	2
CO2	2	2	-	-	1	-	-	-	-	-	-	2	2	-	2
CO3	2	3	2	1	-	-	-	-	-	-	-	2	2	-	2
CO4	2	3	3	3	1	-	-	-	-	-	-	-	2	-	2
CO5	2	3	3	3	1	-	-	-	-	-	-	-	2	-	2
Score	10	13	10	8	4	-	-	-	-	-	-	4	10	-	10
COM	**2**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**

PROGRAM ELECTIVE - II

ECPE22 MODELING AND TESTING OF DIGITAL SYSTEMS (VHDL)

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To understand the VHDL language feature to realize the complex digital systems.
- To explain behavioural modeling of digital systems using VHDL.
- To explain dataflow and structural modeling techniques of digital systems using VHDL.
- To explain predefined attributes and configurations of VHDL.
- To Understand design for synthesis and its role in modern design.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO HDL **08**

Digital system design process, Hardware simulation, Levels of abstraction, VHDL requirements, Elements of VHDL Top-down design, VHDL basic language Elements, VHDL operators, Timing, Concurrency, Objects and classes.

UNIT 2: BEHAVIOURAL MODELING **08**

Signal assignments, Concurrent and sequential assignments, Entity Declaration, Architecture Body, Behavioural Modeling, Process statement, Loop control statements, Multiple Processes, Delay Models, Signal Drivers.

UNIT 3: DATAFLOW AND STRUCTURAL MODELING TECHNIQUE **08**

Data flow Modeling, Concurrent Assignment statements, Block statements, Structural Modeling, Component declaration and Instantiation, Generate statements.

UNIT 4: ADVANCE TOPICS IN VHDL **08**

Generics and Configuration, Subprogram, Overloading, Packages and Libraries, Design Libraries, Attributes.

UNIT 5: DESIGN FOR SYNTHESIS **08**

Language directed view of synthesis, Inference from CSA statements, Inference from within Process, Inference using Signals v/s variables, Latch v/s Flip Flop Inference, Wait statements, Synthesis Hints, Synthesis for dataflow and structural models.

LIST OF EXPERIMENTS

1. Logic Gates.
2. Adder/ Subtractor.
3. Multiplexer/ Demultiplexer.
4. Encoder/ Priority Encoder.
5. Code Converter.
6. Flipflop.
7. Shift Register/ Universal Shift Register.
8. Comparator.
9. Upcounter/ Downcounter.
10. Memory – ROM, RAM.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Understand and use major syntactic elements of VHDL.	(K2)
CO2	:	Model digital logic circuits in behavioural modeling.	(K3)
CO3	:	Model digital logic circuits in dataflow and structural modeling.	(K3)
CO4	:	Demonstrate timing and resource usage associated with modeling approach.	(K2)
CO5	:	Analyse complex digital logic circuits using computer-aided design tools.	(K4)

TEXT BOOKS

1. Bhasker, J., "*VHDL Primer*", 3/e, Addison Wesley, 1999.
2. Navabi, Z., *"HDL: modular design and synthesis of cores and systems*", McGraw, 2007.

REFERENCE BOOKS

1. Roth, C. H., "*Digital system Design using VHDL*", 2nd Edition, Thompson Publishers, 2007.
2. Pedroni, V. A., "*Circuit Design with VHDL*", MIT Press Cambridge, 2004.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	13	13	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

PROGRAM ELECTIVE - III

ECPE31 COMMUNICATION THEORY

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To know the principles of information theory.
- To learn the methods for calculation of the channel capacity for various types of channels.
- To study the various types of coding and decoding techniques.
- To learn the concepts of probability and random signals.
- To understand the effect of various types noises in communication channels.

COURSE CONTENTS

UNIT 1: PROBABILITY AND RANDOM SIGNAL **08**

Introduction to Probability Theory, Definition of Probability of Random Events. Joint and Conditional Probability, Probability Mass Function, Statistical Averages. Probability Density Functions (PDF) and Statistical Averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Binomial. Examples of PDF, Transformation of Random Variables. Random Processes, Stationery and Ergodicity.

UNIT 2: INFORMATION THEORY **08**

Information Theory: Definition of Information, Entropy, Mutual Information, Properties of Mutual Information, Fundamental Inequality, I.T. Inequality, Divergence, Properties of Divergence, Divergence Inequality, Relationship between entropy and mutual information, Chain Rules for entropy, relative entropy and mutual information.

UNIT 3: CHANNEL CAPACITY **08**

Uniform Dispersive Channel, Uniform Focusing Channel, Strongly Symmetric Channel, Binary Symmetric Channel, Binary Erasure Channel. Channel Capacity of the all these channels, Channel Coding Theorem, Shannon-Hartley Theorem. Kraft inequality, Huffman codes, Shannon-Fano coding, Arithmetic Coding.

UNIT 4: CODING **08**

Linear Block Codes, Systematic linear codes and optimum decoding for the binary symmetric channel, Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes, Weight enumerators and the Mac-Williams identities; Perfect codes. Cyclic Codes, BCH codes, Convolution codes, Turbo codes.

UNIT 5: NOISE **08**

Thermal Noise, Shot noise, Partition noise, Flicker noise, Gaussian Noise, Noise in Bipolar Junction Transistors (BJTs), FET noise. Equivalent input noise, Signal to Noise Ratio (SNR), Noise Temperature, Noise equivalent Bandwidth, Noise Figure. Experimental determination of Noise Figure, Pulse Response and Digital Noise and its elimination.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the concepts of information, entropy, and divergence.	(K2)
CO2	:	Make use of various formulae for the calculation of capacity in different channels.	(K2)
CO3	:	Develop various codes for the transmission of data over different channels.	(K3)
CO4	:	Apply the concepts of probability and random process for the calculation of various density functions.	(K3)
CO5	:	Infer the knowledge about various types of noises for the calculation of SNR.	(K2)

TEXT BOOKS

1. Bose, R., "*Information Theory, Coding and Cryptography*", 3rd Edition, Mc-Graw Hill Education, 2017.
2. Peebles, P. Z., "*Probability Random Variables and Random Signal Principles*", 4th Edition, Mc-Graw Hill Education, 2018.

REFERENCE BOOKS

1. Taub, H. and Schilling, D. L., "*Principles of communication systems*," 4th Edition, McGraw Hill India, 2012.
2. Carlson, A. B. and Crilly, P. "*Communication Systems*", 5th Edition, MC Graw Hill India, 2009.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	6	-	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

PROGRAM ELECTIVE - III

ECPE32 EMBEDDED SYSTEMS

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn about characteristics and challenges of embedded systems.
- To learn about the architecture of embedded systems.
- To learn about the design process of Embedded Systems.
- To impart knowledge in various processor scheduling algorithms and real time operating systems.
- To study various network based embedded applications.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO EMBEDDED COMPUTING **08**

Characteristics of Embedding Applications, Concept of Realtime Systems, Challenges in Embedded System Design, Design Process.

UNIT 2: EMBEDDED SYSTEM ARCHITECTURE **08**

Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller.

UNIT 3: DESIGNING EMBEDDED COMPUTING PLATFORM **08**

Bus Protocols, Memory Devices and their Characteristics, Memory mapped I/O, I/O Devices, I/O mapped I/O, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, Mixed Signals Processing.

UNIT 4: PROGRAMMING EMBEDDED SYSTEMS **08**

Basic Features of an Operating System, Kernel Features, Real-time Kernels, Processes and Threads, Dynamic Allocation, Device Drivers, Real-time Transactions and Files, Real-time OS.

UNIT 5: EMBEDDED APPLICATIONS AND CASE STUDY **08**

Embedded Networking Fundamentals, IoT overview and architecture. Overview of wireless sensor networks and design examples. Case study: Hardware and software co-design, Data Compressor, Software Modem, Personal Digital Assistants, Set–Top–Box, System-on-Silicon, FOSS Tools for embedded system development.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Infer the overall landscape and characteristics of embedded systems.	(K2)
CO2	:	Explain the architecture of the ATOM processor and its programming aspects (assembly level).	(K2)
CO3	:	Utilize comprehensive understanding of the overall architecture of modern embedded computing systems for the design of modules.	(K3)
CO4	:	Develop application software for embedded systems using the RTOS functions.	(K3)
CO5	:	Analysis and development of network connectivity of the embedded systems with case study.	(K5)

TEXT BOOKS

1. Wolf, M., "*Computers as Components: Principles of Embedded Computing System Design*", 3rd Edition, Elsevier, 2013.
2. Krishna, C. M. and Shin, K. G., "Real-Time Systems", 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS

1. Hermann, K., "*Real Time Systems: Design Principles for Distributed Embedded Applications*", 2nd Edition, Springer, 2013.
2. Hohl, W., and Hinds,C., "*ARM Assembly Language: Fundamentals and Techniques*", 2nd Edition, CRC Press, 2014.
3. David E-Simon, "*An Embedded Software Primer*," Pearson Education.
4. Prasad, K. K., "*Embedded Real-Time Systems: Concepts, Design & Programming*", Dreamtech Press.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	3	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	2	2
Score	15	10	13	13	-	-	-	-	-	-	-	-	-	10	10
COM	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

PROGRAM ELECTIVE - IV

ECPE41 FIBER OPTIC COMMUNICATION

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To know the principles of Fiber optic communication.
- To learn the concepts and types of optical sources.
- To study the various types of optical detectors and their applications.
- To learn the principle of optical amplification for different types of optical amplifiers.
- To understand the concepts of optical switching and networks.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO OPTICAL FIBER **08**

Optical evolution, advantages of optical communication, its representations, Optical waveguides, basic optical laws, acceptance angle, numerical aperture Skew rays, Rays and modes, step-index, graded-index fibers, phase and group velocities, Signal degradation in optical fibers, attenuation units, absorption, scattering dispersions.

UNIT 2: OPTICAL SOURCES **08**

Optical source properties, finding the energy from the voltage, finding the frequency from the wavelength of light, operating wavelength of optical sources, semiconductor light-emitting diodes and laser diodes, semiconductor material and device operating principles, light-emitting diodes, surface-emitting LEDS, edge-emitting LEDS, super luminescent diodes, laser diodes, comparison of LED and ILD. Fiber optic transmitters, basic optical transmitters, direct versus external modulation, fiber optic transmitter applications, digital applications, analog applications.

UNIT 3: OPTICAL DETECTORS **08**

Light detectors, Role of an optical detector, Detector characteristics: Responsivity, Noise Equivalent Power, Detectivity, Quantum efficiency, Detector response time, Linearity, Spectral response, Noise considerations: Johnson noise, Shot noise, 1/f noise, Photon noise, The PN junction photo diode - PIN photodetector - Avalanche photo diode construction characteristics and properties, APD Specifications, Applications of APD - comparison of performance noise sources - simple model of photo receiver - Its equivalent for circulation of noise SNR, Optical Receivers.

UNIT 4: OPTICAL AMPLIFIERS **08**

Basic Concepts, Gain Spectrum and Bandwidth, Gain Saturation, Amplifier Noise, Amplifier Applications, Semiconductor Optical Amplifiers, Raman Amplifiers, Erbium-Doped Fiber Amplifiers, System Applications - Optical Pre-amplification,

Noise Accumulation in Long-Haul Systems, ASE-Induced Timing Jitter, Accumulated Dispersive and Nonlinear Effects, WDM-Related Impairments.

UNIT 5: OPTICAL SWITCHING AND NETWORKS **08**

Transport Networks, Applications, Requirements, Architectures, Technologies, and Solutions, Introduction to Optical Access Networks, Optical TDM, subscriber multiplexing (SCM), WDM and Hybrid multiplexing methods.

LIST OF EXPERIMENTS

1. Handling of Fibers.
2. Characteristics of LED.
3. Characteristics of Laser Diode.
4. Characteristics of Photo Detector.
5. Characteristics of APD.
6. Measurement of Numerical Aperture.
7. Measurement of Attenuation.
8. Measurement of Bending Loss.
9. Fiber Dispersion Measurement.
10. Study of BER and Q-Factor.
11. Characteristics of WDM Link.
12. Analog and voice communication through optical link.
13. Simulation and BER calculation using OPTSIM.
14. SOA Design using OPTSIM.
15. EDFA Design for D-WDM using OPTSIM.
16. Characteristics of AWGN and BSC channel.
17. BPSK Modulator.
18. Convolutional encoder and decoder.
19. Orthogonal Frequency Division Multiplexing.
20. Analog communication through optical link.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the basic principle and various types of transmission impairments of Fiber-optic communication.	(K2)
CO2	:	Make use of different types of optical sources in various applications.	(K3)
CO3	:	Apply the concepts of optical detection techniques for extracting the original signal.	(K3)
CO4	:	Develop amplified signals with various types of optical amplifiers.	(K3)
CO5	:	Infer the knowledge about WDM and optical networks for optical link design.	(K4)

TEXT BOOKS

1. Senior, J, M., "*Optical Fiber Communications: Principles and Practice*", 3rd Edition, Pearson Education, 2010.
2. Keiser, G., "*Optical Fiber Communications*", 5th Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS

1. Agrawal, G. P., "*Fiber Optic Communication Systems*", 5th Edition, Wiley, 2021.
2. Liu, M. M. K., "*Principles and Applications of Optical Communications*", 1st Edition, McGraw Hill, 2010.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	6	15	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

PROGRAM ELECTIVE - IV

ECPE42 VLSI DESIGN

CREDITS: 05	PE	LTPC: 3 – 0 – 4 – 5

COURSE OBJECTIVES

- To get familiar with emerging VLSI technology and MOS transistor.
- To learn about the various fundamentals used in the design of CMOS logic circuits.
- To understand the concepts related to design of digital CMOS logic circuits.
- To learn about the design techniques for Sequential MOS Logic Circuits.
- To study various low power techniques for CMOS circuits.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO VLSI AND MOS **08**

Need of VLSI, Design Flow, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology, MOS Transistor theory: Basic MOS Transistors, MOSFET operation in Enhancement Mode and depletion mode, The MOSFET Transistor regions of operation Accumulation, Depletion and Strong Inversion, The Threshold voltage, I-V Characteristic of MOSFET.

UNIT 2: MOS INVERTERS AND ITS SWITCHING CHARACTERISTICS **08**

Voltage Transfer Characteristic (VTC), Noise Immunity and Noise Margin, MOS Inverters: Resistive-Load Inverters, CMOS Inverter, Switching Characteristics and Interconnect Effects, Delay-Time Definitions, Rise time, fall time, Calculation of Delay-Times, Switching Power Dissipation of CMOS Inverters.

UNIT 3: DIGITAL CMOS CIRCUITS **08**

Static CMOS Logic Gates (NAND and NOR), Psuedo NMOS, Dynamic Logic Circuits, Basic Principles of Pass Transistor Circuits, Transmission Gates, High Performance Dynamic CMOS Circuits, Domino Circuits.

UNIT 4: ANALOG CMOS CIRCUITS **08**

MOS Switch, Active Resistor/Loads, Currents Sinks and Sources, The Current Mirrors, Cascode Current Mirror, Amplifiers (Common Source, Common Drain, Common Gate).

UNIT 5: LOW POWER VLSI DESIGN **08**

Need for low power VLSI chips, Sources of power dissipation (Switching, Short and Leakage Power Dissipation), Low-Power Design techniques (VTCMOS, MTCMOS, Adiabatic Logic Circuits).

List Of Experiments

1. Obtain the I-V Characteristics of MOS transistors.
2. Transient Analysis and DC Analysis (VTC) of Resistive load inverter.
3. To design and perform of transient Analysis and DC Analysis (VTC) of CMOS inverter.
4. To design and perform of NAND Gate using Static CMOS logic.
5. To design and perform of NOR Gate using Dynamic CMOS logic.
6. To design and perform the given Boolean expression using pseudo techniques.
7. Transient analysis and AC analysis of the common drain amplifier.
8. Transient analysis and AC analysis of Common Source amplifiers.
9. To design and simulate Current Mirror.
10. To design and perform of MTCMOS using CMOS logic.
11. To design and perform of D latch using CMOS logic.
12. Layout design of PMOS, NMOS transistors.
13. Layout design of CMOS inverter.

Total Periods: 40 + 48 = 88

Course Outcomes

After the completion of this course, students will be able to:

CO1	:	To get familiar with emerging VLSI Design and basic theory of MOS transistors.	(K2)
CO2	:	To understand the various characteristics used in the design of CMOS logic circuits.	(K2)
CO3	:	To implementation of logic gates using Digital CMOS circuits.	(K3)
CO4	:	Develop basic understanding to design basic Analog CMOS circuits.	(K3)
CO5	:	Analysis of the low power techniques for CMOS Circuits.	(K4)

Text Books

1. Kang, S. M., Leblebici, Y., and Kim, C., "*CMOS Digital Integrated Circuits: Analysis and Design*", 4th Edition, McGraw Hill Education, 2016.
2. Behzad Razavi "*Design of Analog CMOS Integrated Circuits*" 3rd Edition, Tata McGraw-Hill, 2003.

Reference Books

1. Rabaey, J. M., Chandrakasan, A., and Nikolic, B., "*Digital Integrated Circuits: A Design Perspective*", 2nd edition, Pearson Education, 2016.
2. Johns, David A., and Ken Martin, "*Analog Integrated Circuit Design*", John Wiley and Sons, 2008.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	1	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	3	-	2	-	-	-	-	-	-	-	2	2
Score	15	15	11	13	-	2	-	-	-	-	-	-	-	10	10
COM	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

PROGRAM ELECTIVE - V

ECPE51 ANTENNA AND WAVE PROPAGATION

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basic concepts radiation from antenna element.
- To study different types of aperture and slot antennas.
- To impart knowledge on principle of pattern multiplication in antenna arrays.
- To study various special antennas and their polarization characteristics.
- To learn different wave propagation mechanisms and their applications.

COURSE CONTENTS

UNIT 1: FUNDAMENTALS OF RADIATION **08**

Definition of antenna parameters, Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching, Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole, Folded dipole, Yagi array.

UNIT 2: APERTURE AND SLOT ANTENNAS **08**

Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas, Radiation mechanism, Application, Numerical tool for antenna analysis.

UNIT 3: ANTENNA ARRAYS **08**

N element linear array, Pattern multiplication, Broadside and End fire array, Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array.

UNIT 4: SPECIAL ANTENNAS **08**

Principle of frequency independent antennas, Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active-antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR.

UNIT 5: WAVE PROPAGATION **08**

Propagation in free space. Propagation around the earth, surface wave-propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF, Fading, tropospheric propagation, Super refraction.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain fundamentals of radiation and mechanism of radiation from oscillating dipole.	(K2)
CO2	:	Apply numerical tools and techniques for analysis of radiation from different aperture and slot antennas.	(K3)
CO3	:	Develop different types of antenna arrays and study their radiation pattern.	(K3)
CO4	:	Categorize different types of antennas and examine their radiation characteristics.	(K4)
CO5	:	Assess and compare different mechanisms for wave propagation in free space.	(K5)

TEXT BOOKS

1. Balanis, C. A., "*Antenna Theory: Analysis and Design*", 4th Edition, Wiley, 2016.
2. Collin, R. E., "Antennas and Radiowave Propagation", 4th Edition, McGraw-Hill, 1985.

REFERENCE BOOK

1. Krauss, J. D., "*Antennas for All Applications*", 3rd Edition, McGraw-Hill, 2005.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	2	3	3	3	3	-	-	-	3	3	-	3	-	2	-
CO3	2	3	-	-	2	-	-	-	-	3	-	3	-	-	-
CO4	2	2	2	3	2	-	-	-	-	3	-	3	-	-	-
CO5	2	3	3	3	3	-	-	-	3	3	-	3	3	2	3
Score	10	13	8	9	10	-	-	-	6	15	-	15	3	4	3
COM	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**2**	**3**

PROGRAM ELECTIVE - V

ECPE52 APPLICATION-SPECIFIC INTEGRATED CIRCUIT (ASIC)

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn about Architect ASIC library design.
- To understand issues and tools related to ASIC/FPGA design and implementation.
- To learn about the algorithms used for ASIC construction.
- To understand basics of System on Chip and platform-based design.
- To study about new developments in low power devices.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO ASICS **08**

Types of ASICs, VLSI Design flow, Programmable ASICs - Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.

UNIT 2: ASIC DESIGN **08**

Trade off issues at System Level: Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, Partitioning Methods.

UNIT 3: ALGORITHMS USED FOR ASIC CONSTRUCTION **08**

ASIC floor planning, Placement and Routing.

UNIT 4: SYSTEM ON CHIP DESIGN **08**

SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards.

UNIT 5: LOW POWER DESIGN **08**

Low power design techniques and methodologies-low power design tools- tips and guideline for low power design.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate VLSI tool-flow and appreciate FPGA architecture.	(K2)
CO2	:	Understand the issues involved in ASIC design.	(K2)
CO3	:	Make use of the algorithms used for ASIC construction.	(K3)
CO4	:	Understand the basics of System on Chip, On chip communication architectures like AMBA, AXI and utilizing Platform based design.	(K2)
CO5	:	Identify new developments in low power design.	(K3)

TEXT BOOKS

1. Smith M.J.S, *Application Specific Integrated Circuits*, Pearson Education, 2008.
2. Wolf, W., *FPGA-Based System Design*, Prentice Hall PTR, 2009.

REFERENCE BOOKS

1. Nekoogar F., and Nekoogar, F., *From ASICs to SOCs: A Practical Approach Prentice.*
2. www.vhdl.org/rassp/vhdl/guidelines/DesignReq.pdf

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	10	-	-	-	-	-	-	-	-	-	-	-	10
COM	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

PROGRAM ELECTIVE - VI

ECPE61 NANOSCIENCE AND NANOTECHNOLOGY

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn and understand basic concepts of Nano-science and Nanotechnology.
- To study nanomaterials and its preparation.
- To study about carbon nano tubes.
- To learn different nanotechnology developments.
- To learn about future applications of nanoscience and nano technology.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO NANOTECHNOLOGY **08**

Nanoscience and Nanotechnology, Background of nanotechnology, types of nano-technology and nano-machines, top down and bottom-up techniques, atomic manipulation-nanodots, semi-conductor quantum dots, self-assembly monolayers, Simple details of characterization tools- SEM, TEM, STM, AFM.

UNIT 2: NANOMATERIALS **08**

Nanomaterials and its Preparation- solid state reaction method, Chemical Vapor Deposition, Sol-gels techniques, Electrodeposition, Ball Milling, Introduction to lithography, pulse laser deposition (PLD), Applications of nanomaterials.

UNIT 3: CARBON TUBES **08**

New forms of carbon, Carbon tubes-types of nanotubes, formation of nanotubes, Assemblies, purification of Carbon nanotubes, Properties of nanotubes, applications of nanotubes.

UNIT 4: OPTICS, PHOTONICS AND SOLAR ENERGY **08**

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, Solar cells, optically useful nanostructured polymers, Photonic Crystals.

UNIT 5: FUTURE APPLICATIONS **08**

MEMS, Nanomachines, Nanodevices, quantum computers, Opto-electronic devices, quantum electronic devices, Environmental and Biological applications.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Infer the overall landscape and characteristics of nanoscience and nanotechnology.	(K2)
CO2	:	Understanding of nanomaterials and its preparation.	(K2)
CO3	:	Understanding of different carbon nano structures.	(K2)
CO4	:	Develop competence in understanding of developments in nanotechnology.	(K3)
CO5	:	Analyse the future aspects of nano-science and nanotechnology.	(K4)

TEXT BOOKS

1. Charles P. Poole Jr., Chapman and Hall, "*Introduction to Nanotechnogy*", Wiley Indian Edition, 2010.
2. Masuro Kuno, "*Introductory Nanoscience*", Garland Science, 2011.

REFERENCE BOOKS

1. Edward L. Wolf, "*Nanophysics and Nanotechnology*", Wiley-VCH (2006).
2. Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, "*Nanotechnology-Basic Science and Emerging Technologies*", Overseas Press.
3. Mark Ratner and Daniel Ratner, "*Nanotechnology-A Gentle Introduction to the Next Big Id*ea", Prentice Hall, 2002.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	2	-	-	2
CO2	3	2	1	1	-	-	-	-	-	-	-	2	-	-	2
CO3	3	2	1	1	-	-	-	-	-	-	-	2	-	-	2
CO4	3	2	1	1	-	-	-	-	-	-	-	2	-	-	2
CO5	3	2	1	3	-	-	-	-	-	-	-	2	-	-	2
Score	15	10	5	7	-	-	-	-	-	-	-	10	-	-	10
COM	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

PROGRAM ELECTIVE - VI

ECPE62 WIRELESS COMMUNICATION

CREDITS: 03	PE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To enable students to acquire in-depth knowledge in the field of wireless communication.
- To familiarize with state-of-the-art standards used in wireless cellular systems.
- To develop students to critically analyze the problems in the field of wireless communication technology and find optimal solution.
- To study the various multiple access techniques.
- To learn the different protocols for GSM and CDMA techniques.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO WIRELESS COMMUNICATION SYSTEM 08

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless Communication System, Comparison of common wireless system, Trend in cellular radio and personal communication, Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area Network (WLAN), Bluetooth and Personal Area Networks.

UNIT 2: THE CELLULAR CONCEPT- SYSTEM DESIGN FUNDAMENTALS 08

Concept of frequency reuse, Channel Assignment Strategies, Channel and co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectoring, Repeaters, Micro cell zone concept, Channel antenna system design considerations.

UNIT 3: MOBILE RADIO PROPAGATION MODEL, SMALL SCALE FADING AND DIVERSITY 08

Free Space Propagation model, Reflection, Ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale

fading, Rayleigh and Ricean distribution, Statistical models for multipath fading channels and diversity techniques in brief.

UNIT 4: MULTIPLE ACCESS TECHNIQUES **08**

Introduction, Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Spread Division Multiple Access, Packer Radio, Carrier Sense Multiple Access Protocols, Capacity of Cellular Systems.

UNIT 5: WIRELESS SYSTEMS **08**

GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the cellular system design and technical challenges.	(K2)
CO2	:	Analyze the mobile radio propagation, fading, diversity concepts and the channel modeling.	(K2)
CO3	:	Analyze the design parameters, link design, smart antenna, beam forming and MIMO systems.	(K3)
CO4	:	Analyze Multiuser Systems, CDMA, WCDMA network planning and OFDM concepts.	(K3)
CO5	:	Summarize the principles and applications of wireless systems and standards.	(K3)

TEXT BOOK

1. Rappaport, T. S., "*Wireless Communication: Principles and Practice*", 2nd Edition, Pearson, 2010.

REFERENCE BOOKS

1. Lee, W. C. Y., "*Mobile Communication Engineering: Theory and Applications*", 2nd Edition, McGraw Hill Education, 2017.
2. Feher, K., "*Wireless Digital Communications: Modulation and Spread Spectrum Applications*", 1st Edition, Prentice Hall India, 1995.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	13	11	-	-	-	-	-	-	-	-	-	9	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

STREAM – I
APPLICATIONS

(OFFERED BY DEPARTMENT OF IT)

ITSE11 MOBILE APPLICATIONS DEVELOPMENT

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of Android development.
- To get familiarized with various routinely used mobile application development tools and techniques.
- To know the development and utility of Android applications in our daily life.
- To comprehend and adapt the Android environment for mobile application development.
- To learn the frameworks and additional tools for development of applications aiming at improved user experience.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO ANDROID **08**

Native Android Application, SDK Features, Introduction to Open Handset Alliance, Development Framework, Application Fundamentals, Device Compatibility, System permissions.

UNIT 2: USER INTERFACE AND APPLICATION COMPONENTS **08**

Basic UI Design, Fragments, Widget Toolbox, Creating New View, Introduction to Intents, Intent Filters and Broadcast Receivers, Activities, Services, Content Providers, Application Widgets, Processes and Threads.

UNIT 3: FILES AND DATABASE HANDLING **08**

Saving Application Data, Shared Preferences; Preference Framework and Activity, Static File as Resource, File System; Introduction to SQLite Database, Querying SQLite, Storage options, Data backup.

UNIT 4: USER EXPERIENCE ENHANCEMENT **08**

Action Bar, Menus and Action Bar Items, Settings, Dialogs, Customizing Toast, Notifications, Search, Drag and Drop.

UNIT 5: MULTIMEDIA, WIRELESS CONNECTIVITY AND TELEPHONY **08**

Audio and Video Handling, Manipulating Raw Audio, Sound Effects, Camera Programming, Video Recording, Managing Wireless Connectivity, WiFi, Bluetooth, Near Field Communication, Hardware Support for Telephony, Telephony Management, SMS and MMS.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate understanding of the fundamentals of Android environment.	(K2)
CO2	:	Develop user interface with proposed tools for best user experience.	(K3)
CO3	:	Develop a database capable of efficient storage and access to data.	(K3)
CO4	:	Applying development techniques for best user interface and experience in the android application.	(K3)
CO5	:	Applying suitable connectivity controls to the android application.	(K3)

TEXT BOOKS

1. Meier Reto and Lake Ian, "*Professional Android*", 4th Edition, Wrox, 2018.
2. Gifford Matt, "*Phone Gap Mobile Application Development Cookbook*", PACKT, 2012.

REFERENCE BOOK

1. Kosmaczewski Adrian, "*Mobile JavaScript Application Development*", 1st Edition, O'RELLY, 2012.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	2	-	-	-	-	-	-	-	2
CO4	-	-	2	-	1	2	2	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Score	6	4	5	1	4	4	4	2	-	-	-	-	2	-	4
COM	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**2**

ITSE12 CLOUD COMPUTING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the fundamentals of cloud computing.
- To study different cloud computing technologies.
- To learn the functionality of cloud storage and standards.
- To study various case studies.
- To design efficient and reliable cloud environment.

COURSE CONTENTS

UNIT 1: CLOUD COMPUTING BASICS **08**

Cloud Computing Overview, Applications, Internet and the Cloud, First move in the Cloud, Benefits, Limitations and Security Concerns in the Cloud.

UNIT 2: CLOUD COMPUTING TECHNOLOGY **08**

Hardware and Infrastructure, Clients, Security, Network, Services, Accessing the Cloud, Platforms, Web Applications, Web APIs, Web Browsers.

UNIT 3: CLOUD STORAGE AND STANDARDS **08**

Cloud Storage Overview, Cloud Storage Providers, Standards, Application, Client, Infrastructure, Service.

UNIT 4: CLOUD COMPUTING AT WORK **08**

Software as a Service, Overview, Driving Forces, Company Offerings, Industries Developing Applications, Google, Microsoft, Intuit Quick Base, Cast Iron Cloud, Bungee Connect, Development.

UNIT 5: ORGANIZATIONS AND CLOUD COMPUTING **08**

Cloud Computing with the Titans, Google, EMC, NetApp, Microsoft, Amazon, IBM, Partnerships, The Business case for going to the Cloud.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of Cloud Computing.	(K3)
CO2	:	Examine the functionality of different cloud technologies.	(K4)
CO3	:	Analyse the role and functioning of various cloud storage platforms.	(K5)

CO4	:	Analyse the working of cloud environment.	(K5)
CO5	:	Examine the working of different cloud services.	(K4)
CO6	:	Deploy Cloud network.	(K6)

TEXT BOOKS

1. Sosinsky Barrie, "*Cloud Computing: Bible*", Wiley Publication, 2018.
2. Velte Anthony T., Velte Toby J. and Elsenpeter Robert, "*Cloud Computing: A Practical Approach*", Indian Edition, McGraw Hill, 2018.

REFERENCE BOOK

1. Buyya Rajkumar, Broberg James and Goscinski Anderzej, "*Cloud Computing: Principles and Paradigms*", Wiley Publication, 2011.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	3	2	2	2	2	1	3	-	3	3	3	3
CO 2	2	3	2	3	3	2	-	-	-	3	-	3	-	2	2
CO 3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO 4	2	3	3	3	3	-	-	-	-	3	-	3	-	2	2
CO 5	2	3	3	1	-	-	-	-	-	3	-	3	-	2	2
CO 6	2	3	3	3	3	2	2	2	1	3	3	3	3	3	3
Score	12	17	17	16	12	6	4	4	2	18	3	18	9	14	14
COM	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**3**

ITSE13 INTERNET OF THINGS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of Internet of Things and its architecture.
- To understand the architecture and networking in Internet of Things.
- To study the various IoT communication protocols.
- To gain insights about the fog and cloud computing in IoT framework.
- To study the real-life applications of IoT.

COURSE CONTENTS

UNIT 1: IOT INTRODUCTION AND FUNDAMENTALS 08

Basics of networking (types of networks, layered models, addressing, TCP/IP transport layer), Introduction to the architecture of wireless sensor networks, Machine-to-Machine (M2M) communication and cyber physical systems. Introduction to IoT and its comparison with M2M, WSN and CPS. IoT networking components, Addressing strategies in IoT.

UNIT 2: IOT ARCHITECTURE AND NETWORKING 08

Introduction to IoT Sensors and their characteristics, Sensing types and their considerations, Introduction to IoT Actuators, their types and characteristics, IoT processing topologies, their types and its importance, Data formatting, Processing topologies, IoT device design and selection considerations, Processing offloading, IoT connectivity technologies.

UNIT 3: IOT COMMUNICATION TECHNOLOGIES 08

Introduction to nodes, Constrained nodes and network, and the type of devices, Low power and lossy networks, Infrastructure protocols, Discovery protocols, Data protocols, Identification protocols, Device management protocols, Sematic protocols, IoT interoperability standards and frameworks.

UNIT 4: CLOUD AND FOG COMPUTING IN IOT 08

Introduction to cloud computing, Virtualization, Cloud Models, SLA in cloud computing, Cloud implementation in Sensor – Cloud, Introduction to fog computing and its architecture, Fog computing in IoT, Application of fog computing in IoT, Edge computing in IoT.

UNIT 5: IOT APPLICATIONS AND DATA ANALYTICS 08

IoT applications in agriculture, vehicular networks and healthcare, IoT analytics, Uses of machine learning in IoT, Advantages and challenges of ML in IoT, ML

algorithms for IoT applications, Performance metrices for evaluating ML algorithms.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Associate and classify the architecture of various communication systems.	(K2)
CO2	:	Elaborate the IoT infrastructure and data processing methodologies.	(K2)
CO3	:	Interpret the various networking protocols used in IoT.	(K2)
CO4	:	Acquire the concepts of fog and cloud computing in IoT.	(K3)
CO5	:	Illustrate the various real-life applications of IoT.	(K3)

TEXT BOOKS

1. Misra, S., Mukherjee, A. and Roy, A. *Introduction to IoT*. Cambridge University Press, 2021.
2. Serpanos, D. and Wolf, M. *Internet-of-things (IoT) systems: architectures, algorithms, methodologies*. Springer, 2017.

REFERENCE BOOKS

1. Xiao, P. *Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed*. John Wiley & Sons, 2018.
2. Hersent, O., Boswarthick D., and Elloumi, O., *The Internet of Things: Key Applications and Protocols*. John Wiley & Sons, 2011.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	3	2	2	2	2	1	3	-	3	3	3	3
CO 2	2	3	2	3	3	2	-	-	-	3	-	3		2	2
CO 3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO 4	2	3	3	3	3	-	-	-	-	3	-	3		2	2
CO 5	2	3	3	1	-	-	-	-	-	3	-	3		2	2
CO 6	2	3	3	3	3	2	2	2	1	3	3	3	3	3	3
Score	12	17	17	16	12	6	4	4	2	18	3	18	9	14	14
COM	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**3**

ITSE14 BIG DATA ANALYTICS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To know the fundamental concepts of Big Data and Analytics.
- To explore tools and practices for working with Big Data and stream computing.
- To understand the Big Data use cases.
- To apply analytics on structured and unstructured data with R.
- To provide comprehensive knowledge on developing and applying Machine Learning algorithms for massive real-world datasets in distributed frameworks.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO BIG DATA **08**

Evolution of big data, Best practices for Big Data Analytics, Big data characteristics, Validating, Promotion of the value of Big Data, Big Data use cases Characteristics of Big Data Applications, Perception and quantification of value, Big Data Tools and Techniques, Understanding big data storage, General overview of high-performance architecture, HDFS, Map Reduce and YARN, Map Reduce programming model, Review of basic data analytic methods using R.

UNIT 2: REGRESSION AND CLASSIFICATION **08**

Advanced analytical theory and methods, Regression, Linear regression, Logistic regression; Classification, Decision trees, Overview of a decision tree, Decision tree algorithms, Evaluating a decision tree, Decision trees in R, Naïve Bayes, Bayes' theorem, Naïve Bayes classifier in R.

UNIT 3: DATA STREAM ANALYSIS **08**

Introduction to streams concepts: Stream data model and architecture, Stream computing, Sampling data in a stream, Filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, Decaying window, Real Time Analytics Platform (RTAP) applications, Case studies, Real time sentiment analysis, Stock market predictions.

UNIT 4: FREQUENT ITEMSETS AND CLUSTERING **08**

Mining frequent itemsets, Market based model, Apriori algorithm, Handling large data sets in main memory, Limited Pass algorithm, Counting frequent itemsets in a stream, Clustering techniques, Hierarchical, k-Means, Clustering high dimensional data.

UNIT 5: NOSQL DATA MANAGEMENT FOR BIG DATA **08**

NoSQL databases, Schema-less models, Increasing flexibility for data manipulation, Key value stores, Document stores, Tabular stores, Object data stores, Graph databases; Hive, Sharding; HBase, Case Study, Analyzing Big Data with twitter, Big data for E-Commerce Big data for blogs.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the concept and significance of Big Data and its analysis.	(K2)
CO2	:	Analyze regression and classification algorithms for Big Data analytics.	(K4)
CO3	:	Apply the process of stream computing for data stream analysis.	(K3)
CO4	:	Analyze different mining algorithms and clustering techniques for Big Data Analytics.	(K4)
CO5	:	Design and develop Big Data-based analytics for real-word ubiquitous computing scenarios.	(K6)

TEXT BOOKS

1. David Loshin,"*Big Data Analytics: From Strategic Planning to Enterprise Integration With Tools, Techniques, NoSQL, and Graph*", Morgan Kaufmann/Elsevier Publishers, 2013.
2. Rajaraman Anand and Ullman Jeffrey David, "*Mining of Massive Datasets*", Cambridge University Press, 2012.

REFERENCE BOOKS

1. EMC Education Services, "*Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*", Wiley Publishers, 2015.
2. Baesens Bart, "*Analytics in a Big Data World: The Essential Guide to Data Science and its Applications*", Wiley Publishers, 2015.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	1	1	-	-	3	-	-	-		1	3	2
CO 2	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO 3	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO 4	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO 5	2	2	3	3	1	-	-	3	-	-	-	3	3	3	3
COM	**2**	**3**	**3**	**3**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**3**	**3**

ITSE15 COMPUTER VISION

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of computer vision.
- To get familiarized with various routinely used computer vision tools and techniques.
- To understand the role of computer vision applications in our daily life.
- To comprehend and adapt the computer vision techniques for application in different devices.
- To learn the frameworks and additional tools for development of computer vision applications aiming at improved user experience.

COURSE CONTENTS

UNIT 1: CAMERA GEOMETRY **08**

Transformations in 2D, Transformations in 3D, Composition of transformations in 2D and 3D, Homogeneous coordinates in 2D and 3D, Pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera, Camera calibration.

UNIT 2: IMAGE ALIGNMENT **08**

Motion models and degrees of freedom, non-parametric image alignment, Control point based image alignment using least squares, SIFT algorithm, Forward and reverse image warping, bilinear and nearest-neighbour interpolation, Image alignment using image similarity measures, mean squared error, normalized cross-correlation, Monomodal and multimodal image alignment.

UNIT 3: ROBUST METHODS IN COMPUTER VISION **08**

Least squares problems, Outliers in computer vision, Laplacian Distribution, the importance of heavy-tailed distributions in robust statistics, mean versus median, L2 fit versus L1 fit, least median of squares algorithm (LMedS), RanSaC (Random Sample Consensus) algorithm.

UNIT 4: STRUCTURE FROM MOTION **08**

Motion as a cue to inference of 3D structure from images, Motion factorization algorithm by Tomasi and Kanade, SVD, concept of SVD as a weighted summation of rank-one matrices.

UNIT 5: OPTICAL FLOW **08**

Dealing with the aperture problem, regularization, Horn and Shunck method, algorithm using discrete formulation, steps of Jacobi's method for matrix inversion,

and comments about limitations, Lucas-Kanade algorithm for optical flow, Applications of optical flow.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate understanding of the fundamentals of camera geometry.	(K2)
CO2	:	Develop understanding and underlying techniques of Image alignment.	(K3)
CO3	:	Develop understanding of application of robust statistical techniques.	(K3)
CO4	:	Develop understanding of techniques used to recover structure and motion from image sequences	(K3)
CO5	:	Develop understanding of optical flow techniques used for describing image motion	(K3)

TEXT BOOKS

1. Forsyth and Ponce, "*Computer Vision: A Modern Approach*", 2nd Edition, Pearson Education, 2015.
2. Szeliski Richard, "*Computer Vision: Algorithms and Applications*", Springer, 2011.

REFERENCE BOOK

1. Trucco Emanuele and Verri Alessandro, "*Introductory Techniques for 3D Computer Vision*", Prentice Hall, 1998

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO 2	2	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO 3	2	2	3	3	2	2	-	-	-	-	-	-	2	-	2
CO 4	2	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO 5	2	2	2	1	1	-	-	3	-	-	-	-	-	-	-
Score	10	12	13	12	11	8	2	3	-	-	-	-	6	4	4
COM	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**2**

STREAM – II
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(OFFERED BY DEPARTMENT OF CSE)

CSSE11 MACHINE LEARNING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To introduce the basic building blocks and general principles of machine learning techniques.
- To impart adequate knowledge about modelling and performance evaluation of machine learning algorithms.
- To understand the concepts of supervised, unsupervised, and reinforcement learning methods.
- To construct programs in Python to solve machine learning algorithms.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO MACHINE LEARNING **08**

Basic Concepts, Introduction to Machine Learning (ML), Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning.

UNIT 2: MODELLING **08**

Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostics, learning curves, Accuracy and Error measures.

UNIT 3: DECISION TREE AND LEARNING RULES **08**

Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifiers.

UNIT 4: UNSUPERVISED LEARNING TECHNIQUES **08**

Clustering Algorithms- Introduction, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm, Bayesian networks, Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.

UNIT 5: REINFORCEMENT LEARNING **08**

Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of the machine learning and experiment with the standard machine learning models.	(K3)
CO2	:	Test and evaluate the performance supervised machine learning models using various performance metrics.	(K5)
CO3	:	Experiment with decision trees and learning rules and analyze the performance of algorithms.	(K4)
CO4	:	Identify the real-world problems and apply classification and clustering models on the datasets.	(K3)
CO5	:	Illustrate reinforcement learning and solve problems using reinforcement learning algorithm.	(K3)

TEXT BOOKS

1. Mitchell, T., "*Machine Learning*", McGraw-Hill, 2017.
2. Shalev-Shwartz, S., David, B., "U*nderstanding Machine Learning from Theory to Algorithms*", Cambridge University Press, 2014.

REFERENCE BOOKS

1. Alpaydin, E., "*Introduction to Machine Learning*", PHI, 2005.
2. Bishop, C, "*Pattern Recognition and Machine Learning*", Springer, 2006.
3. Duda, R.O., Hart, P.E. and Stork, D.G., "*Pattern Classification*", 2nd Edition, Wiley-Interscience, November, 2000.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO3	3	-	3	3	-	-	-	-	-	2	-	3	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Score	15	4	3	3	6	-	-	-	-	2	-	6	3	-	-
COM	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**2**		**3**	**3**	**-**	**-**

CSSE12 DEEP LEARNING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of an artificial neuron.
- To learn the fundamentals of neural networks and their training process.
- To optimize the training of neural networks and recurrent neural networks.
- To learn architecture and training of convolutional neural networks and various generative models.
- To learn the architecture of generative models.

COURSE CONTENTS

UNIT 1: BASICS **08**

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

UNIT 2: FEEDFORWARD NETWORKS **08**

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders. Deep Neural Networks, Difficulty of training deep neural networks, Greedy layer wise training.

UNIT 3: BETTER TRAINING OF NEURAL NETWORKS **08**

Newer optimization methods for neural networks (Adagrad, Adadelta, RMSprop, Adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization), Recurrent Neural Networks, Back propagation through time, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

UNIT 4: CONVOLUTIONAL NEURAL NETWORKS **08**

Introduction to CNNs, Generative models, Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, Gradient Vomputations in RBMs, Deep Boltzmann Machines.

UNIT 5: RECENT TRENDS AND APPLICATIONS **08**

Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning, Applications, Vision, NLP, Speech, Recent trends and Applications.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the basics of an artificial neuron, its origin, and the motivation behind AI.	(K2)
CO2	:	Able to create a basic feedforward neural network, given a dataset.	(K3)
CO3	:	Able to create, train and optimize a neural network, a recurrent neural network, and its variants.	(K6)
CO4	:	Able to create, train and optimize a convolution neural network on different image processing tasks.	(K6)
CO5	:	Construct new examples of input data using generative models.	(K6)

TEXT BOOKS

1. Goodfellow, I., and Bengio, Y., and Courville, A., "*Deep Learning*", MIT Press, 2017

REFERENCE BOOKS

1. Bishop, C., "*Pattern Recognition and Machine Learning*", Springer, 2006

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

CSSE13 ARTIFICIAL INTELLIGENCE

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of Artificial Intelligence.
- To be able to mathematically represent knowledge.
- To learn the methods of solving problems in Artificial Intelligence.
- To learn various game playing and planning techniques.
- To learn the semantic analysis and its application in NLP.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO AI **08**

Control strategies, Search strategies, Production system characteristics, Specialized production system, Problem-solving methods, Problem graphs, Matching, Indexing, and Heuristic functions, Hill Climbing, Depth-first and Breadth-first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

UNIT 2: KNOWLEDGE REPRESENTATION **08**

Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other Logic-Structured representation of knowledge.

UNIT 3: REASONING **08**

Production-based system, Frame-based system, Inference – Backward chaining, forward chaining, Rule value approach, Fuzzy reasoning, Certainty factors, Bayesian Theory, Bayesian Network, Dempster-Shafer theory.

UNIT 4: GAME PLAYING AND PLANNING **08**

Overview, MinMax search procedure, Alpha-beta cut-offs, Iterative Deepening, Components of planning system, goal stack planning, non-linear planning, hierarchal planning and other planning techniques, reactive system security.

UNIT 5: UNDERSTANDING AND NLP **08**

Introduction to Understanding, Understanding as constraint satisfaction, Introduction to NLP, Syntactic and Semantic analysis, Statistical NLP, and Spell Checking.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the basic concepts of artificial intelligence.	(K2)
CO2	:	Represent the knowledge using predicate calculus.	(K2)
CO3	:	Ability to identify problems that are amenably solved by AI methods.	(K3)
CO4	:	Apply various game-playing techniques in artificial intelligence.	(K3)
CO5	:	Ability to utilize semantic information in NLP applications.	(K3)

TEXT BOOK

1. Night, K. R., Elaine, and Nair B., "*Artificial Intelligence*", 3rd Edition, McGraw Hill, 2017.

REFERENCE BOOK

1. Kheemani, D., "*A First Course in Artificial Intelligence*", 1st Edition, McGraw Hill Education, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
Score	15	8	-	-	-	-	-	-	-	-	-	-	8	-	-
COM	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

CSSE14 SOFT COMPUTING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To understand the concepts of feed forward and feedback networks.
- To impart adequate knowledge about Fuzzy Logic Controllers and Neural Networks.
- To understand the general principles of evolutionary computing algorithms.
- To understand the concepts of fuzzy classification and clustering techniques.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO SOFT COMPUTING **08**

Soft computing vs. Hard computing, Applications of Soft Computing, Various types of Soft Computing Techniques, Neuron-Nerve Structure and Synapse-Neural Network Architecture, Single layer and Multilayer feed forward networks, McCulloch Pitts neuron model, Perceptron model, MLP-back propagation learning methods, Effect of learning rule coefficient.

UNIT 2: EVOLUTIONARY COMPUTATION **08**

Historical Development of EC, Genetic Algorithms, Genetic programming, Evolutionary Strategies, Evolutionary programming, Features of Evolutionary computation, Advantages and Applications of Evolutionary Computation, Basic concept of Genetic algorithm, Conventional Optimization and Search Techniques, Comparison of Genetic Algorithm with Other Optimization Techniques, Advantages, Applications and Limitations of Genetic Algorithm.

UNIT 3: TERMINOLOGIES AND OPERATORS OF GA **08**

Introduction to basic Terms, Encoding, Breeding, Search Termination, Diploidy, Dominance and Abeyance, Classification of Genetic Algorithm, Simple Genetic Algorithm (SGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Adaptive Genetic Algorithm (AGA), Fast Messy Genetic Algorithm (FmGA), Independent Sampling Genetic Algorithm (ISGA).

UNIT 4: INTRODUCTION TO FUZZY LOGIC **08**

Utility, Limitations, Different faces of imprecision, inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of Membership Functions, Fuzzification, and Defuzzification.

UNIT 5: AUTOMATED METHODS FOR FUZZY SYSTEMS **08**

Batch Least square and Recursive Least Square Algorithms, Clustering methods, Fuzzy system Simulation- fuzzy relational equations, Fuzzy associative memories. Fuzzy Classification and pattern Recognition- Cluster analysis and validity, c-Means clustering, Single sample Identification, Multi-feature pattern recognition and Image processing.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Experiment with various soft computing techniques and analyze the performance of neural network model using various evaluation metrics.	(K4)
CO2	:	Explain evolutionary computation and apply it for solving optimization problems.	(K3)
CO3	:	Experiment with genetic algorithm and apply genetic operators in various applications.	(K3)
CO4	:	Explain fuzzy systems and contrast fuzzification and defuzzification techniques.	(K2)
CO5	:	Classify and compare automated methods for fuzzy systems.	(K2)

TEXT BOOKS

1. Deepa, S.N. and Sivanandam, S.N., "*Principles of Soft Computing*", 2nd Edition, Wiley India, 2011.
2. Tom, M., "*Machine Learning*", McGraw-Hill, 2017.

REFERENCE BOOKS

1. Zimmermann H. J. "*Fuzzy set theory and its applications*" Springer, 2011.
2. Timothy, J. R., "*Fuzzy Logic with Engineering Applications*," 3rd Edition, Wiley India, 2010.
3. Shai, S. S., and Shai, B. D., "*Understanding Machine Learning from Theory to Algorithms*", Cambridge University Press, 2014.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO 2	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	10	4	-	-	6	-	-	-	-	-	-	9	-	-	-
COM	**2**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

CSSE15 NLP WITH DEEP LEARNING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn various representations of words.
- To learn to generate text using neural networks.
- To perform machine translation using recurrent neural networks.
- To learn the basics of attention mechanism.
- To learn the advanced model architectures for natural language processing.

COURSE CONTENTS

UNIT 1: VECTOR SEMANTICS AND EMBEDDINGS **08**

Human language and word meanings, Words and vectors, Word2Vec, Word2Vec objective function, Skip-grams, Continuous bag-of-words, Word vectors similarity, Evaluating word vectors, Visualizing Embeddings, Data pre-processing and sentiment analysis with NLTK.

UNIT 2: NEURAL LANGUAGE MODELS **08**

Revisiting the basics of neural networks, gradient descent, backpropagation, N-gram language models, Feedforward neural language modeling, Training Neural Nets, An RNN language model, Training an RNN language model, Evaluating language models, Perplexity.

UNIT 3: MACHINE TRANSLATION **08**

Early Machine Translation (MT), Statistical MT, Neural Machine Translation (NMT), Sequence-to-Sequence (Seq2Seq) model architecture, Training an NMT system, Evaluating MT system, BLEU score.

UNIT 4: CNNS AND ATTENTION **08**

From RNNs to CNNs, 1D convolution for text, Single layer CNNs for text classification, Purely character-level models, Sub-word models, Byte-Pair Encoding, Bottleneck problem in Seq2Seq architecture, Attention, Seq2Seq with attention.

UNIT 5: PRE-TRAINING AND TRANSFORMERS **08**

Pre-trained word embeddings, Encoder-Decoder architecture, query, key, and value, calculation of self-attention, multi-head attention, Transformers for various NLP tasks, Transfer learning.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Construct word embeddings and make use of NLTK for various data pre-processing tasks.	(K3)
CO2	:	Construct a simple neural network for language modeling task.	(K3)
CO3	:	Build a machine translation system using sequence-to-sequence model architecture.	(K6)
CO4	:	Construct neural network models with attention mechanism.	(K3)
CO5	:	Make use of advanced deep neural architectures on various NLP tasks.	(K3)

TEXT BOOKS

1. Jurafsky, D. and Martin, J. H., "*Speech and Language Processing*", 3rd Edition, Pearson Education, 2022.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

STREAM – III
DATABASE AND NETWORKING

(OFFERED BY DEPARTMENT OF CSE)

CSSE21 RELATIONAL DATABASE MANAGEMENT SYSTEMS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To describe the basics of SQL and construct queries using SQL.
- To emphasize the importance of normalization in databases.
- To familiarize issues of concurrency control and transaction management.
- To understand different types of databases and recovery techniques.
- To discuss emerging database technologies and database applications.

COURSE CONTENTS

UNIT 1: QUERY PROCESSING AND OPTIMIZATION 08

Basic Algorithms for executing Query Operations, Using Heuristics in Optimization. Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts Desirable Properties of transaction, Schedules and recoverability, Serializability of schedules.

UNIT 2: CONCURRENCY CONTROL TECHNIQUES 08

Locking Techniques for concurrency control Techniques Based on Time Stamp Ordering, Multi-version concurrency control Techniques, Validation Concurrency Control Techniques. Recovery techniques: Recovery Concepts, Recovery Techniques Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, and Recovery in Multi database Transaction.

UNIT 3: DATABASE SECURITY AND AUTHORIZATION (SQL) 08

Introduction to Database Security Issues, Discretionary Access Control Based on Privileges, Mandatory Access Control for Multilevel Security, Statistical Database Security. Advanced Data Modelling Concepts: Enhanced – ER (ERR)-to-Relational Mapping, Data Abstraction and Knowledge Representation Concepts, Integrity Constraints in data modelling, EER Update Operations and Transaction Specification.

UNIT 4: OBJECT-ORIENTED DATABASES 08

Overview of Object-Oriented concepts, Object Identity, Object Structure and Type Constructor. Encapsulations of Operations, Methods and Persistence, Type and Class Hierarchies and Inheritance, Complex Objects, Other O – O concepts.

UNIT 5: DEDUCTIVE DATABASES 08

Introduction to Deductive Databases, Prolog/Data log Notation, Interpretation of Rules, Basic interference Mechanism for Logic Programs and their evaluation. The

LDL System, Other Deductive Database Systems, Emerging Database Technologies and applications- Progression of Database Technology, Emerging Database Applications, Next Generation of Databases and Database Management Systems, Interfaces with other Technologies.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Learn and apply Structured query language (SQL) for database definition and database manipulation.	(K3)
CO2	:	Explain various transaction processing, concurrency control mechanisms and database protection mechanisms.	(K2)
CO3	:	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.	(K2)
CO4	:	Explain the concepts of object-oriented databases.	(K2)
CO5	:	Discuss deductive database and identify different types of Deductive Database Systems and next generation databases.	(K3)

TEXT BOOKS

1. Elmasri, R. N. and Shamkant, B., *"Fundamentals of Database Systems"* The Benjamin/Cummings Publishing Company Narosa, 2016.
2. Dabir, H. and Meher, D., "*Advanced RDBMS Using Oracle*", 2nd Edition, Vision Publications, 2014.
3. Silberschatz A., Korth H. F., Sudarshan, S., "*Database System Concepts"*, 6th Edition, McGraw Hill Education (India) Private Limited, 2010.

REFERENCE BOOK

1. Ceri S. and Palagatti, G, "*Distributed Database: Principles and System*", McGraw Hill, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	3	-	-	-	-	-	-	-	2	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	5	-	3	-	-	-	-	-	-	-	10	-	-
COM	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

CSSE22 ADVANCED DATABASE MANAGEMENT SYSTEMS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To understand the different issues related to RDBMS.
- To familiarize with the distributed databases.
- To familiarize with the object-oriented databases.
- To understand the emerging database systems and the current issues.

COURSE CONTENTS

UNIT 1: RELATIONAL MODEL ISSUES **08**

ER Model, Normalization, Query Processing, Query Optimization, Transaction Processing, Concurrency Control, Recovery, Database Tuning.

UNIT 2: DISTRIBUTED DATABASES **08**

Parallel Databases, Inter and Intra Query Parallelism, Distributed Database Features, Distributed Database Architecture, Fragmentation, Distributed Query Processing, Distributed Transactions Processing, Concurrency Control, Recovery, Commit Protocols.

UNIT 3: OBJECT ORIENTED DATABASES **08**

Introduction to Object Oriented Databases, Approaches Modelling and Design, Persistence, Query Languages, Transaction, Concurrency, Multi Version Locks, Recovery, POSTGRES, JASMINE, GEMSTONE, ODMG Model.

UNIT 4: EMERGING SYSTEMS **08**

Enhanced Data Models, Client/Server Model, Data Warehousing and Data Mining, Web Databases, Mobile Databases, XML and Web Databases, MongoDB, No SQL.

UNIT 5: CURRENT ISSUES **08**

Rules, Knowledge Bases, Active and Deductive Databases, Multimedia Databases Multimedia Data Structures, Multimedia Query languages, Spatial Databases.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Ability to identify issues in the relational models.	(K3)
CO2	:	Explain the basics of distributed database.	(K2)
CO3	:	Explain the fundamentals of object-oriented database.	(K2)
CO4	:	Analyze the emerging database systems.	(K4)
CO5	:	Identify the issues in different database systems.	(K3)

TEXT BOOK

1. Connolly, T. and Begg, C., "*Database Systems: A Practical Approach to Design, Implementation, and Management*", 5th Edition, Addison-Wesley, 2014.

REFERENCE BOOKS

1. Elmasri, R. and Navathe, S. B. "*Fundamentals of Database Systems*", 5th Edition, Pearson/ Addison Wesley, 2017.
2. Silberschatz, Abraham, Korth, Henry F., and Sudharshan, S., "*Database System Concepts*", 6th Edition, Tata McGraw Hill, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

CSSE23 DATABASE SECURITY

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of database security.
- To learn the security models and security mechanism.
- To learn the secure software design.
- To understand the database protection.

COURSE CONTENTS

UNIT 1: INTRODUCTION AND SECURITY MODELS 08

Introduction to Database Security, Problems in Database Security, Controls, Conclusions, Security Models, Introduction, Access Matrix Model, Take-Grant Model, Acten Model, PN Model Hartson and Hsiao's Model Fernandez's Model, Bussolati and Martella's Model for Distributed databases.

UNIT 2: SECURITY MODELS AND MECHANISMS 08

Security Models, Bell and LaPadula's Model, Biba's Model, Dion's Model, Sea View Model, Jajodia and Sandhu's Model, The Lattice Model for the Flow Control, Security Mechanisms, Introduction, User Identification/Authentication, Memory Protection, Resource Protection, Control Flow Mechanisms, Isolation, Security Functionalities in Some Operating Systems, Trusted Computer System, Evaluation Criteria.

UNIT 3: SECURITY SOFTWARE DESIGN 08

Security Software Design, Introduction, Methodological Approach to Security Software Design, Secure Operating System, Design Secure DBMS, Design Security Packages, Database Security Design.

UNIT 4: STATISTICAL DATABASE PROTECTION & INTRUSION DETECTION SYSTEM 08

Introduction, Statistics Concepts and Definitions, Types of Attacks, Inference Controls, Evaluation Criteria for Control Comparison, Introduction to IDES System, RETISS System and ASES System Discovery.

UNIT 5: MODELS FOR PROTECTION OF NEW GENERATION DATABASE SYSTEM 08

Introduction, Model for the Protection of Frame Based Systems, A Model for the Protection of Object-Oriented Systems, SORION Model for the Protection of Object-Oriented Databases, Models for the Protection of New Generation Database

Systems, the Orion Model Jajodia and Kogan's Model, A Model for the Protection of Active Databases, Conclusions.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the basics database security and understand the basic security models.	(K3)
CO2	:	Able to understand the database security models and mechanism.	(K3)
CO3	:	Identify security threats in database systems.	(K3)
CO4	:	Analyse and evaluate the different attacks on statistical databases.	(K4)
CO5	:	Test and evaluate secure database systems.	(K5)

TEXT BOOKS

1. Hassan A. A., *Database Security and Auditing*, India Edition, CENGAGE Learning, 2009.
2. Castano, S., *Database Security,* 2nd Edition, Pearson Education, 1994.

REFERENCE BOOK

1. Basta, A., Zgola, M., *Database Security*, CENGAGE Learning, 2011.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

CSSE24 MOBILE COMPUTING AND COMMUNICATION

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the fundamentals of Wireless Networks.
- To study different protocols.
- To learn the functionality of Wireless LAN.
- To study the working of mobile network layer.

COURSE CONTENTS

UNIT 1: WIRELESS TRANSMISSION **08**

Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems, Frequency Management and Channel Assignment, Types of hand-off and their characteristics.

UNIT 2: MEDIUM ACCESS CONTROL **08**

MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM, Architecture, Location tracking and call setup, Mobility Management Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

UNIT 3: WIRELESS LAN **08**

Infrared vs Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11, WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture and protocols.

UNIT 4: MOBILE NETWORK LAYER **08**

Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/ Fast recovery, Transmission / Time-out freezing, Selective retransmission, Transaction Oriented TCP.

UNIT 5: MOBILITY **08**

WAP Model- Mobile Location based services, WAP Gateway, WAP protocols, WAP user agent profile, caching model, wireless bearers for WAP, WML, WML Scripts, WTA, iMode, SyncML.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of Wireless Transmission.	(K3)
CO2	:	Examine the functionality of medium access control and global system for mobile communication.	(K3)
CO3	:	Analyse the role of various wireless local area networks and architectures.	(K3)
CO4	:	Analyse different architectures & protocols of wireless networks.	(K4)
CO5	:	Examine the different Wireless application protocols.	(K5)
CO6	:	Simulate real time data transmission over wireless network.	(K6)

TEXT BOOK

1. Schiller, J., "*Mobile Communication*", 2nd Edition, Pearson Education, 2018

REFERENCE BOOKS

1. Theodore and Rappaport, "*Wireless Communications, Principles, Practice*", PHI, 2015
2. Tanenbaum A. S. and Wetherall, D. J., "*Computer Networks*", 5th Edition, Pearson, 2013.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	3	2	2	2	2	1	3	-	3	3	3	3
CO 2	2	3	2	3	3	2	-	-	-	3	-	3	-	2	2
CO 3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO 4	2	3	3	3	3	-	-	-	-	3	-	3	-	2	2
CO 5	2	3	3	1	-	-	-	-	-	3	-	3	-	2	3
CO6	2	3	3	3	3	2	2	2	1	3	3	3	3	3	3
Score	10	17	17	16	12	6	4	4	2	15	3	15	9	14	15
COM	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**3**

CSSE25 WIRELESS SENSOR NETWORKS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To understand the fundamentals of Wireless Sensor Networks (WSN) technology and its relevance in the Scientific and Industrial context.
- To understand the basics of Wireless Communication, Sensor Operations and Management.
- To discuss the relevance, challenges, and open research issues in localization.
- To understand the core routing issues and algorithms in WSN.
- To understand the QoS challenges and current solutions for the same in WSN.

COURSE CONTENTS

UNIT 1: INTRODUCTION AND FUNDAMENTALS 08

Introduction to sensor networks, Applications of WSNs, Difference between mobile ad-hoc networks and WSNs, Architecture of a WSN node, Hardware components. Energy consumption of WSN nodes, Operating systems and execution environments, Sensor network scenarios, Optimization goals in WSNs, Design principles of WSNs, Service interfaces and gateways in WSNs.

UNIT 2: WSN COMMUNICATION PROTOCOLS 08

Physical layer, Wireless channel and communication fundamentals, Physical layer and trans-receiver design in WSNs, Fundamentals of wireless MAC protocols, Low duty cycle protocols, Contention based protocols, Schedule based protocols, IEEE 802.15.4 MAC protocol, Link layer protocols, Error control, framing and link management in WSNs.

UNIT 3: LOCALIZATION AND POSITIONING OF WSN NODES 08

Fundamentals of naming and addressing of senor nodes, Assignment of MAC addresses, Distributed addressing, Content based and geographical addressing, Time synchronization of WSN nodes, Sync. Protocols for sender/receiver and receiver/receiver, Localization and positing procedures, Basics of lateration, Single-hop localization, Positing in multi-hop environments, Impacts of anchor placement.

UNIT 4: TOPOLOGY CONTROL AND ROUTING PROTOCOLS 08

Basics of topology control, Power control in flat networks, Hierarchical networks by dominating sets and clustering, Adaptive node activity, Routing in WSN nodes, Gossiping and agent based unicast forwarding, Energy efficient unicast, Broadcasting and multicasting in WSN nodes, Geographical routing, Mobile nodes.

UNIT 5: NETWORKING AND QOS IN WSN **08**

Datacentric and content-based networking, Data centric routing, Data aggregation and data centric storage, Transport layer in WSN, Coverage and deployment of WSN nodes, Reliability requirements in WSNs, Single packet and block delivery, Congestion and rate control in WSN.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the architecture of Wireless Sensor Networks.	(K2)
CO2	:	Describe the various WSN communication protocols.	(K2)
CO3	:	Experiment with the concepts of localization and positioning of WSN nodes.	(K3)
CO4	:	Analyse the various routing and topology control algorithms in WSN.	(K4)
CO5	:	Explain the QoS principles followed in WSN.	(K2)

TEXT BOOKS

1. Holger, K, and Willig, A., *Protocols and architectures for wireless sensor networks*. John Wiley & Sons, 2007.
2. Mohamed, I. *Wireless sensor networks: a cognitive perspective*. CRC Press, 2012.

REFERENCE BOOKS

1. Waltenegus, D., and Poellabauer, C. *Fundamentals of Wireless Sensor Networks: theory and practice*. John Wiley & Sons, 2010.
2. Rastko, R., Selmic, P, and Serwadda, V.V., *Wireless Sensor Networks: Security, Coverage, and Localization*. Springer, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	2		-	-	-	-	-	-	-	-	3	-	2
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	3	3	3	3	3	3	3	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	10	12	-	-	-	-	3	3	3	3	3	15	3	10
COM	3	2	3	-	-	-	-	3	3	3	3	3	3	3	2

STREAM – IV
SECURITY

(OFFERED BY DEPARTMENT OF IT)

ITSE21 INFORMATION SECURITY

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn the basics of Information security.
- To get familiarized with various routinely used information security tools and techniques.
- To understand the role of information security approaches in our daily life.
- To comprehend and implement the information security techniques of data protection.
- To learn the frameworks and additional tools for development of information security techniques aiming at improved data security.

COURSE CONTENTS

UNIT 1: OVERVIEW OF INFORMATION SECURITY **08**

Computer Security Concepts, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy.

UNIT 2: ACCESS CONTROL **08**

Access Control Principles, Subjects-Objects and Access Rights, Discretionary Access Control, UNIX File Access Control, Role- Based Access Control, Attribute-Based Access Control, Trust Frameworks. Case Study: RBAC System for a Bank.

UNIT 3: DATABASE SECURITY **08**

The need for Database Security, RDBMS and SQL Injection attacks, Database Access Control, Inference, Database Encryption.

UNIT 4: AUTHENTICATION AND AUTHORIZATION **08**

Introduction, Authentication Methods, Passwords, Biometrics, Two-Factor Authentication, Single Sign-On and Web Cookies. Steganography, Authorization: A Brief History, Access control Matrix, Multilevel Security Models, Covert Channels, Inference Control, CAPTCHA.

UNIT 5: FIREWALLS AND INTRUSION DETECTION AND PREVENTION SYSTEMS **08**

Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Biasing, Firewall Location and Configuration, Intrusion Detection Systems, Intrusion Prevention Systems, Unified Threat Management Productive.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Demonstrate understanding of the fundamentals of Information security.	(K2)
CO2	:	Develop understanding of underlying principles of access control.	(K3)
CO3	:	Develop understanding of database security techniques.	(K3)
CO4	:	Develop understanding of techniques used for authentication and authorization models.	(K3)
CO5	:	Develop understanding of firewall characteristics and intrusion detection and prevention techniques.	(K3)

TEXT BOOKS

1. Stallings, W., and Brown, L., "*Computer Security: Principles and Practice*", Pearson, 4th Edition, 2018.
2. Stamp, M., "*Information Security: Principles and Practices*", Wiley Publication, 2nd Edition, 2011.

REFERENCE BOOK

1. Stallings W., "*Cryptography and Network Security: Principles and Practice*", Pearson, 7th Edition, 2017.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	2	-	-	-	-	-	-	-	2
CO4	-	-	2	-	1	2	2	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Score	6	4	5	1	4	4	4	2	-	-	-	-	2	-	4
COM	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**2**

ITSE22 PRINCIPLES OF CRYPTOGRAPHY

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn fundamentals of cryptography.
- To understand the application of cryptographic techniques in real world applications.
- To learn applications of cryptography.
- To learn and apply public and private key methods.
- To learn the notion of provable security and its implication with improved security.

COURSE CONTENTS

UNIT 1: CLASSICAL CRYPTOGRAPHY **08**

Introduction: Some Simple Cryptosystems, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher, Stream Ciphers, Cryptanalysis.

UNIT 2: ADVANCED ENCRYPTION STANDARD **08**

Introduction to DES, Finite field arithmetic, AES Structure, AES Transformation functions, AES Key expansion, An AES Example, AES Implementation.

UNIT 3: THE RSA SYSTEM AND FACTORING **08**

Introduction to Public-key Cryptography, Number Theory, The Euclidean Algorithm, The Chinese Remainder Theorem, The RSA Cryptosystem, Implementing RSA, Probabilistic Primality Testing, Attacks On RSA.

UNIT 4: ELLIPTIC CURVE CRYPTOSYSTEMS **08**

The basic setup, Diffie-Hellman Key exchange, Massy-Omura Encryption, ElGama Public key encryption.

UNIT 5: DIGITAL SIGNATURE SCHEMES **08**

Introduction, The ElGamal Signature Scheme, The Digital Signature Standard, One-time Signatures, Undeniable Signatures, Fail-stop Signatures, Blind, Dual and ElGama Elliptic Curve signature scheme. Hash Functions: Signatures and Hash Functions, Collision-free Hash Functions, The Birthday Attack, Te Discrete Logarithm problem, A Discrete Log Hash Function, Extending Hash Functions, Hash Functions from Cryptosystems, The MD4 Hash Function.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of applied cryptography.	(K2)
CO2	:	Explain the concepts of advance encryption techniques.	(K2)
CO3	:	Illustrate applications of public key cryptographic algorithms.	(K2)
CO4	:	Explain the Elliptic curve cryptosystems.	(K2)
CO5	:	Compare various digital signature schemes.	(K5)

TEXT BOOK

1. Schneier B., "*Applied Cryptography: Protocols, Algorithms and Source Code in C*", Wiley Publication, 2nd Edition, 2012.

REFERENCE BOOK

1. Stallings W., "*Cryptography and Network Security: Principles and Practice*", 7th Edition, Pearson, 2017

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	1	3	-	-	-	-	-	3	-	-	3	-	3
CO 2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	3
CO 3	3	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	15	12	1	9	8	-	-	-	-	3	-	-	6	-	9
COM	**3**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**3**	**-**	**3**

ITSE23 NETWORK SECURITY

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the various types of attacks and services related to network layer protocol.
- To discuss how to apply authentication techniques to safeguard the data transfer.
- To inspect the security requirements and standards for IP and web-based systems.
- To understand the design principles of authentication protocols.
- To investigate the security issues involved in wireless networks.

COURSE CONTENTS

UNIT 1: OVERVIEW OF NETWORK SECURITY **08**

Security services, attacks, Security Issues in TCP/IP suite, Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, DNS security, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits.

UNIT 2: DIGITAL SIGNATURES AND AUTHENTICATION **08**

Requirements, Authentication functions, Message Authentication Codes, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures.

UNIT 3: INTERNET PROTOCOL SECURITY AND STANDARDS **08**

IP Security Overview and Architecture, Authentication Header, Encapsulating Security Payload, Secure E-mail and S/MIME, Domain Keys Identified Mail, Secure Socket Layers (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security.

UNIT 4: INTERNET AUTHENTICATION APPLICATIONS **08**

Kerberos, X.509, Public Key Infrastructure.

UNIT 5: WIRELESS NETWORK SECURITY **08**

Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Firewall security.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Identify the various security services and attacks in network layer.	(K3)
CO2	:	Determine appropriate mechanisms to verify the integrity of the message.	(K5)
CO3	:	Relate how existing standards help to enable digital acceleration in network modernization.	(K2)
CO4	:	Analyse the need for automated tools for protecting files and other information stored on the networked system.	(K4)
CO5	:	Construct security solutions for a given wireless application or system.	(K6)

TEXT BOOKS

1. Stallings W. and Brown L., "*Computer Security: Principles and Practice*", Pearson, 4th Edition, 2018.
2. Stamp M., "*Information Security: Principles and Practices*", Wiley Publication, 2nd Edition, 2011.

REFERENCE BOOKS

1. Kahate A., "*Cryptography and Network Security*", Tata McGraw-Hill, 3rd Edition, 2013.
2. Stallings W., "*Cryptography and Network Security: Principles and Practice*", 7th Edition, Pearson, 2017

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	-	2	2	-	-	-	-	-	-	-	-	-	3	-	-
Score	2	6	4	-	-	-	-	-	-	-	-	-	3	6	-
COM	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**

ITSE24 APPLIED CRYPTOGRAPHY

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To learn fundamentals of applied cryptography.
- To understand the application of cryptographic techniques in real world applications.
- To learn applications of applied cryptography.
- To learn and apply public and private key methods.
- To learn the notion of provable security and its implication with improved security.

COURSE CONTENTS

UNIT 1: FOUNDATIONS **08**

Terminology, Steganography, Substitution Cipher and Transposition Cipher, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers. Intermediate Protocols: Timestamping Services, Subliminal Channel, Undeniable Digital Signatures, Proxy Signatures, Group Signatures, Fail-Stop Digital Signatures, Computing with Encrypted Data, Bit Commitment, Fair Coin Flips, Mental Poker, One-Way Accumulators, All-or-None Disclosure of Secrets.

UNIT 2: CRYPTOGRAPHIC PROTOCOLS **08**

Esoteric Protocols: Secure Elections, Secure Multiparty Computation, Anonymous Message Broadcast, Digital Cash. Key Length: Symmetric and Public-Key Key Length, Comparison, Birthday attacks against One-Way Hash Functions, Caveat Emptor.

UNIT 3: CRYPTOGRAPHIC TECHNIQUES **08**

Key Management: Generating Keys, Non-linear Key-space, Transferring Keys, Verifying Keys, Using Keys, Updating Keys, Storing Keys, Backup Keys, Compromised Keys, Lifetime of Keys, Destroying Keys, Public-key key Management. Using Algorithms: Choosing an Algorithm, Public-Key vs Symmetric Cryptography, Encrypted Communications Channels, Encrypting Data for Storage, Hardware vs Software Encryption, Detecting Encryption, Hiding Ciphertext in Ciphertext, Destroying Information.

UNIT 4: CRYPTOGRAPHIC ALGORITHMS **08**

Block Ciphers: Lucifer, Madryga, NewDES, FEAL, REDOC, LOKI, Khufu and Khafre, RC2, IDEA, MMB, CA-1.1, Skipjack. Combining Block Ciphers: Double and Triple Encryption, Doubling the Block Length, Other Multiple Encryption

Schemes, CDMF Key Shortening, Whitening, Cascading Multiple Block Algorithms, Combining Multiple Block Algorithms.

UNIT 5: THE REAL WORLD **08**

Example Implementation: IBM Secret-Key Management Protocol, Kerberos, Privacy-Enhanced Mail, Pretty Good Privacy, Smart Cards, Universal Electronic Payment System.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the fundamentals of applied cryptography.	(K2)
CO2	:	Explain the concepts of cryptographic protocols.	(K2)
CO3	:	Illustrate cryptographic techniques.	(K2)
CO4	:	Explain cryptographic algorithms.	(K2)
CO5	:	Compare various real-world applications.	(K5)

TEXT BOOK

1. Schneier B., "*Applied Cryptography: Protocols, Algorithms and Source Code in C*", Wiley Publication, 2nd Edition, 2012.

REFERENCE BOOK

1. Stallings W., "*Cryptography and Network Security: Principles and Practice*", 7th Edition, Pearson, 2017

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	1	3	-	-	-	-	-	3	-	-	3	-	3
CO 2	2	2	-	-	3	-	-	-	-	-	-	-	3	-	3
CO 3	2	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	-	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	10	12	1	9	8	-	-	-	-	3	-	-	6	-	9
COM	**2**	**3**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**3**	**-**	**3**

ITSE25 CYBER PHYSICAL SYSTEMS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the mathematical models behind cyber-physical systems.
- To utilize scheduling analysis techniques to verify timing effects of the systems.
- To identify the security issues and requirements to build secured cyber-physical systems.
- To understand the interactions and issues related to distributed cyber-physical systems.
- To get detailed insights on different cyber physical systems to expose new opportunities.

COURSE CONTENTS

UNIT 1: **SYMBOLIC SYNTHESIS FOR CYBER-PHYSICAL SYSTEMS** **08**

Introduction and Motivation, Basic Techniques, Layered Models in CPS, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools.

UNIT 2: **SOFTWARE AND PLATFORM ISSUES IN FEEDBACK CONTROL SYSTEMS** **08**

Introduction, Basic Techniques, Controller Timing, Controller Design for resource efficiency, Advanced Techniques. Logical Correctness of Hybrid Systems: Introduction, Basic Techniques, Discrete Verification, Advanced Techniques.

UNIT 3: **SECURITY OF CYBER-PHYSICAL SYSTEMS** **08**

Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches.

UNIT 4: **SYNCHRONIZATION IN DISTRIBUTED CYBER-PHYSICAL SYSTEMS** **08**

Challenges in Cyber- Physical Systems, A Complexity Reduction Technique for Synchronization, Basic Techniques.

UNIT 5: **CYBER PHYSICAL SYSTEMS APPLICATION DOMAIN** **08**

Medical Cyber-Physical Systems, Energy Cyber-Physical Systems, Cyber-Physical Systems Built on Wireless Sensor Networks.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	To construct the symbolic models for a given cyber physical system.	(K3)
CO2	:	To design a controller system to improve resource efficiency.	(K6)
CO3	:	To inspect the security requirements of various cyber physical systems.	(K4)
CO4	:	To compare different synchronous and asynchronous architectures to improve the interactions of globally connected (distributed) CPS.	(K2)
CO5	:	To the existing challenges of various cyber physical systems.	(K5)

TEXT BOOK

1. Rajkumar R., de Niz, D., and Klein, M., "*Cyber-Physical Systems*", 1st Edition, Addison-Wesley Professional, 2017.

REFERENCE BOOKS

1. Alur R., "*Principles of Cyber-Physical Systems*", MIT Press, 2015.
2. Roy, S., and Das, S. K., "*Principles of Cyber-Physical Systems: An Interdisciplinary Approach*", Cambridge University Press, 2020.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	2	-	3	2	-	-	-	-	-	-	-	3	-	-
Score	10	10	3	6	2	-	-	-	-	-	-	-	6	-	-
COM	**2**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

STREAM – V
CYBER PHYSICAL SYSTEMS

(OFFERED BY DEPARTMENT OF ECE)

ECSE11 INTRODUCTION TO IOT

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of Internet of Things and its architecture.
- To understand the architecture and networking in Internet of Things.
- To study the various IoT communication protocols.
- To gain insights about the fog and cloud computing in IoT framework.
- To study the real-life applications of IoT.

COURSE CONTENTS

UNIT 1: IOT INTRODUCTION AND FUNDAMENTALS 08

Basics of networking (types of networks, layered models, addressing, TCP/IP transport layer), Introduction to the architecture of wireless sensor networks, Machine-to-Machine (M2M) communication and cyber physical systems. Introduction to IoT and its comparison with M2M, WSN and CPS. IoT networking components, Addressing strategies in IoT.

UNIT 2: IOT ARCHITECTURE AND NETWORKING 08

Introduction to IoT Sensors and their characteristics, Sensing types and their considerations, Introduction to IoT Actuators, their types and characteristics, IoT processing topologies, their types and its importance, Data formatting, Processing topologies, IoT device design and selection considerations, Processing offloading, IoT connectivity technologies.

UNIT 3: IOT COMMUNICATION TECHNOLOGIES 08

Introduction to nodes, Constrained nodes and network, and the type of devices, Low power and lossy networks, Infrastructure protocols, Discovery protocols, Data protocols, Identification protocols, Device management protocols, Sematic protocols, IoT interoperability standards and frameworks.

UNIT 4: CLOUD AND FOG COMPUTING IN IOT 08

Introduction to cloud computing, Virtualization, Cloud Models, SLA in cloud computing, Cloud implementation in Sensor – Cloud, Introduction to fog computing and its architecture, Fog computing in IoT, Application of fog computing in IoT, Edge computing in IoT.

UNIT 5: IOT APPLICATIONS AND DATA ANALYTICS 08

IoT applications in agriculture, vehicular networks and healthcare, IoT analytics, Uses of machine learning in IoT, Advantages and challenges of ML in IoT, ML

algorithms for IoT applications, Performance metrices for evaluating ML algorithms.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Associate and classify the architecture of various communication systems.	(K2)
CO2	:	Elaborate the IoT infrastructure and data processing methodologies.	(K2)
CO3	:	Interpret the various networking protocols used in IoT.	(K2)
CO4	:	Acquire the concepts of fog and cloud computing in IoT.	(K3)
CO5	:	Illustrate the various real-life applications of IoT.	(K3)

TEXT BOOKS

3. Misra, S., Mukherjee, A. and Roy, A. *Introduction to IoT*. Cambridge University Press, 2021.
4. Serpanos, D. and Wolf, M. *Internet-of-things (IoT) systems: architectures, algorithms, methodologies*. Springer, 2017.

REFERENCE BOOKS

3. Xiao, P. *Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed*. John Wiley & Sons, 2018.
4. Hersent, O., Boswarthick D., and Elloumi, O., *The Internet of Things: Key Applications and Protocols*. John Wiley & Sons, 2011.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	10	10	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE12 WIRELESS SENSOR NETWORKS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To understand the fundamentals of Wireless Sensor Networks (WSN) technology and its relevance in the Scientific and Industrial context.
- To understand the basics of Wireless Communication, Sensor Operations and Management.
- To discuss the relevance, challenges, and open research issues in localization.
- To understand the core routing issues and algorithms in WSN.
- To understand the QoS challenges and current solutions for the same in WSN.

COURSE CONTENTS

UNIT 1: INTRODUCTION AND FUNDAMENTALS 08

Introduction to sensor networks, Applications of WSNs, Difference between mobile ad-hoc networks and WSNs, Architecture of a WSN node, Hardware components, Energy consumption of WSN nodes, Operating systems and execution environments, Sensor network scenarios, Optimization goals in WSNs, Design principles of WSNs, Service interfaces and gateways in WSNs.

UNIT 2: WSN COMMUNICATION PROTOCOLS 08

Physical layer, Wireless channel and communication fundamentals, Physical layer and trans-receiver design in WSNs, Fundamentals of wireless MAC protocols, Low duty cycle protocols, Contention based protocols, Schedule based protocols, IEEE 802,15,4 MAC protocol, Link layer protocols, Error control, framing and link management in WSNs.

UNIT 3: LOCALIZATION & POSITIONING OF WSN NODES 08

Fundamentals of naming and addressing of senor nodes, Assignment of MAC addresses, Distributed addressing, Content based and geographical addressing, Time synchronization of WSN nodes, Sync, Protocols for sender/receiver and receiver/receiver, Localization and positing procedures, Basics of lateration, Single-hop localization, Positing in multi-hop environments, Impacts of anchor placement.

UNIT 4: TOPOLOGY CONTROL AND ROUTING PROTOCOLS 08

Basics of topology control, Power control in flat networks, Hierarchical networks by dominating sets and clustering, Adaptive node activity, Routing in WSN nodes, Gossiping and agent based unicast forwarding, Energy efficient unicast, Broadcasting and multicasting in WSN nodes, Geographical routing, Mobile nodes.

UNIT 5: NETWORKING AND QOS IN WSN **08**

Datacentric and content-based networking, Data centric routing, Data aggregation and data centric storage, Transport layer in WSN, Coverage and deployment of WSN nodes, Reliability requirements in WSNs, Single packet and block delivery, Congestion and rate control in WSN.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain the architecture of Wireless Sensor Networks.	(K2)
CO2	:	Describe the various WSN communication protocols.	(K2)
CO3	:	Experiment with the concepts of localization and positioning of WSN nodes.	(K3)
CO4	:	Analyse the various routing and topology control algorithms in WSN.	(K4)
CO5	:	Explain the QoS principles followed in WSN.	(K2)

TEXT BOOKS

1. Holger, K., and Willig, A., *Protocols and Architectures for Wireless Sensor Networks*, John Wiley & Sons, 2007.
2. Mohamed, A., *Wireless Sensor Networks: A Cognitive Perspective*, CRC Press, 2012.

REFERENCE BOOKS

1. Waltenegus, D., and Poellabauer, C., *Fundamentals of Wireless Sensor Networks: theory and practice*, John Wiley & Sons, 2010.
2. Rastko, R., Selmic, P., and Serwadda V. V., *Wireless Sensor Networks: Security, Coverage, and Localization*, Springer, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	2		-	-	-	-	-	-	-	-	3	-	2
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	3	3	3	3	3	3	3	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	10	12	-	-	-	-	3	3	3	3	3	15	3	10
COM	3	2	3	0	0	0	0	3	3	3	3	3	3	3	2

ECSE13 INDUSTRIAL IOT

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of industry 4.0 and industrial internet of things.
- To understand the architecture of IIoT.
- To study the key enabling technologies in IIoT.
- To gain insights about the networking protocols in IIoT.
- To study the applications of AI and ML in IIoT.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO INDUSTRY 4.0 **08**

Overview of IoT, IoT architecture, Application-based IoT protocols, Cloud and fog computing in IoT, Sensor cloud, Introduction to Industry 4.0, CPS and IIoT, Prerequisites for IIoT and CPS, Design requirements and drivers of Industry 4.0, Sustainability assessments and cybersecurity in industries, Impacts of Industry 4.0.

UNIT 2: BASICS OF IIOT **08**

Introduction to IIoT, Industrial internet systems, Industrial sensing and processes, Business models and reference architecture of IIoT, Business models of IoT and IIoT, Reference architecture of IoT and IIoT, IIRA framework, Key performance indicators for safety and health in IIoT.

UNIT 3: KEY TECHNOLOGIES OF IIOT **08**

Introduction to Onsite technologies: Cloud and fog computing for IIoT, Introduction to On-site technologies. Augmented reality, Virtual reality, Big data and advanced analytics, Smart factories, Lean manufacturing systems.

UNIT 4: NETWORKING IN IIOT **08**

Sensors in IIoT and their characteristics and categories, Actuators in IIoT and their types, Industrial data transmission protocols: fieldbus, profibus, HART, Interbus, Bitbus, CC-link, Modbus, CAN, DeviceNet, LonWorks, ISA 100,11a, Wireless HART, LoRa and LoRaWAN, NB-IoT, IEEE 802,11AH, Industrial data acquisition: DCS, PLC and SCADA.

UNIT 5: MACHINE LEARNING & DATA SCIENCE IN IIOT AND APPLICATIONS **08**

Need for analytics in IIoT, IIoT analytics: categorization, usefulness, challenges, mapping with IIRA architecture, use of AI in analytics, Machine learning and data science in IIoT, Applications of deep learning in Industries, Applications of IIoT

for: Healthcare applications, Inventory management and quality control and Plant safety and security.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Associate and classify the architecture of Industry 4.0 and IIoT.	(K2)
CO2	:	Elaborate the IIoT infrastructure and data processing methodologies.	(K2)
CO3	:	Interpret the key technologies used in IIoT.	(K3)
CO4	:	Acquire the concepts of networking in IIoT.	(K4)
CO5	:	Illustrate the applications of AI and data science in IIoT.	(K2)

TEXT BOOKS

1. Misra, S., Roy, C., and Mukherjee, A., *Introduction to Industrial Internet of Things and Industry 4.0*, CRC Press, 2021.
2. Gilchrist, Alasdair, *Industry 4.0: The Industrial Internet of Things*, Apress, 2016.

REFERENCE BOOKS

1. Zaigham, M., *The Internet of Things in the Industrial Sector*, Springer International Publishing, 2019.
2. Giacomo, A., and Capasso, A., *Hands-on industrial Internet of Things: Create a powerful industrial IoT infrastructure using industry 4.0*, Packt Publishing Ltd, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	10	10	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE14 PRINCIPLES OF CYBER-PHYSICAL SYSTEMS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the mathematical models behind cyber-physical systems.
- To utilize scheduling analysis techniques to verify timing effects of the systems.
- To identify the security issues and requirements to build secured cyber-physical systems.
- To understand the interactions and issues related to distributed cyber-physical systems.
- To get detailed insights on different cyber physical systems to expose new opportunities.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO CYBER PHYSICAL SYSTEMS **08**

Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools, Open challenges in CPS.

UNIT 2: CLASSICAL CONTROL AND HYBRID SYSTEMS **08**

Introduction, Basic Techniques, Controller Timing, Controller Design for resource efficiency, Advanced Techniques, Logical Correctness of Hybrid Systems: Introduction, Basic Techniques, Discrete Verification, Advanced Techniques.

UNIT 3: SECURITY & SYNCHRONIZATION IN CPS **08**

Introduction to Security of CPS, Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches, Sync, Challenges in CPS, Complexity reducing techniques, Basic and advanced techniques for synchronization: Formal software engineering, Distributed consensus algorithms, Sync, lockstep functions, Time triggered architecture, physically asynchronous, logically synchronous systems.

UNIT 4: SCHEDULING AND INTEGRATION IN CPS **08**

Introduction and motivation for real-time scheduling in CPS, Basic and advanced techniques for real-time scheduling, Introduction and motivation for model integration in CPS, Causality, Sematic domains, Integration models for Computational Process, Schematics of CPS DSMLs, Advanced techniques like ForScec, CyPhyML, Formalization of semantics and language challenges, Open challenges in scheduling and integration of CPS.

UNIT 5: APPLICATIONS OF CYBER PHYSICAL SYSTEMS **08**

System description, operational scenarios, Key technology drivers and quality attributes for Medical Cyber-Physical Systems, Energy Cyber-Physical Systems and Cyber-Physical Systems Built on Wireless Sensor Networks.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Characterize the basics of cyber physical systems.	(K2)
CO2	:	Elaborate the concepts of control theory and hybrid systems in CPS framework.	(K2)
CO3	:	Interpret the role of security and synchronization in CPS.	(K2)
CO4	:	Acquire the concepts of scheduling and integration of CPS.	(K3)
CO5	:	Illustrate the real-life applications of CPS.	(K3)

TEXT BOOKS

1. Rajkumar, D., Niz, D. D., and Klein, M., *Cyber-physical systems*, Addison-Wesley Professional, 2016.
2. Alur, R., *Principles of cyber-physical systems*, MIT press, 2015.

REFERENCE BOOKS

1. Lee, E. A., and Seshia S. A., *Introduction to embedded systems: A cyber-physical systems approach*, MIT Press, 2016.
2. Roy, S., and Das, S. K., *Principles of Cyber-Physical Systems: An Interdisciplinary Approach*, Cambridge University Press, 2020.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	13	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE15 COMMUNICATION IN CYBER-PHYSICAL SYSTEMS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of cyber physical systems.
- To understand the communication capacity requirements of CPS.
- To study the network topology design in CPS.
- To gain insights about the communication network operation in CPS.
- To study the physical layer design in CPS.

COURSE CONTENTS

UNIT 1: BASICS OF CPS **08**

Elements of a CPS, Basics of Communication, Information measures, comm, Channels, source coding, modulation, networking and typical comm, systems, Modelling of controlled dynamical systems, Observability, controllability and optimal control, Typical cyber physical systems, power networks and robot networks.

UNIT 2: COMMUNICATION CAPACITY REQUIREMENTS **08**

Methodologies for communication, Basic Models, Deterministic Models: Stability, Stochastic systems, Estimation, Stochastic systems, Stability, Stochastic systems: reduction of Shannon entropy, Networked stochastic systems, Control communication complexity.

UNIT 3: NETWORK TOPOLOGY DESIGN **08**

WDM networks and design constraints, Optimization procedure, Optimization based on topology design, Formulation of objective function, Optimization of topology, Team decision theory and its application in optimal control.

UNIT 4: COMMUNICATION NETWORK OPERATION FOR CPS **08**

Hybrid system modelling for CPS, Optimization of scheduling policy, Mode provisioning, Model scheduling, Information based scheduling, Estimation oriented routing, System dynamics – aware multicast routing.

UNIT 5: PHYSICAL LAYER DESIGN FOR CPS **08**

Physical layer in CPS, Adaptive modulation, Source coding in CPS: point-to-point case and distributed case, Physical dynamics-aware channel decoding, Control-

oriented channel coding, Channel coding for interactive communication in computing.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Characterize the basics of communication in cyber physical systems.	(K2)
CO2	:	Elaborate the communication capacity requirements in CPS framework.	(K2)
CO3	:	Illustrate the network topology in CPS.	(K3)
CO4	:	Investigate the operation of communication network in CPS.	(K3)
CO5	:	Determine the physical layer requirements in CPS.	(K3)

TEXT BOOKS

1. Li, H., *Communications for control in cyber physical systems: theory, design and applications in smart grids*, Morgan Kaufmann, 2016.
2. Ferrari, S., and Thomas A, W., *Information-driven Planning and Control*, MIT Press, 2021.

REFERENCE BOOKS

1. Hu, F., *Cyber-physical systems: integrated computing and engineering design*, CRC Press, 2013.
2. Rodrigues, Joel JPC, and Gawanmeh A., *Cyber-Physical Systems for Next-Generation Networks*, IGI Global, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	13	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

STREAM – VI
INTELLIGENT SYSTEMS

(OFFERED BY DEPARTMENT OF ECE)

ECSE21 MOBILE ROBOTS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of mobile robotics.
- To understand the dynamic and kinematic modelling of mobile robots.
- To study the path and motion planning algorithms.
- To gain insights about the SLAM.
- To study the control aspects in mobile robots.

COURSE CONTENTS

UNIT 1: MOBILE ROBOTS: GENERAL CONCEPTS AND SENSORS 08

Introduction to robotics and mobile robotics, Historical developments, Ground robot locomotion, Types of robot drives, Sensor Classification and Characteristics, Position and Velocity Sensors, Distance Sensors, LiDAR, Gyroscope.

UNIT 2: MOBILE KINEMATICS AND DYNAMICS 08

Mobile robot kinematics, Direct and inverse robot kinematics, Homogeneous transformations, Nonholonomic constraints, Nonholonomic Mobile Robots: Unicycle, Differential drive WMR, Universal Omnidirectional WMR Kinematic Modeling, General robot dynamic modelling: Newton-Euler method and Lagrange method, Differential-Drive WMR.

UNIT 3: PATH AND MOTION PLANNING 08

Introduction to robot planning, Path planning for mobile robots, Model-based robot path planning, Configuration Space, Road Map Path Planning Method, Integration of Global and Local Path Planning, Complete Coverage Path Planning, Mobile Robot Motion Planning, Motion Planning Using Vector Fields, Analytic Motion Planning, Mobile Robot Task Planning, Plan Representation and Generation.

UNIT 4: LOCALIZATION AND MAPPING 08

Basic concepts of robot localization, Stochastic modelling, Kalman filtering, and Bayesian estimation techniques, Sensor Imperfections, Relative Localization, Kinematic Analysis of Dead Reckoning, Kalman Filter-Based Localization and Sensor, Calibration and Fusion, Simultaneous Localization and Mapping, EKF, Bayesian estimator, PF SLAM, Omnidirectional Vision-Based SLAM.

UNIT 5: CONTROL OF MOBILE ROBOTS 08

Generic intelligent control architectures, Design Characteristics of Mobile Robot Control Software Architectures, Introduction to and performance evaluation of Two

Mobile Robot Control Software Architectures, Intelligent Human – Robot Interfaces, Case study, Future developments in robotic control.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Characterize the basics of mobile robots.	(K2)
CO2	:	Investigate the kinematic and dynamic modelling of mobile robots.	(K2)
CO3	:	Acquire the concepts of path and motion planning in mobile robotics.	(K3)
CO4	:	Acquire the concepts of localization and mapping in mobile robotics.	(K3)
CO5	:	Acquire the concepts of control of mobile robotics.	(K3)

TEXT BOOKS

1. Tzafestas, S. G, *Introduction to mobile robot control*, Elsevier, 2013.
2. Kagan, E., Shvalb, N., and Gal, I. B., *Autonomous mobile robots and multi-robot systems: Motion-planning, communication, and swarming*, John Wiley & Sons, 2019.

REFERENCE BOOKS

1. Bräunl, T., *Embedded robotics: mobile robot design and applications with embedded systems*, Springer Science & Business Media, 2008.
2. Castellanos, J. A., and Tardos, J. D. *Mobile robot localization and map building: A multisensor fusion approach*, Springer Science & Business Media, 2012.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	14	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE22 MACHINE VISION AND PERCEPTION

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics machine vision and robotic sensors.
- To understand the basics of computer vision.
- To study the concepts of positioning and orientation.
- To gain insights about SLAM.
- To study the role of AI and ML in mobile robots.

COURSE CONTENTS

UNIT 1: ROBOTIC VISION SENSORS **08**

Importance of robot vision, Classification of robotic sensors, Sensor Performance, Common sensors for mobile robots, Computer vision, Concepts of sensor fusion.

UNIT 2: BASICS OF COMPUTER VISION **08**

Fundamentals of Computer Vision: Image accusation and representation, image transformation, filtering, restoration, morphing, Camera Models, Calibration, Single view geometry, Multiple view geometry, Epipolar geometry, RANSAC.

UNIT 3: POSITION AND ORIENTATION **08**

Feature based alignment; Pose estimation; Time varying pose and trajectories, Structure from motion, dense Motion Estimation, Visual Odometry (Semi-direct VO, direct sparse odometry), Bundle Assignment.

UNIT 4: LOCALIZATION AND MAPPING **08**

Initialization, Tracking, Mapping, Geometric SLAM formulations (indirect vs. direct error formulation, Geometry parameterization, Sparse vs. dense model, optimization approach), Relocalization and Map Optimization, Visual SLAM, Examples, Indirect (Feature based) methods (MonoSLAM, PTAM, ORB-SLAM), Direct methods (DTAM, LSD-SLAM), Sensor combinations (IMU, mono vs. Stereo, RGB-Depth), Analysis and parameter studies, multi-sensor perception and sensor fusion.

UNIT 5: RECOGNITION AND INTERPRETATIONS **08**

Concepts of machine learning and deep learning, sequence modelling, learning for robotic vision, Active learning, incremental and class incremental learning identify unknowns, uncertainty estimation, Embodiment for robotic vision, active vision, spatial and temporal embodiment, reasoning for object, scene and scene semantics.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Distinguish between various robotic vision sensors.	(K2)
CO2	:	Generalize the concepts of computer vision.	(K2)
CO3	:	Acquire the concepts of position and orientation using robotics vision.	(K3)
CO4	:	Acquire the concepts of localization and mapping using robotic vision.	(K3)
CO5	:	Examine the applications of AI in robotic vision systems.	(K3)

TEXT BOOKS

1. Dudek, G., and Jenkin, M., "*Inertial Sensors, GPS and Odometry*", In: Springer Handbook of Robotics, Springer, 2008, pp, 477–490.
2. Dahiya, R. S., Valle, M., *Robotic Tactile Sensing*, Springer, 2013.
3. Sonka M., Hlavac, V., and Boyle, R., *Image Processing, Analysis and Machine Vision*, Cengage, 3rd Edition, 2013.

REFERENCE BOOKS

1. Deb S. R., Deb, S., *Robotics Technology and Flexible Automation*, 2nd Edition, McGraw Hill Education, 2017.
2. Wael, A., Revan, M., *Visual Robot Slam of 2D & 3D Indoor Environment*, LAP Lambert Academic Publishing, 2014.
3. Forsyth D. A., and Ponce, J., *Computer Vision, A Modern Approach*, Pearson Education, 2003.
4. Ballard D. H., and Brown, C. M., *Computer Vision*, Prentice Hall, 1982.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE23 PATTERN RECOGNITION AND COMPUTATIONAL INTELLIGENCE

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of pattern recognition and computation intelligence.
- To understand the basics of fuzzy logic.
- To study the artificial immune systems.
- To gain insights about optimization theory.
- To study the basics of evolutionary computing.

COURSE CONTENTS

UNIT 1: INTRODUCTION **08**

Computational intelligence, basic concepts, Relation to Artificial Intelligence, Application of Pattern Recognition, Pattern classification, regression, Polynomial Curve Fitting, Model Selection, Linear Model for Classification, Linear Model for Regression, Curse of Dimensionality, Feature extraction, PCA, feature selection, data visualization, Object Detection, Facial and Voice Detection.

UNIT 2: UNCERTAINTY BASED INFORMATION **08**

Information & Uncertainty, Non-specificity of Fuzzy and Crisp Sets, Fuzziness of Fuzzy Sets, Introduction of Neuro-Fuzzy Systems. Architecture of Neuro Fuzzy Networks, Membership Function, Fuzzy rule generation, Operations on Fuzzy Sets, Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations, Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

UNIT 3: ARTIFICIAL IMMUNE SYSTEM **08**

Natural Immune System, Artificial Immune Models, Clonal Selection Theory Models, Network Theory Models, Network Theory Models.

UNIT 4: OPTIMIZATION THEORY **08**

Basic Ingredients of Optimization Problems, Constrained Optimization, Unconstrained Optimization, Multi-Solution Problems, Multi-Objective Optimization, Dynamic Optimization Problems.

UNIT 5: EVOLUTIONARY COMPUTING **08**

Genetic Algorithm: An Overview, GA in problem solving, Implementation of Genetic Programming, Differential Evolution, Evolution Strategies, Cultural

Evolution, Computational Swarm Intelligence, Particle Swarm Optimization, Multi-objective genetic algorithm.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Infer the basics of pattern recognition and computation intelligence	(K2)
CO2	:	Generalize the concepts of fuzzy logic.	(K2)
CO3	:	Acquire the concepts of artificial immune systems.	(K3)
CO4	:	Acquire the concepts of optimization theory.	(K3)
CO5	:	Acquire the concepts of evolutionary computing.	(K3)

TEXT BOOKS

1. Engelbrecht A., *Computational Intelligence: An Introduction,* 2nd Edition, John Willey and Sons, 2007.
2. Marsland S., *Machine Learning: An Algorithmic Perspective*, 2nd Edition, CRC Press, 2015.

REFERENCE BOOKS

1. Klir G. J, and Yuan B., "*Fuzzy Sets & Fuzzy Logic*", PHI, 1995.
2. Melanie M., "*An Introduction to Genetic Algorithm*", PHI, 1996.
3. Craenen B., Eiben A, *Computational Intelligence*, In: Encyclopedia of Life Support Sciences, EOLSS Publishers Co., 2003.
4. Russell S., Norwig P, *Artificial Intelligence: A Modern Approach*, 3rd Edition, Prentice Hall, 2010.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE24 AUTONOMOUS MOBILE ROBOTS

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of kinematics of mobile robots.
- To understand the basics of perception.
- To study the concepts of positioning.
- To gain insights about simultaneous mapping and localization.
- To gain insights about swarm robotics.

COURSE CONTENTS

UNIT 1: MOBILE ROBOT KINEMATICS **08**

Motion of robotic systems, Key challenges in robotic movement, Legged mobile robots, Wheeled mobile robots, Kinematic models of mobile robots, Mobile robot manoeuvrability, Mobile robot workspace, Motion control of mobile robots.

UNIT 2: PERCEPTION **08**

Sensors for mobile robots: sensor classification, characteristics, motor sensors, heading sensors, ground-based beacons, ranging sensors, motion/speed sensors, vision-based sensors, Uncertainty representation, Feature extraction.

UNIT 3: MOBILE ROBOT LOCALIZATION **08**

Concept of localization, Challenges in localization, Navigation based localization, Belief representation, Map representation, Probabilistic map-based localization, Different types of localizations, Autonomous map building.

UNIT 4: PLANNING AND NAVIGATION **08**

Competences for Navigation: Planning and Reacting, Path planning, Obstacle avoidance, Navigation Architectures, Modularity for code reuse and sharing, Control localization, Techniques for decomposition, Case studies: tiered robot architectures.

UNIT 5: SWARM ROBOTICS **08**

Introduction to swarm robotics and its need, Performance, communication and levels of swarm, Homogeneous and heterogenous swarms, Concepts of aggregation, clustering, dispersion, pattern formation, sorting and self-assembly, Collective construction, transportation and manipulation, Flocking, collective motion, foraging and task scheduling, Heterogenous swarms, Error detection, security and interfacing, Swarm robotics as field robotics.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Characterize the kinematics of mobile robots.	(K2)
CO2	:	Investigate the perception in autonomous robots.	(K2)
CO3	:	Generalize the concept of localization in mobile robotics.	(K3)
CO4	:	Acquire the concepts of navigation in autonomous robots.	(K3)
CO5	:	Acquire knowledge of the swarm robotics.	(K3)

TEXT BOOKS

1. Siegwart, R., Nourbakhsh I. R., and Scaramuzza, D., *Introduction to Autonomous Mobile Robots*, MIT press, 2011.
2. Hamann, H., *Swarm robotics: A formal approach*, Springer, 2018.

REFERENCE BOOKS

1. Choset, H., *Principles of robot motion: theory, algorithms, and implementations*, MIT press, 2005.
2. Lozano-Perez, T., *Autonomous Robot Vehicles*, Springer Science & Business Media, 2012.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	14	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

ECSE25 REINFORCEMENT LEARNING

CREDITS: 03	SE	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To infer the basics of reinforcement learning.
- To understand the basics of Bellman optimality and Monte Carlo methods.
- To study the concepts of function approximation.
- To study the applications of reinforcement learning.

COURSE CONTENTS

UNIT 1: INTRODUCTION TO REINFORCEMENT LEARNING **08**

Basics of neuroscience, Introduction to RL, RL Framework and applications, Immediate RL, Bandit opticalities, Value function-based methods, UCB – 1, Concentration bounds, UCB – 1 theorem, PAC bounds, Median elimination, Thompson sampling.

UNIT 2: MDP MODELLING AND BELLMAN OPTIMALITY **08**

MDP modelling, Bellman equations and optimality proof, Cauchy sequence and Green's equation, Banach fixed point theorem and its convergence proof, LPI convergence, Value and policy iteration, Dynamic programming, Monte Carlo methods, Control in Monte Carlo, Off- policy Monte Carlo, UCT, TD (0) and TD (0) control, Q – learning, Afterstates.

UNIT 3: ELIGIBILITY TRACES AND FUNCTION APPROXIMATION **08**

Eligibility trace and its backward view, Eligibility trace control, Thomson sampling, Function approximation, Linear parametrization, State aggregation methods, Function approximation and eligibility traces, LSTD and LSTDQ, LSPI and Fitted Q.

UNIT 4: POLICY GRADIENT APPROACHES **08**

Policy Approximation and its Advantages, The Policy Gradient Theorem, REINFORCE: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor–Critic Methods, Policy Gradient for Continuing Problems, Policy Parameterization for Continuous Actions.

UNIT 5: APPLICATIONS OF RL AND CASE STUDIES **08**

Case studies: TD – Gammon, Watson's Daily -Double wagering, Optimizing memory control, AlphaGo, Personalized web services, Applications of RL in

healthcare, industries, agriculture, robotics, communication technologies, Future of AI.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Acquire knowledge about the basics of reinforcement learning.	(K3)
CO2	:	Investigate the Bellman optimality and Monte Carlo methods.	(K2)
CO3	:	Generalize the concept of function approximation.	(K3)
CO4	:	Acquire the concepts of policy gradient approaches.	(K3)
CO5	:	Acquire knowledge of the real-life applications of RL.	(K3)

TEXT BOOKS

1. Richard S, and Barto, A. G., *Reinforcement learning: An introduction*, 2nd Edition, MIT Press, 2019.
2. Platt, A., *Reinforcement learning: An introduction*, Springer, 2020.

REFERENCE BOOKS

1. Platt, A., *Deep reinforcement learning*, Springer, 2022.
2. Sugiyama, M., *Statistical reinforcement learning: modern machine learning approaches*, CRC Press, 2015.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO 5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

MANAGEMENT ELECTIVES

HME861 ORGANIZATIONAL BEHAVIOUR

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- Understand organizational behavior which can foster job satisfaction leading towards higher productivity.
- Develop skills like command-and-control mentality, leadership and conflict resolution.

COURSE CONTENTS

UNIT 1: FOCUS AND PURPOSE **08**

Definition, need and importance of organizational behavior, Nature and scope, Frame work, Organizational behavior models.

UNIT 2: INDIVIDUAL BEHAVIOUR **08**

Personality types, Factors influencing personality, Theories, Learning, Types of learners, The learning process, Learning theories, Organizational behavior modification, Misbehavior Types, Management Intervention, Emotions - Emotional Labor, Emotional Intelligence, Theories, Attitudes, Characteristics, Components, Formation, Measurement, Values, Perceptions, Importance, Factors influencing perception, Interpersonal perception, Impression Management, Motivation, importance, Types, Effects on work behavior.

UNIT 3: GROUP BEHAVIOUR **08**

Organization structure, Formation, Groups in organizations, Influence, Group dynamics, Emergence of informal leaders and working norms, Group decision making techniques, Team building. Interpersonal relations, Communication, Control.

UNIT 4: LEADERSHIP AND POWER **08**

Meaning, Importance, Leadership styles, Theories, Leaders versus Managers, Sources of power, Power centres, Power and Politics.

UNIT 5: DYNAMICS OF ORGANIZATIONAL BEHAVIOUR **08**

Organizational culture and climate, Factors affecting organizational climate, Importance, Job satisfaction, Determinants, Measurements, Influence on behavior, Organizational change, Importance, Stability versus Change, Proactive versus Reaction change, the change process, Resistance to change, Managing change, Stress, Work Stressors, Prevention and Management of stress, Balancing work and Life, Organizational development, Organizational effectiveness.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Define organizational behavior and explain various organizational behavior models.	(K2)
CO2	:	Explain and interpret various components of individual behavior and development of learning attitude by understanding the learning theories.	(K2)
CO3	:	Develop effective communication and interpersonal skills and apply the concepts related to group behavior required significantly for the working in team in the organization.	(K3)
CO4	:	Evaluate various leadership styles to inspire and get the things done from others.	(K5)
CO5	:	Analyze various dynamics of organizational behavior to apply healthy working style in competitive environment and manage the stress in personal and professional life.	(K4)

TEXT BOOKS

1. Luthans, F., "*Organizational Behavior: An Evidence-Based Approach*", 12th Edition, McGraw Hill, 2017.
2. Robins, S, P., Judge, T, A., and Vohra, N., "*Organizational Behavior*", 18th Edition, Pearson Education, 2018.

REFERENCE BOOK

1. Pareek, U, and Khanna, S., "*Understanding Organizational Behavior*", 4th Edition, Oxford, 2018.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
CO 2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Score	-	-	-	-	-	-	4	-	9	3	-	2	-	-	-
COM	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**2**	**-**	**-**	**-**

HME862 ENTREPRENEURSHIP DEVELOPMENT

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVE

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

COURSE CONTENTS

UNIT 1: ENTREPRENEURSHIP **08**

Entrepreneur, Types of Entrepreneurs, Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT 2: MOTIVATION **08**

Major Motives Influencing an Entrepreneur, Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test, Stress Management, Entrepreneurship Development Programs, Need, Objectives.

UNIT 3: BUSINESS **08**

Enterprises, Definition, Classification, Characteristics, Ownership Structures, Project Formulation, Steps Involved in Setting up a Business, Identifying, Selecting a Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment, Preparation of Preliminary Project Reports, Project Appraisal, Sources of Information, Classification of Needs and Agencies.

UNIT 4: FINANCING AND ACCOUNTING **08**

Need, Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty, Sales Tax.

UNIT 5: SUPPORT TO ENTREPRENEURS **08**

Sickness in small Business, Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators, Government Policy for Small Scale Enterprises – Growth Strategies in small industry, Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Understand the entrepreneurial mind-set and what it takes to create value.	(K2)
CO2	:	Develop essential knowledge of how to start one's own business.	(K3)
CO3	:	Analyse the business environment in order to identify business opportunities.	(K4)
CO4	:	Learn to secure financial backing and coordinate business growth.	(K1)
CO5	:	Evaluates the effectiveness of different entrepreneurial strategies.	(K5)

TEXT BOOKS

1. Khanka, S. S., "*Entrepreneurial Development*" S, Chand & Co, Ltd., 2013.
2. Donald, F, K., "*Entrepreneurship – Theory, Process and Practice*", 9th Edition, Cengage Learning, 2014.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	3	-	-	3	-	-	-
CO 2	-	-	-	-	-	-	-	3		-	-	3	-	-	-
CO 3	-	-	-	-	-	-	2	-	-	-	-	3	-	-	2
CO 4	-	-	-	-	-	-	-	-	-	-	3	3	-	-	3
CO 5	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-
Score	-	-	-	-	-	-	2	3	3	-	6	15	-	-	5
COM	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**-**	**3**	**3**	**-**	**-**	**3**

HME863 E-COMMERCE AND DIGITAL MARKETING

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To identify several factors and web store requirements needed to succeed in e-commerce.
- To understand the main technologies behind e-commerce systems and how these technologies interact.
- To define various electronic payment types and associated security risks and the ways to protect against them.

COURSE CONTENTS

UNIT 1: ELECTRONIC COMMERCE **08**

Frame work, anatomy of E-Commerce applications, E- Commerce Consumer applications, E-Commerce organization applications, Consumer Oriented Electronic commerce, Mercantile Process models.

UNIT 2: ELECTRONIC PAYMENT SYSTEMS **08**

Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems, Inter Organizational Commerce – EDI, EDI Implementation, Value added networks.

UNIT 3: INTRA ORGANIZATIONAL COMMERCE **08**

Work Flow, Automation Customization and internal Commerce, Supply chain management.

UNIT 4: DIGITAL MARKETING **08**

Introduction, email marketing, social media marketing, Facebook, Twitter, LinkedIn, mobile marketing, web analytics.

UNIT 5: SEARCH ENGINE OPTIMIZATION **08**

Introduction, SEO- white hat, black hat, tools for SEO, Pay per click.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Explain various E-commerce applications related to organization and the consumer usability.	(K2)
CO2	:	Explain various electronic payment systems and inter-organizational commerce for various commercial applications.	(K2)
CO3	:	Explain intra-organizational commerce for workflow through automation customization and supply chain management.	(K2)
CO4	:	Create and evaluate various digital marketing solutions for various commercial applications.	(K6)
CO5	:	Develop solutions for promotional and e-commercial activities through search engine optimization keeping in view the ethical practices.	(K6)

TEXT BOOKS

1. Schneider, G, P., "*Electronic Commerce*", Cencage learning publishers, 10th Edition, 2012.
2. Chan, H., Lee, R., Dillon, T., and Chang, E., "*E-Commerce Fundamentals and Applications*", Wiley, 1st Edition, 2007.

REFERENCE BOOKS

1. Kalakata, "*Frontiers of Electronic Commerce*", Pearson, 1st Edition, 2002.
2. Dodson, I., "*The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns*", 1st Edition, Wiley 2016.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 3	-	-	-	-	-	-	-	-	3	-	-	3	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 5	-	-	-	-	-	-	-	3	3	-	-	3	-	-	2
Score	-	-	-	-	-	-	-	3	7	-	-	15	-	-	2
COM	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**2**

HME864 USABILITY ANALYSIS

CREDITS: 03	GIR	LTPC: 3 – 0 – 0 – 3

COURSE OBJECTIVES

- To understand the concept of usability analysis.
- To analyze the usability requirements to succeed in e-commerce.
- To introduce students to the techniques being used for web usability.

COURSE CONTENTS

UNIT 1: USABILITY ANALYSIS **08**

Concept of usability analysis, Advantages of usability analysis, Framework of usability analysis, Models of usability evaluation, System quality, Information quality, Service quality, Application of usability analysis in e-commerce, and web-design.

UNIT 2: USABILITY AND CUSTOMER RETENTION IN E-COMMERCE **08**

Usability measures in e-commerce, User-interface architecture, Customer conversion, Customer satisfaction and retention in business-to-business e-commerce and business to consumer e-commerce.

UNIT 3: WEB USABILITY **08**

Introduction, Dimensions of web usability, Web usability criteria, Principles and evaluation methods, Serviceability, Learnability, Simplicity, Efficiency, Control, Customer relationship management.

UNIT 4: WEB DESIGN OPTIMIZATION **08**

Web analytics, Web design errors, Web design conventions, Design features to promote usability, Search engine optimization.

UNIT 5: USABILITY TESTING **08**

Process of usability testing, Elements and techniques of usability testing, Comparative and explorative usability testing, Qualitative and quantitative usability testing, System usability scale (SUS), Heuristic evaluations.

Total Periods: 40

COURSE OUTCOMES

After the completion of this course, students will be able to:

CO1	:	Understand the advantages and be able to distinguish between good and poor human – computer interaction design.	(K2)
CO2	:	Understand the way of retaining customers with their changing attitudes and behaviours.	(K1)
CO3	:	Understand the different internet and social media uses on today's society in context to e-commerce.	(K2)
CO4	:	Analyse web interaction design activities to integrate into the wider product development lifecycle.	(K4)
CO5	:	Evaluates the effectiveness of usability testing and basics of experimental design.	(K5)

TEXT BOOKS

1. Travis, D., "*E-Commerce Usability: Tools and Techniques to Perfect the On-Line Experience*", Taylor and Francis, 2nd Edition, 2017.
2. Steve, K., "*Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability*", Pearson Education, 3rd Edition, 2014.

CO TO PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO 3	-	-	-	-	-	-	-	3	-	-	-	3	-	-	2
CO 4	-	-	-	-	-	-	-	3	-	2	-	3	-	-	3
CO 5	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Score	-	-	-	-	-	-	-	9	-	2	-	15	-	-	5
COM	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**3**	**-**	**-**	**3**

COURSE OUTCOME SURVEY FROM

Date : ___/___/_____

COURSE CODE : _____

COURSE NAME : _____

YEAR/SEMESTER : _____

FACULTY : _____

S, No,	Your satisfaction on the following statements	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
1	Faculty has made the subject interesting				
2	Faculty is enthusiastic about what is taught				
3	Faculty is good at explain things				
4	The course is well organized				
5	The course is intellectually stimulating				
6	Any changes in the course or teaching have been communicated effectively				
7	The criteria used in assessment have been clearly stated in advance				
8	Assessment and marking have been fair				
9	I have been able to contact faculty when I needed to				
10	I have received detailed comments on my work				
11	I have received sufficient advice and support from the faculty for my studies				
12	I have been able to access general IT resources when I needed to				
13	My communication skills have improved				
14	Feedback on my work has been prompt				
15	Feedback on my work has helped me clarify things I did not understand				
16	As a result of the course, I feel confident in tackling problems related to this course				
17	Overall, I am satisfied with the quality of the course				

Signature of Student

COURSE OUTCOME SURVEY FROM

(FOR FINAL YEAR B.TECH. STUDENTS)

Date : ___/___/_____

1. COURSE OUTCOMES

Overall, Your satisfaction on the following statements:	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
How current the content is in most subjects in your courses?				
How interesting the teaching is in most subjects in your courses?				
The variety of courses offered in your program.				
How helpful and accurate the academic advising is in your course?				
How helpful and accurate the career counselling is in your program?				
How challenging the work is intellectually in most courses in your program?				
The overall educational experience in your program.				

2. ABOUT FACULTY

To what extent do you agree or disagree with the following statements:	Strongly Agree	Agree	Disagree	Strongly Disagree
Faculties are good at explaining things.				
Faculties are good at motivating me to do my best work.				
Faculties normally give me helpful feedback on how I am doing.				
Faculties give feedback promptly.				
Faculties work hard to make the subjects Interesting.				
Faculties grading method are fair.				
Faculties treat students with respect.				
Faculties are available when I need them.				
Course objectives are clear in most courses.				
Course objectives are met in most courses.				

3. TEACHING AND LEARNING ENVIRONMENT

What extents are you satisfied with the following aspects of the teaching and learning environment?	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Intellectual stimulation of most courses.				
Amount of work required in most courses.				
Relevance of lab/practical classes.				
Group work for assignments.				
Level of class interactions in most courses.				
Course content in most courses.				
Assistance from most faculty outside of class.				
Library access to reading materials.				
Opportunities to be involved with other students outside of class.				
Being informed about things in the department.				

4. SKILL DEVELOPMENT

What extent does your coursework in your major improve the following skills?	Strongly Agree	Agree	Disagree	Strongly Disagree
Communication skills				
Writing skills				
Interpersonal relationship skills				
Self-reliance skills				
Decision-making skills				
Ability to execute plans				
Ability to work in groups on projects				
Leadership skills				
Analytical skills				
Research skills				
Making logical judgements				
Producing independent work				
Understanding my strengths and weaknesses				

Achieving personal goals				
Achieving career goals				
My education from IIITU is important to me				

5. PROFESSIONAL ETHICS

What extent do you agree or disagree with the following statements	Strongly Agree	Agree	Disagree	Strongly Disagree
I show respectful behavior toward faculty and other students in most of my classes.				
I actively participate in most class discussions.				
I usually attend my classes.				
I usually read the text or other readings prior to class.				
I study extensively for exams and quizzes.				
I study a few days before the cycle tests/ end semester exam.				
I complete all course assignments as explained in syllabus.				
I ask for help from most of my faculty when I need it.				
I am motivated to learn course materials.				
I care about what grade I will receive in most courses.				

Signature of Student

ALUMNI SURVEY FROM

(ASSESSMENT OF OUTCOMES – B.TECH. (ECE)) **Date : ___/___/_____**

Name : _____ **Year of Graduation :**_____

Organization : _____

Address : _____

Email : _____ **Phone :** _____

Overall, are you satisfied with:	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Demonstrate basic knowledge in mathematics, science, engineering, and humanities.				
Define the problems and provide solutions by designing and conducting experiments, interpreting and analyzing data, and reporting the results.				
Demonstrate the ability to design Computer Science and Engineering systems.				
Ability to participate as members of multidisciplinary design teams along with mechanical, electrical, and other engineers.				
Understand quantitative modelling and analysis of a broad array of systems-level techniques to identify, formulate and solve ECE problems.				
Broadly educated and will understand ethical responsibilities.				
Proficient in English language in both communicative and technical forms.				
Awareness to apply engineering solutions in global, national, and societal contexts.				
Capable of self-education and clearly understand the value of updating their professional knowledge to engage in life-long learning.				
Demonstrate the ability to apply advanced technologies to solve contemporary and new problems.				
Demonstrate the ability to choose and apply appropriate resource management techniques.				

Signature of Alumnus

EMPLOYER/SCHOLAR SURVEY FROM

B.TECH. (ECE) IIIT Alumni **Date : ___/___/___**

Name of B.Tech. (ECE) IIITU Alumni : _____

Batch : 20____ to 20____ **Job Spec of Alumni :** _____

Name of the Assessor: _____

Designation : _____

How do you rate the current potential of IIITU ECE alumni working in your organization on the following criteria	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Application of mathematical foundations.				
Application of computer science theory and algorithmic principles.				
Application of modeling and design of computer- based systems.				
Application of engineering knowledge in their domain. Domain: Health care/ Banking/ Finance/ Medical/ Law/ Others Others, specify:				
Design and conduct of experiments and to analyze and interpret data.				
Analyze the problem, subdivide into smaller tasks with well-defined interface for interaction among components.				
Complete the project (given task) within the specified time frame and financial constraints.				
Proposal of original ideas and solutions.				
Design, implement, and evaluation of hardware/ software systems with security features.				
Design, implement, and evaluation of hardware/ software systems with assured quality and efficiency.				
Effective communication of engineering solution to peers and leads.				
Effective communication of engineering solution to customers and users.				
Understanding of contemporary issues.				
Engagement in lifelong learning.				

Signature of Assessor

TIME TABLE

Day \ Period	Period – I 08:30 AM – 09:20 AM	Period – II 09:20 AM – 10:10 AM	10:10 AM – 10:30 AM	Period – III 10:30 AM – 11:20 AM	Period – IV 11:20 AM – 12:10 PM	12:10 PM – 01:30 PM	Period – V 01:30 PM – 02:20 PM	Period – VI 02:20 PM – 03:10 PM	Period – VII 03:10 PM – 04:00 PM	Period – VIII 04:00 PM – 04:50 PM
Monday			BREAK			LUNCH BREAK				
Tuesday										
Wednesday										
Thursday										
Friday										

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COURSE ENROLMENT FORM

This form has to be submitted, on the day of Registration of Courses, First working day of the odd/even semester, attaching the proof for fee payment.

Date:____/ /_____

Student Name: _____

Roll No.:_____Program: _____ Branch: ECE

Academic Year: _____Semester: _____

S, No,	Course Code	Course Name	Credits
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

FEES PAYMENT DETAILS:

Date of Payment	Bank Name	Transaction/ DD Number	Amount	Is proof of payment attached

Encl.: Proof of Payment details


भारतीय सूचना प्रौद्योगिकी संस्थान, ऊना
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