DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND SYLLABUS

IIITUGCSE22

2022-2023

SCHOOL OF COMPUTING

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA

HIMACHAL PRADESH

B. Tech. Curriculum and Syllabus

Computer Science and Engineering

Batch 2022-2026

IIITUGCSE22

SCHOOL OF COMPUTING

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH

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History of School of Computing

Program	Description
UG in B.Tech. (Computer Science and Engineering)	Started with 30 seats in 2014. Intake increased to 66 in 2020.
UG in B.Tech. (Information Technology)	Started with 40 seats in 2017. Intake increased to 44 in 2020. Intake increased to 66 in 2022.

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 Computing Vision and Mission

School of Computing Vision:

To become a center of excellence in emerging areas and train students to become professionals solving challenging societal problems.

School of Computing Mission:

M1: To impart state-of-the-art knowledge in computer science and information technology with emphasis on practical knowledge and to promote specialization in emerging streams.

M2: To participate in research and development in industries and research organizations.

M3: To make the students aware of ethics and apply them in solving social problems.

B Tech. in CSE

Program Educational Objective (PEO):

PEO1 Career: To ensure that the graduates will work in renowned industries/research organizations, pursue higher education, or become entrepreneurs.

PEO2 Professionalism: To ensure that the graduates will apply professional ethics and demonstrate their ability to solve socially relevant problems in multidisciplinary contexts.

PEO3 Innovation: To ensure that graduates will have the ability to create innovative software products, and an attitude in adapting to emerging technological changes.

PEO to Mission Mapping:

Mission / PEO	M1	M2	M3
PEO1	3	3	1
PEO2	3	2	3
PEO3	2	2	3

PEO	Mission	Mapping Level	Justification
PEO1	**M1**	3	Mapped strongly as student state of the art knowledge is required for a successful career.
	M2	3	Mapped strongly as student participation in research and development is required for a successful career.
	M3	2	Mapped moderately as the students' needs to aware of ethics and apply them in social problems.
PEO2	**M1**	2	Mapped moderately as student state of art and practical knowledge is required for a professionalism.
	M2	3	Mapped strongly as student participation state of the art knowledge is required for a successful career.
	M3	2	Mapped moderately as student participation state of the art knowledge is required for a successful career.
PEO3	**M1**	3	Mapped strongly as student state of the art knowledge is required for a life-long learning.
	M2	3	Mapped strongly as student participation in research and development is required for a life-long learning.
	M3	2	Mapped moderately as student participation state of the art knowledge is required for a life-long learning.

Program Specific Outcome (PSO):

PSO1: To identify and formulate computational problems and solve them by applying software engineering principles.

PSO2: To identify and capitalize opportunities in the areas of Artificial Intelligence and Computer Networks and become a successful entrepreneur.

PSO3: To design robust innovative solutions incorporating security aspects using open-source technologies within the ambit of ethical and social norms.

PO/ PSO to PEO Mapping

		PEO1 Career	PEO2 Professio-nalism	PEO3 Innovation
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 identify and formulate computational problems and solve them by applying software engineering principles	3	2	3
PSO2	To identify and capitalize opportunities in the areas of Artificial Intelligence and Computer Networks and become a successful entrepreneur	2	3	2
PSO3	To design robust innovative solutions incorporating security aspects using open-source technologies within the ambit of ethical and social norms	1	2	3

Design of Curriculum

The B.Tech. Course Curriculum has been designed conforming to the recommendations of 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 CSE	The student should be employable as Technical Assistant CSE in any industry/organization.
2.	Second Exit	After completion of Second year.	Diploma in CSE	The student should be employable as Technician CSE in any industry/organization.
3.	Third Exit	After completion of Third year.	BS in CSE	The student should be employable as Technical Supervisor CSE in any industry/organization.
4.	Normal Exit	After completion of Fourth year.	B. Tech. in CSE	The student should be employable as Engineer CSE in any relevant industry/organization.

II. Multiple Entry 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 CSE/IT/ECE from our institute.
3.	Third Entry	V-Sem. of the program	The successful completion of diploma in CSE/IT/ECE from our institute.
4.	Fourth Entry	VII-Sem. of the program	The successful completion of BS in CSE/IT/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. The Academic Bank of Credits will be maintained.

Curriculum consists of the underlying components of study:

1. General Institute Requirements (GIRs)

This group of courses contain the basic subjects which all undergraduate students must complete.

2. Program Core (PC)

The PC consist of 11 courses out of which 8 courses comprise labs. All the PC subjects will be covered in first two years which covers almost the GATE syllabus.

3. Program Elective (PE)

The total number of 4 PE will be offered in V and VII semester. Student will have to choose one out of two subjects as per their choice.

4. Stream Electives (SE)

The stream electives are grouped into two streams. The following are the streams offered by CSE Department:

1. Artificial Intelligence and Machine Learning
2. Database and Networking

Besides the above-mentioned streams, students are also free to opt the stream electives offered by other departments. The electives are offered in V, VII and VIII semesters. If the student desires to specialize in any of the given stream, student can select the course in V, VII and VIII semesters from the specified stream respectively.

5. Internship (IN)

In VI semester, the students are given the opportunity to experience the industrial ambience through a minimum of five months Internship (IN). Internship may be carried out in industries and premier academic institutions in this semester. Students are also encouraged to do internship in abroad.

6. Practicum (PM)

This is a semester project work included in I, II, III and IV semesters. The practical course constitutes reverse engineering and a minor project work based on the concurrently studied theory in that semester.

7. Project Work (PW)

The project work is designed for a total duration of three semesters (V, VII and VIII) as a single project involving detailed literature survey, implementation and experimentation plan.

8. Online Courses (OC)

- **Honors 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.

- **Optional Online Courses**
  This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfill 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.

9. L-T-P-C Notation

L-T-P-C => Lecture-Tutorial-Practicum/Practical-Credit.

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.

10. Grading Criteria

1. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades. All assessments 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', 'I', 'L' and 'R' with the credit points of '10', '9', '8', '7', '6', '5', '0', '0', and '0' respectively.
3. The cut-off mark for completion of a course shall be calculated as $\frac{\bar{x}}{2}$, where 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.

11. Highlights of Curriculum

The students will study the curriculum with the following features:

- More Practical Oriented Teaching and Learning.
- More hands-on Projects.
- Stream Oriented Specialization.
- Multi-Disciplinary Electives/ Projects.
- Relative Grading.

- Soft Skill Enhancement.
- Overall Personality Development.
- Employable Graduates for Industries.
- Excellent Placements.

Curriculum Components

S. No.	Category	Total Credits	%age of Credits
1.	General Institute Requirements Theory (GIR-T)	31	19
2.	Program Core Theory (PC-T)	35	22
3.	Program Elective Theory (PE-T)	12	08
4.	General Institute Requirements Lab (GIR-L)	14	09
5.	Program Core Lab (PC-L)	16	10
6.	Program Elective Lab (PE-L)	06	04
7.	Stream Electives (SE)	15	09
8.	Practicum (PM)	12	08
9.	Internship (IN)	00	00
10.	Project Work (PW)	18	11
	Total	**159**	**100**

The curriculum consists of 58% of Theory and 42% of Practical work.

B.Tech. (CSE) Subjects

General Institute Requirements (GIRs)

S. No.	Subjects
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.	Basic Electrical and Electronics Engineering*
10.	Electronics/ Computer/ IT Workshop
11.	Internship
12.	Project Work
13.	Technical Clubs/Sports/Cultural/Yoga/NCC/NSS
14.	Industrial/Expert Lectures

*Includes Lab

Program Core (PC)

S. No.	Subjects
1.	Discrete Structures
2.	Data Structures and Algorithms*
3.	Computer Organization*
4.	Digital Systems Design*
5.	Automata and Formal Languages
6.	Operating Systems*
7.	Object Oriented Programming*
8.	Database Management Systems*
9.	Computer Networks*
10.	Design and Analysis of Algorithms

*Includes Lab

Online Courses (OC)

S. No.	Honors/Optional Courses	Credits
1.	Honors Online Courses (4 Courses)	12
2.	Optional Online Courses (4 Courses)	0-12*
	***Based on number of courses and credits audited.**	

Program Electives (PE)

S. No.	Subject
1.	Principles of Compiler Design*#
	Software Engineering*
2.	Microprocessors and Interfacing*#
	Software Maintenance*
3.	Advanced Operating Systems*
	Advanced Computer Networks*
4.	Parallel Architectures and Programming
	Digital Image Processing

* Includes Lab # GATE Subjects

Stream Electives (SE)

S. No.	Streams	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 ELECTIVE–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	DBMS
5.	ITSE15	Computer Vision	Probability and Random Processes, Linear Algebra, DIP

STREAM ELECTIVE–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 ELECTIVE–III: Database and Networking			
S. No.	**Course Code**	**Course Name**	**Expected Prior Study**
1.	CSSE21	Relational Database Management Systems	DBMS
2.	CSSE22	Advanced Database Management Systems	DBMS
3.	CSSE23	Database Security	ADBMS, Computer Networks
4.	CSSE24	Mobile Computing and Communication	Computer Networks
5.	CSSE25	Wireless Sensor Networks	Computer Networks

STREAM ELECTIVE–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, Principles of Cryptography, Graph Theory
5.	ITSE25	Cyber Physical Systems	--

STREAM ELECTIVE–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	Data communication and networks, Communication systems, Communication theory, Embedded systems.
4.	ECSE14	Principles of Cyber Physical Systems	Data communication and networks, Communication systems, Communication Theory, Control systems.
5.	ECSE15	Communication in Cyber Physical Systems	Data communication and networks, Communication systems, Communication theory, Control systems.

STREAM ELECTIVE–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	Control Systems, Embedded systems.
5.	ECSE25	Reinforcement Learning	Artificial neural networks, Probability, Linear algebra.

Semester-wise Stream Electives

Stream Elective–I (V Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE11	Mobile Applications Development	Applications
2.	CSSE11	Machine Learning	AI 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

Stream Elective–II (VII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE12	Cloud Computing	Applications
2.	CSSE12	Deep Learning	AI 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

Management Elective (VII Semester)		
S. No.	**Course Code**	**Course Name**
1.	HME731	Organizational Behavior
2.	HME732	Entrepreneurship Development
3.	HME733	E-commerce and Digital Marketing
4.	HME734	Usability Analysis

Stream Elective–III (VIII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE13	Internet of Things	Applications
2.	CSSE13	Artificial Intelligence	AI 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 (VIII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE14	Big Data Analytics	Applications
2.	CSSE14	Soft Computing	AI 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 (VIII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE15	Computer Vision	Applications
2.	CSSE15	NLP with Deep Learning	AI and Machine Learning
3.	CSSE25	Wireless Sensor Networks	Database and Networking
4.	ITSE25	Cyber Physical Systems	Security
5.	ECSE15	Communication in Cyber Physical Systems	Cyber Physical Systems
6.	ECSE25	Reinforcement Learning	Intelligent Systems

Semester-wise Curriculum

I Semester						
S. No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	MAC111	Engineering Mathematics	3	1	0	4
2.	CYC102	Engineering Chemistry	2	0	4	4
3.	EEC103	Basic Electrical and Electronics Engineering	3	0	4	5
4.	BIC104	Introduction to Biotechnology	3	0	0	3
5.	CSL105	Computer Workshop	0	0	4	2
6.	CSL106	Practicum-I	0	0	6	3
		Total	**11**	**1**	**18**	**21**
		Total Hours	**30**			

II Semester						
S. No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	MAC211	Probability and Random Process	3	1	0	4
2.	PHC202	Engineering Physics	3	0	4	5
3.	CSC203	Basics of Programming in C	3	0	4	5
4.	ENC204	Communication Skills	3	0	4	5
5.	EVC205	Basic Environmental Science and Engineering	3	0	0	3
6.	CSL206	Practicum-II	0	0	6	3
		Total	**15**	**1**	**18**	**25**
		Total Hours	**34**			

III Semester						
S.No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CSC301	Discrete Structures	3	0	0	3
2.	CSC302	Data Structures and Algorithms	3	0	4	5
3.	CSC303	Computer Organization	3	1	4	6
4.	CSC304	Digital Systems Design	3	1	4	6
5.	CSC305	Automata and Formal Languages	3	1	0	4
6.	CSL306	Practicum-III	0	0	6	3
		Total	**15**	**3**	**18**	**27**
		Total Hours	**36**			

IV Semester						
S.No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CSC401	Database Management Systems	3	1	4	6
2.	CSC402	Design and Analysis of Algorithms	3	1	0	4
3.	CSC403	Operating System	3	0	4	5
4.	CSC404	Computer Networks	3	0	4	5
5.	CSC405	Object Oriented Programming	3	0	4	5
6.	CSL406	Practicum-IV	0	0	6	3
		Total	**15**	**2**	**22**	**28**
		Total Hours	**39**			

V Semester						
S.No.	**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	Stream Elective-I	3	0	0	3
4.	ENL511	Professional Communication and Soft Skills	0	0	4	2
5.	CSL502	Computational Tools and Techniques	0	0	4	2
6.	CSL503	Project Phase-I	0	0	6	3
7.	CSO504	Honors Online Course-I*	5	1	0	3
		Optional Online Course-I*	5	1	0	0-3
Total			**9**	**0**	**22**	**20**
Total Hours			**31**			

VI Semester						
S.No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CSL601	Internship	0	0	40	0
2.	CSO602	Honors Online Course-II*	5	1	0	3
		Optional Online Course-II*	5	1	0	0-3
Total			**0**	**0**	**40**	**0**
Total Hours			**40**			

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

VII Semester						
S.No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	HMC701	Professional Ethics	1	0	0	0
2.	XXXXXX	Program Elective-III	3	0	4	5
3.	XXXXXX	Program Elective-IV	3	0	0	3
4.	XXXXXX	Stream Elective-II	3	0	0	3
5.	HME7XX	Management Elective	3	0	0	3
6.	CSL702	Project Phase-II	0	0	12	6
7.	CSO703	Honors Online Course-III*	5	1	0	3
		Optional Online Course-III*	5	1	0	0-3
Total			**13**	**0**	**16**	**20**
Total Hours			**29**			

VIII Semester						
S.No.	**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.	CSL801	Project Phase-III	0	0	18	9
5.	CSO802	Honors Online Course-IV*	5	1	0	3
		Optional Online Course-IV*	5	1	0	0-3
Total			**9**	**0**	**18**	**18**
Total Hours			**27**			

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

Summary

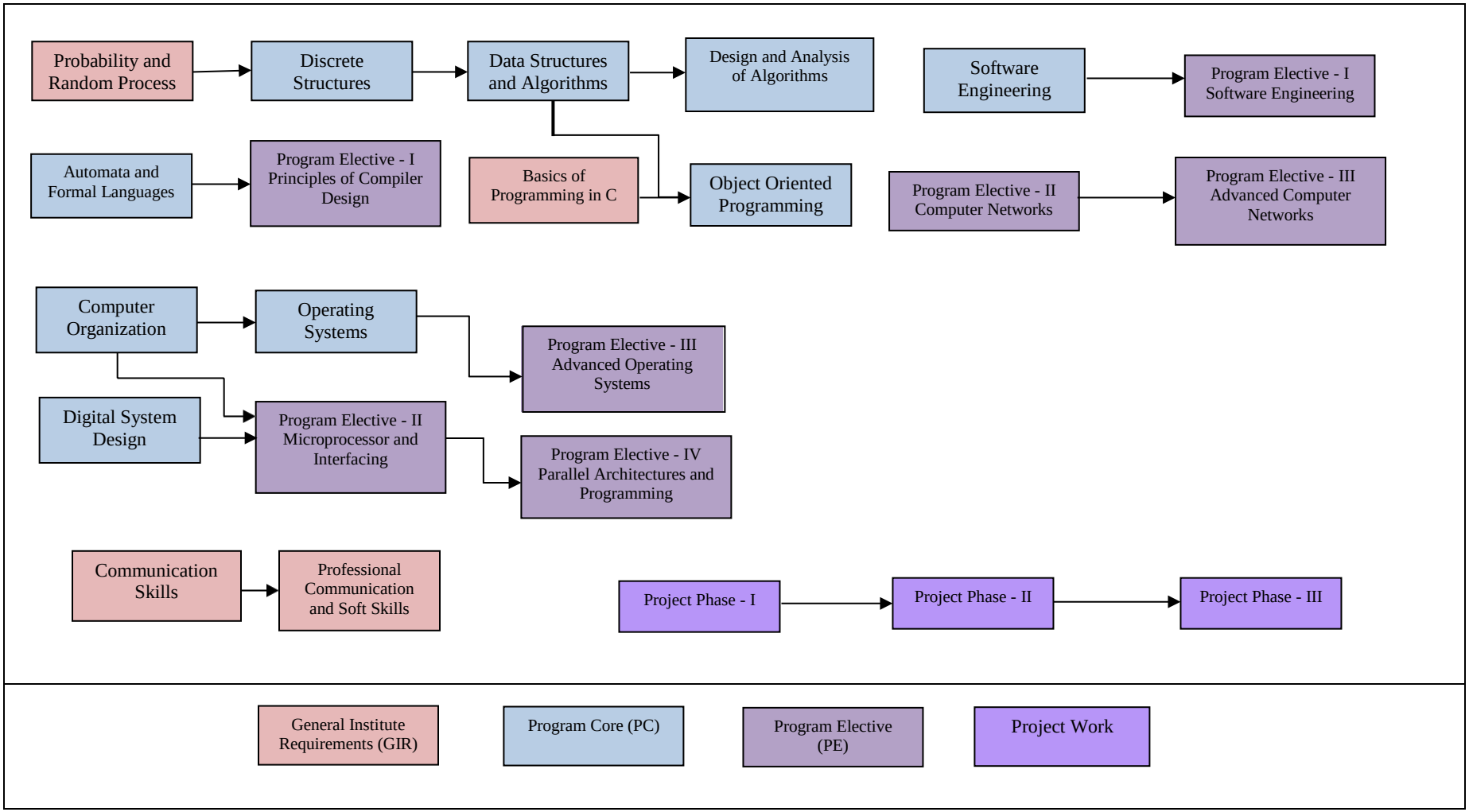
Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	21	25	27	28	20	00	20	18	**159**

STUDY CHART

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Semester VII	Semester VIII
Engineering Mathematics	Probability and Random Process	Discrete Structures	Database and Management Systems	Professional Communication and Soft Skills	Internship	Professional Ethics	Stream Elective - III
Engineering Chemistry	Engineering Physics	Data Structures and Algorithms	Design and Analysis of Algorithms	Computational Tools and Techniques Lab		Management Elective	Stream Elective - IV
Basic Electrical and Electronics Engineering	Basic of Programming in C	Computer Organization	Operating Systems	(Program Elective: I) 1.Principles of Compiler Design 2.Software Engineering		(Program Elective: III) 1.Principles of Compiler Design 2.Software Engineering	Stream Elective - V
Introduction to Biotechnology	Communication Skills	Digital System Design	Computer Networks	(Program Elective: II) 1.Microprocessor and Interfacing 2.Software Maintenance		(Program Elective: IV) 1.Principles of Compiler Design 2.Software Engineering	
Computer Workshop	Basic Environmental Science and Engineering	Automata and Formal Languages	Object Oriented Programming	Stream Elective - I		Stream Elective - II	
Practicum (PM) - I	Practicum (PM) - II	Practicum (PM) - III	Practicum (PM) - IV	Project Phase - I		Project Phase - II	Project Phase - III

General Institute Requirements (GIR) | Program Core (PC) | Program Elective (PE) | Stream Elective (SE) | Practicum (PM) | Internship | Project Work

DEPENDENCY-CHART



B. TECH. (CSE)

SYLLABUS

FIRST SEMESTER

Course Code	**MAC111**
Course Title	**Engineering Mathematics**
Number of Credits	**3-1-0-4**
Course Type	**GIR**

Course Objectives

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

Course Content:

Unit-I Matrices **8**

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-II Infinite Series **8**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, Comparison test, D'Alembert'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-III Elementary calculus **8**

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

Unit-IV Vector Spaces **8**

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

Unit-V Linear Transformations **8**

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.

Total Periods: 40

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. and 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.
3. K. Hoffman and R. Kunze, "*Linear Algebra*", Prentice Hall, 2008.

Reference Books

1. G. Strang, "*Linear Algebra and its Applications*", 4th Edition, Thomson, 2006.
2. Wilfred Kaplan, "*Advanced Calculus*", Pearson, 2003.
3. 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**

Course Code	**CYC102**
Course Title	**Engineering Chemistry**
Number of Credits	**2-0-4-4**
Course Type	**GIR**

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.

Course Content:

Unit-I Water and its Treatment **8**

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-II Polymer and Composites **8**

Introduction, functionality, classification, mechanism of polymerization, molecular weight, structure property relationship, molding techniques, synthesis, properties and application of commercially important polymers, conducting polymers, Composites: Introduction classification, constituents, advantages and applications.

Unit-III Engineering Materials **8**

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-IV Characterization Techniques **8**

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.

LAB EXPERIMENTS

1. Volumetric Analysis (Titrations):

i. To determine the total hardness of the given hard water using EDTA titration method to estimate of total.
ii. To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method.
iii. To determine the strength of given solution of Mohr's salt.
iv. To estimate amount of chlorine present in given sample of bleaching powder.

v. To determine free residual chlorine in sample water by iodometric titration.
vi. To determine the Cu present in given brass sample by iodometrically.
vii. To determine the iron content in the given salt by using external indicator.

2. Colorimetric Analysis:

i. To determine free residual chlorine content in given water sample.
ii. To estimate ferric ions in aqueous solution using thiocyanate solution.
iii. To find out the concentration of given $KMnO_4$ solution spectrophotometrically.
iv. To estimate the amount of ferrous iron present in the given sample of cement by colorimetry using ammonium thiocyanate as the reagent.
v. To determine the concentration of Cr in unknown solution of $K_2Cr_2O_7$ using calibration curve method.

3. Physical Chemistry:

i. To determine the strength of an acid by pH –metric method.
ii. To determine the strength of hydrochloric acid solution by titrating against sodium hydroxide solution conductometrically.
iii. To identify given unknown liquid by surface tension measurement using Stalagmometer.
iv. To identify given unknown liquid by viscosity using Ostwald viscometer.
v. To determine the viscosity coefficient of the given polymer PEG and find out the composition of unknown solution. To separate the mixture of amino acids by thin layer chromatography.

4. Lubricant Analysis:

i. To determine the flash point and fire point of given lubricant using Abel's/Pensky Martin closed cup apparatus.
ii. To determine the acid value of a given oil/fat sample.

5. Organic Synthesis:

i. To prepare polymer of Bakelite.
ii. To prepare urea formaldehyde resin.
iii. To prepare a pure sample of Aspirin.

Total Periods: 32 + 48 = 80

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. Dara, S. S. and Umare, S. S., "*A Text Book of Engineering Chemistry",* S. Chand Publishing, 2011.
2. Poole, Jr, Charles, P., and Frank J. Owens., "*Introduction to nanotechnology"*, John Wiley and Sons, 2009.

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
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	2	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
Score	15	10	-	15	-	5	2	-	-	-	-	-	4	-	3
COM	3	2	-	3	-	3	2	-	-	-	-	-	2	-	3

Course Code	**EEC103**
Course Title	**Basic Electrical and Electronics Engineering**
Number of Credits	**3-0-4-5**
Course Type	**GIR**

Course Objectives

- To learn the problem-solving techniques in RLC circuits and power measurements.
- To learn the fundamentals of alternating current and direct current machinery.
- To study the characteristics and use of PN junction diode and Zener diode.
- To study the various configurations of NPN and PNP transistors and their applications.
- To understand the JFET characteristics and its use as an amplifier.

Course Content:

Unit-I Electrical Circuits **8**

Kirchoff's Laws: KVL and KCL, Nodal and Mesh analysis, delta to wye and wye to delta transformations, RL, RC, and RLC circuits, sinusoids, AC fundamentals, self and mutual inductances, and energy in coupled circuit.

Unit-II Network Theorems **8**

Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem, Maximum power transfer theorem, Compensation theorem, Tellegen's theorem, and their applications.

Unit-III Semiconductor Diodes **8**

Operation of p-n junction diodes, Rectifier circuits, Zener diode and its characteristics, Zener diode as voltage regulator.

Unit-IV Bipolar Junction Transistor (BJTs) **8**

Simplified structure, operation of n-p-n and p-n-p transistors, BJT as an amplifier and as a switch, Input and Output Characteristics of CE, CB, and CC configurations.

Unit-V Junction Field Effect Transistor (JFET) **8**

Structure, Basic operation, Drain and Transfer Characteristics, JFET as an Amplifier and as a Switch. Comparison of BJT and FET.

LAB EXPERIMENTS

1. To calibrate a given wattmeter by direct loading, verify ohm's law for BPLL element, calibrate a voltmeter & ammeter, calibrate a single-phase energy meter by direct loading.
2. To verify the Kirchoff's laws.
3. To verify network theorems, polarity test, voltage ratio test, open circuit test, short circuit test, load test on single phase transformer.
4. To study DSO, Function generator, Multimeter, and DC power supply.
5. To observe the V-I characteristics of PN Junction and Zener diode.
6. To study the half-wave and full-wave rectifier circuits without and with capacitor filter.
7. To observe the input and output characteristics of a transistor, DC biasing the transistorin common- emitter configuration and determine its operating point (i.e., various voltages and currents).
8. To draw the Transfer and Drain Characteristics of JFET.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Apply the various laws and methods to solve the electrical problems.	(K2)
CO2	:	Apply different network theorems to find the current and voltage in every branch of a given circuit.	(K3)
CO3	:	Explain various semiconductor diodes to develop an electronic circuitry.	(K2)
CO4	:	Develop different circuits using the BJT for various applications.	(K3)
CO5	:	Make use of different types of FETs for developing an amplifier.	(K3)

Text Books

1. Charles, K.A. and Sadiku, N.O., "Fundamental of Electric Circuits", Tata Mc-Graw Hill, Sixth Edition, 2018.
2. Hayt, W. H. and Kemmerly, J., “Engineering Circuit Analysis”, 8th Edition, McGraw Hill Education, 2013.
3. Boylestad, R. L. and Nashelsky, L., "Electronic Devices and Circuits theory", 10th Edition, Pearson Education, 2013.

Reference Books

1. Sudhakar, A. and Palli, S. S., “Circuits and Networks: Analysis and Synthesis”, McGraw-Hill Education, 2017.
2. Sedra and Smith K. C., "Microelectronics Circuits", 5th Edition, Oxford University, 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	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	8	15	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	**BIC104**
Course Title	**Introduction to Biotechnology**
Number of Credits	**3-0-0-3**
Course Type	**GIR**

Course Objectives

- To learn the basics of biotechnology.
- To get familiarized 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 Content:

Unit-I Basics concept of Biotechnology **8**

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-II DNA and Protein Biotechnology **8**

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-III Microbial, Plant, and Animal Biotechnology **8**

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, Knockout's animals, Human antibodies in animals.

Unit-IV Environmental and Medical Biotechnology **8**

Environmental biotechnology: Bioremediation basics, Chemicals in the environment, Fundamentals of cleanup reactions, Aerobic and anaerobic biodegradation, Bioremediation genomics programs, Phytoremediation, Cleanup 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-V Biotechnology regulations and Ethics **8**

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. William J. Thieman and Michael A. Palladino, *"Introduction to Biotechnology"*, Pearson New International Edition, 3rd Edition, 2014.

Reference Books

1. Reinhard Renneberg, Arnold L. Demin and Tom Papoport, *"Biotechnology for Beginners"*, Academic Press, Annotated Edition, 2007.
2. Ratledge Colin and Kristiansen Bjorn, *"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	-	-	-	-	-	-	-	-	-
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

Course Code	**CSL105**
Course Title	**Computer Workshop**
Number of Credits	**0-0-4-2**
Course Type	**GIR**

Course Objectives

- To impart the knowledge of various hardware components of a computer system
- To provide the skill of assembling the computer system.
- To impart knowledge about the troubleshooting and fault finding the computers and the peripherals
- To impart the knowledge and usage of various tools such as Power Point, Word Excel, MS Outlook and Latex.
- To learn the basic commands in Linux operating system.
- To learn the basics of computer networks and different networking devices.

List of Experiments:

1. Introduction to Von-Neumann Architecture, study and demonstrate the working of SMPS, Optical drive and Hard disc, the working of CPU processor, Memory Slots, System Buses, Heat Sinks, working of IDE Connectors/PATA, SATA Connectors, CMOS Battery, Expansion Slots, I/O ports.
2. To study and demonstrate the working of Chip Set, BIOS chip, Capacitors, Inductors, Resistors, Hub and Switch, Repeater and Bridges, Router and NIC.
3. To assemble a PC.
4. Dual Booting (Warm Booting and cold booting)
5. Installation process of Windows, Linux operating system
6. Study of Device Drivers and Installation process of Device Drivers
7. Hardware Troubleshooting (Demonstration):
8. Students have to be given a PC which does not boot due to improper assembly or defective peripherals. Identifying problem and fixing it for getting to working condition.
9. Software Troubleshooting (Demonstration): Students have to be given a malfunctioning CPU due to system software problems
10. Introduction to MS Word, MS Excel, Power Point Presentation, MS Outlook, Latex.
11. Exposure to Basic commands and system administration in Linux.
12. Exposure on file, directory handling, security, file permissions, pipes, quotes, aliases, variables and filters in linux.
13. Orientation and Connectivity Boot Camp and surfing the Web using Web Browsers, Search Engines and Netiquette, Cyber Hygiene.
14. Introduction to Cyber Security.

Total Periods: 24

COURSE OUTCOMES:

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

CO1 : Describe various hardware components of a computer system. (K2)

CO2 : Identify existing configuration of the computer and peripherals and to troubleshoot common problems (K3)

CO3 : Make use of various Microsoft tools to solve the problems. (K3)

CO4 : Experiment with basic commands in Linux operating system. (K3)

CO5 : Explain the basics concepts related to computer networks and identify different networking devices. (K3)

Text Books

1. Mueller, Scott, *"Upgrading and Repairing PCs, 22nd Edition*", QUE, Pearson Education, 2015.
2. Meyers, Mike, "*Introduction to PC Hardware and Troubleshooting*", Tata McGraw Hill, New Delhi, 2003.
3. Zacker, Craig and Rourke, John, "*The complete reference: PC hardware, 1st Edition*", Tata McGraw Hill, New Delhi, 2001.

Reference Book

1. Govindarajulu, B., "*IBM PC and Clones hardware troubleshooting and maintenance, 2nd Edition*", Tata McGraw-Hill, New Delhi, 2008.

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	3	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Score	15	4	-	6	-	-	-	-	6	6	-	-	2	-	-
COM	3	2	-	3	-	-	-	-	3	3	-	-	2	-	-

Course Code	**CSL106**
Course Title	**Practicum-I**
Number of Credits	**0-0-6-3**
Course Type	**GIR**

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 Content:

Unit-I 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-II Fundamentals of Basic Electrical Engineering **12**

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

Unit-III Fundamentals of Basic Electronics Engineering **12**

Apply The Basic Concepts of Electronics Engineering to The Routine Appliances Of Daily Use.

Unit-IV Engineering of Electro-Mechanical Devices **12**

Apply The Basic Concepts of Mechanical Engineering to The Routine Appliances of Daily Use.

Unit-V 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	:	Analyze a product to find the scope of improvements.	(K4)
CO5	:	Improve the performance of existing products by adding a feature to it.	(K6)

Reference 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 (Eds), "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	-	-	-	-	-
CO2	2	2	3	-	3	-	2	2	-	2	3	3	2	-	-
CO3	2	2	3	3	3	-	3	-	-	-	-	3	2	-	-
CO4	2	2	3	3	2	-	-	-	-	-	2	3	3	-	-
CO5	2	2	3	-	3	-	-	-	-	-	-	-	-	-	-
Score	10	10	13	7	12	2	7	2	-	5	5	9	7	-	-
COM	2	2	3	2	3	2	3	2	-	3	3	3	3	-	-

SECOND SEMESTER

Course Code	**MAC211**
Course Title	**Probability and Random Process**
Number of Credits	**3-1-0-4**
Course Type	**GIR**

Course Objectives

- To understand probabilistic models that are employed in countless applications in all areas of science and engineering.
- To provide necessary mathematical support and confidence to tackle real life problems.

Course Content:

Unit-I Probability and Random Variable **8**

Axioms of probability, Conditional probability, Total probability, Baye's theorem, Random variable, Probability mass function, probability density function, properties, Moments, Moment generating function and their properties.

Unit-II Standard Distributions **8**

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties- Function of a random variable. Probability density function and its properties.

Unit-III Two Dimensional Random Variables **8**

Joint distributions, Marginal and conditional distribution, Covariance, Correlation and regression, Transformation of random variables, Central limit theorem.

Unit-IV Random Processes and Markov Chains **8**

Classification, Stationary process, Markov process, Poisson process, Birth and death process, Markov chains, transition probabilities, Limiting distributions.

Unit-V Introduction to Queueing Theory **8**

Markovian models, M /M/1, M/M/C, finite and infinite capacity, M/M/∞ queues, Finite source model, M/G/1 queue (steady state solution only), Pollaczek, Khintchine Formula-Special cases.

Total Periods: 40

COURSE OUTCOMES:

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

CO1	:	Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.	(K2)
CO2	:	Classify the function of random variables based on Discrete and Continuous Distributions, which can describe the real phenomenon.	(K2)
CO3	:	Simplify the problems on Correlation and Regression and use these concepts in real world problems.	(K4)
CO4	:	Make use of the concepts of random processes such as Markov Process, Poisson Process in real phenomenon.	(K3)
CO5	:	Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.	(K2)

Text Books

1. Ross S., *"A First Course in Probability"*, Pearson Education, Tenth Edition, 2015.
2. Taha H.A., *"Operations Research- An Introduction",* Pearson Education Edition Asia, Ninth Edition, 2014.

Reference Book

1. Medhi J., *"Stochastic Processes"*, New Age Publishers, Third Edition, 1994.

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	-	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	15	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	PHC202
Course Title	Engineering Physics
Number of Credits	3-0-4-5
Course Type	GIR

Course Objectives

- To impart knowledge about the limitations of Newtonian Mechanics and alternate formalism of Lagrange and Hamilton.
- To introduce students to 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 and to make an understanding of concepts of quantum computing.
- To understand the basic framework of solid-state physics.
- To recognize and classify the structures of Optical fiber and types.

Course Content:

Unit-I Classical Mechanics **8**

Review of 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.

Unit-II Special Theory of Relativity (STR) **8**

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-III Modern Physics **8**

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, Tunneling, 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 and 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 (Bloch Theorem, Kronig-Penney Model), Quantum Computing.

Unit-IV Physics of Materials **8**

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 and Lattice Parameter Determination, Hall Effect, Exposure to Semiconductors, Superconductors: Meissner effect, type I and II superconductors, BCS theory (qualitative), high temperature superconductors, Josephson effects applications.

ii) Magnetic and Dielectric Properties of Materials:

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

Unit-V Fiber Optics **8**

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.

LAB 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.	(K3)
CO2	:	Apply the knowledge of Special Theory of Relativity.	(K2)
CO3	:	Describe and analyze the dynamics of systems that move under the influence of given potential, and to make use of basics of Quantum Mechanics in Quantum Computing, and real time applications in engineering studies.	(K4)
CO4	:	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)
CO5	:	Demonstrate optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	(K2)

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.
3. Kittel, Charles "Introduction to Solid State Physics, 8th edition", John Wiley and Sons, Inc, USA, 2005.

Reference Books

1. Kaye, Phillip, Laflamme, R. and Mosca M. “Introduction to Quantum Computing”, Oxford University Press, New York, 2007.
2. Goldstein, Herbert, Poole, Charles and Safko, John “Classical Mechanics, 2nd edition”, Narosa, 1985.
3. Puri, R. K. and Babbar V. K. “Solid State Physics”, S. Chand and Co. Pvt. Ltd, New Delhi, 2000.
4. Beiser, Arthur “Concepts of Modern Physics”, Tata McGraw-Hill, New Delhi, 1995.
5. Resnick, R. “Introduction to Special Relativity” John Wiley, Singapore, 2000.
6. Avadhanulu, M. N. and Kashirsagar, P. G. “A Text Book of Engineering Physics”, S. Chand and Co. Pvt. Ltd, New Delhi, 2008.
7. Ida, Nathan “Engineering Electromagnetics”, Springer, 2005.
8. 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	2	2	-	3	-	-	-	-	-	-	-	2	2	-	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Score	10	6	-	9	-	-	-	-	-	-	-	2	10	-	-
COM	2	2	-	3	-	-	-	-	-	-	-	2	2	-	-

Course Code	**CSC203**
Course Title	**Basics of Programming in C**
Number of Credits	**3-0-4-5**
Course Type	**GIR**

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 Content:

Unit-I Introduction to Computers, Problem Solving Tools **8**

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-II Introduction to C Programming **8**

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-III Control Statements, Array and Pointers **8**

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-IV Functions, String Handling **8**

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-V Structures, Unions and File Handling **8**

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.

LAB EXPERIMENTS

1. Implementation of basics of C programming. 4
2. Implementation of concepts of conditional statements in C programming. 6

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

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 : Solve Real world problems utilizing different concepts in C programming. (K5)

Text Books

1. Deital Paul and Deital Harvey, "C How to Program", Prentice Hall London, Eighth Edition, 2015.
2. Kernighan Brian W. and Ritchie Dennis M., "The C Programming Language", Prentice Hall, Second Edition, 2012.
3. "Programming with C", by Byron S Gottfried, Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2016

Reference Books

1. Dromey R.G., "How to solve it by Computer", Pearson Education, Fourth Reprint, 2007.
2. Y.Kanetkar, "Let us C", BPB Publication.
3. Hanly J.R. and Koffman E.B., "Problem Solving and Program Design in C", Pearson Education, Sixth Edition, 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	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	3	3	-	-	-	-	-	-	-	-	2	-	-
Score	18	12	6	15	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	ENC204
Course Title	Communication Skills
Number of Credits	3-0-4-5
Course Type	GIR

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 and social behaviour.
- To empower students with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

Course Content:

Unit-I The Process of Communication 8

1. Grammar Refresh: Synonyms and Antonyms, Homophones, Homonyms and Homographs, Tenses, Active Voice and Passive Voice, Idioms and Phrasal Verbs, Reported Speech.
2. 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.
3. How to write Accurately, Briefly, clearly. Precis writing.
4. How to Read, Introduction to Comprehension Skills, Skills to improve Comprehension Skills
5. Telephonic Communication, Templates for Telephonic Conversation, Do's and Don'ts of Telephonic Communication, Leaving a message.

Unit-II Job Applications and Interviews 8

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

Unit-III Managing Organizational Structure 8

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

Unit-IV Taking Notes and Preparing Minutes 8

1. 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.
2. Elements of Report Writing, Procedure and Guidelines, Types and Format.
3. Taking notes, Note-taking skill: essential components.

Unit-V Presentation Skills and Negotiation Skills **8**

1. 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 and A from Audience, Podium Panic, Body Language, Do's and Don'ts of PD, Mock PD.
2. Types of Corporate Conversations, Negotiation, Mediation and Arbitration, resolving arguments, Models of Negotiation Process, Types of Negotiation, Skills of a Negotiator, Steps of the Negotiation Process, Skills to improve Negotiation Process.

LAB EXPERIMENTS

1. Introduction to Phonetics, Phonetic alphabet.
2. Introduction to Speech Sounds: Vowels and 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 organization. (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 and 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

Course Code	**EVC205**
Course Title	**Basic Environmental Science and Engineering**
Number of Credits	**3-0-0-3**
Course Type	**GIR**

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 Content:

Unit-I Introduction to Non-Conventional Energy Sources **8**

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- impacts.

Unit-II Environmental Impact of Various Energy Sources **8**

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-III Introduction to Environment and Pollution **8**

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-IV Impact of Organisms on The Environment **8**

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-V Applications of Environmental Technology **8**

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. (K3)
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," 3 rd Edition, The McGraw Hill Education, 2017.
2. Rai, G. D., "Non-conventional Energy Sources," 6 th 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	-	-	-	-	-	-	-	-
CO2	3	2	2	1	1	-	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	-	-	8
COM	3	2	2	2	1	2	2	3	-	-	-	2	-	-	2

Course Code	**CSL206**
Course Title	**Practicum-II**
Number of Credits	**0-0-6-3**
Course Type	**GIR**

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 Linux and 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 Content:

Unit-I Basics of MATLAB/SIMULINK **18**

A. MATLAB Basics
   1. Introduction to MATLAB and its programming.
   2. Arithmetic and logical operations.
   3. Handling matrix.
   4. Common MATLAB functions.
   5. Plotting.
   6. MATLAB editor.

B. Solving RC, RL, RLC networks.

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

D. Introduction to SIMULINK
   1. Creating a Simulink model.
   2. Simulink solution of differential equation.
   3. Storing/saving data.
   4. Observing variables during simulation.

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

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

G. Arrays and its significance in MATLAB
   1. Vector handling and its application.

H. Flow controls and functions.

I. Data visualisation and its interpretation.

Unit-II 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/R Programming. Execute basic operations: read a csv/data file, display the content of a file, data visualization (plot various graphs).

Unit-III 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-IV Basic principles of Physics **18**

A. Detailed study of electronic circuitry of various devices/equipment, i.e., Music System, Grinder, Printer etc.
B. Design of some utility devices/equipment based on the practicum learnings.
C. Simulate the circuitry of various utility devices/equipment using MATLAB

Unit-V Engineering Applications

Application of Matlab/Simulink, machine learning, data analytics, Python, arduino technology, makeblockmBot 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, R Programming and Machine learning.	(K3)
CO3	:	Experiment with Arduino and the various interfaced Input/Output devices.	(K3)
CO4	:	Examine the functionality of the circuitry of Makeblock mBot and Air-block modular and programmable drone.	(K4)
CO5	:	Constructing a solution for the estimation and designing of the Electronic or Electrical system and Computational tool using the Matlab, Python, Machine learning 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	-	-	2	2	3	2	2	2

THIRD SEMESTER

Course Code	**CSC301**
Course Title	**Discrete Structures**
Number of Credits	**3-0-0-3**
Course Type	**PC**

Course Objectives

- To study the objects that have discrete as opposed to continuous values including the foundations of logic, algorithms and their complexity.
- To study mathematical reasoning, relations, graphs, trees and combinatorics.

Course Content:

Unit- I Introduction to Preliminaries and Predicate Calculus **8**

Basic concepts of discrete mathematics and related problems, propositions and predicates, disjunction and conjunction, tautologies and contradiction, laws of equivalence, rules of substitution and transitivity, normal forms, proof techniques.

Unit-II Set Theory and Functions **8**

Basic concepts, Venn Diagrams, set operations, power set, methods of proof for sets, Relations and ordering, Types of relations, Graph and matrix of a relation, properties of a relation, Functions: definitions and notation, one to one, onto, one to one and onto, composition, identity and inverse, related results, Counting: Principle of Inclusion and Exclusion, Division and Euclidean Algorithm in Integers, Elements of Probability, Recurrence Relations.

Unit-III Graph Theory **8**

Basic concepts of graph theory, multigraphs and weighted graphs, Bipartite graph, walk, path and circuits, Warshall's algorithm: shortest path, Eulerian paths and circuits, Hamiltonian paths and circuits, factors of a graph and planar graphs, Graph colorings, Graph isomorphism.

Unit-IV Binary Trees **8**

Introduction, complete and extended binary tree, traversing binary tree, binary search tree, Minimum spanning trees, Heaps, Huffman's algorithm.

Unit-V Basics of Structures **8**

Mathematical induction, Algebraic structures properties, Semi group, Monoid, Group and Sub group - examples and standard results, generators and evaluation of powers, cosets and Langrange's theorem, rings, integral domains, fields.

Total Periods:40

COURSE OUTCOMES:

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

CO1	:	Explain the basics of discrete mathematics, predicate calculus.	(K3)
CO2	:	Understand set theory, relations and functions, and recurrence relation.	(K2)
CO3	:	Illustrate the concepts of graph theory.	(K2)
CO4	:	Experiment with trees to solve problems like minimum spanning tree, traversal of binary tree.	(K3)
CO5	:	Explain different algebraic structures.	(K3)

Text Books

1. Tremblay, J. P. and Manohar, R., "*Discrete Mathematical structures with applications to Computer Science*", McGraw Hill, 2017.
2. Liu, C.L., "*Elements of Discrete Mathematics*", McGraw Hill, 2012.

Reference Books

1. Scheinerman, Edward, "*Mathematics: A Discrete Introduction, 3rd Edition*", Cengage, 2012.
2. Rosen, Kenneth H., "*Discrete Mathematics and Its Applications*", McGraw Hill, 2012.
3. Graham, L. R., Donald, E. K. and Patashnik, O.*, "Concrete Mathematics: A Foundation for Computer Science",* Addison Wesley, 2nd Edition 1994.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	3	-	-	-	-	-	-	-	-	-	2
CO2	2	3	2	3	3	-	-	-	3	3	3	3	-	-	3
CO3	2	0	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	3	-	-	-	-	-	-	-	-	-	-	-
Score	10	11	8	9	6	-	-	-	3	3	3	3	-	-	5
COM	2	3	3	3	3	-	-	-	3	3	3	3	-	-	3

Course Code	**CSC302**
Course Title	**Data Structures and Algorithms**
Number of Credits	**3-0-4-5**
Course Type	**PC**

Course Objectives

- To impart the basic concepts of data structures and algorithms.
- To understand writing algorithms and step by step approach to solving problems with the help of fundamental data structures.
- To understand concepts about searching and sorting techniques.
- To be familiar with basic techniques of algorithm analysis.
- To learn and implement various data structures and algorithms.

Course Content:

Unit-I Complexity of algorithms and Algorithmic paradigms **8**

Introduction to Asymptotic notations and their significance, complexity analysis of algorithms, worst case and average case. Arrays and Recursion functions.

Unit-II Basic Data Structures **8**

Stacks and Queues- Abstract data types, sequential and linked implementations, applications of stacks and queues. Lists- Abstract data type, sequential and linked representations, comparison of insertion, deletion and search operations for sequential and linked lists, doubly linked lists, circular lists, skip lists, applications of lists.

Unit-III Trees and Heaps **8**

Trees- Abstract data type, sequential and linked implementations, tree traversal methods and algorithms, Binary trees. Search Trees- Binary search trees, search efficiency, insertion and deletion operations, importance of balancing, AVL trees, searching, insertion and deletions in AVL trees, 2-3 tree, B-tree, B+ Trees. Heaps- Heaps as priority queues, heap implementation, insertion and deletion operations, binary heaps, binomial and Fibonacci heaps, heapsort, heaps in Huffman coding.

Unit-IV Graphs **8**

Definition, terminology, directed and undirected graphs, properties, implementation – adjacency matrix and linked adjacency chains, connectivity in graphs, graph traversal – breadth first and depth first, spanning trees, Graph algorithms: DFS and BFS with applications, MST and shortest paths.

Unit-V Basic algorithmic techniques **8**

Sorting and Searching techniques with analysis, Greedy algorithms, divide and conquer, dynamic programming and Introduction to hashing.

LAB EXPERIMENTS

1. Implementation and Operations on Arrays.
2. Implementation of ADT of Stacks.
3. Implementation of Applications of Stacks.
4. Implementation of ADT of Queues.
5. Implementation of Applications of Queues.
6. Implementation of ADT of Lists.

7. Implementation of Applications of Lists.
8. Implementation of Binary Trees.
9. Implementation of Search Trees.
10. Implementation of Heaps.
11. Implementation of Applications of Heaps.
12. Implementation of algorithms of graphs.
13. Implementation of sorting algorithms.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of data structures and algorithms. (K2)
CO2 : Build data structures for a given problem. (K3)
CO3 : Illustrate applications and use of tree data structures. (K3)
CO4 : Compare algorithms for graph data structures. (K4)
CO5 : Compare the basic algorithmic techniques and choose a suitable one for a given problem. (K5)

Text Books

1. Skiena Steven S., "*The Algorithm Design Manual*", Springer, 2nd edition, 2008.
2. Cormen, T., Lieserson, C., Rivest, R., and Stein, C., *"Introductions to Algorithms*", Prentice-Hall India, 3rd edition, 2009.

Reference Books

1. Dasgupta, Sanjoy, Papadimitriou, Christos H. and Vazirani, Umesh V. "Algorithms", Tata McGraw-Hill, 2008.
2. Kruse, Tondo and Leung, "Data Structures and Program Design in C", 2nd edition, Prentice-Hall, 1997.
3. Lipschutz, Seymour, "Data structures", McGraw Hill revised first edition, 2014.
4. Skiena Steven S., "The Algorithm Design Manual", Springer, 2nd edition, 2008.

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	-	-	3	-	3
CO2	-	-	-	-	3	-	-	-	-	-	-	-	3	-	3
CO3	2	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	3	3	-	-	-	3	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	8	8	-	9	8	-	-	-	3	3	-	-	6	-	9
COM	2	2	-	3	2	-	-	-	3	3	-	-	3	-	3

Course Code	**CSC303**
Course Title	**Computer Organization**
Number of Credits	**3-1-4-6**
Course Type	**PC**

Course Objectives

- To learn the basics of Computer System Architecture.
- To understand the core concepts of Processor Design.
- To learn and demonstrate the basics of Computer Arithmetic and Control Design.
- To learn about the structure and organization of Memory in Computer Systems.
- To understand the concepts of Parallelism in Computer Systems.

Course Content:

Unit-I General System Architecture **8**

Stored Program control concept (Von-Neumann architecture principle), Flynn's Classification of computers (SIMD, MISD, MIMD), Structure organization (CPU, Caches, Main memory, Secondary memory unit and I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic and logical, Data transfer, Control flow), Instruction set format, Instruction Set Architecture (Instruction set based classification of processor i.e., RISC, CISC, RISC vs CISC Comparison).

Unit-II Processor Design **8**

Arithmetic and logic unit, Stack organization, CPU Architecture types, Accumulator Based-Register, Stack Memory, Register, Detailed data path of a typical register-based CPU, Fetch, Decode, and Execute Cycle.

Unit-III Computer Arithmetic and Control Design **8**

Addition and Subtraction, Multiplication Algorithms (Booth's Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations. Control Design: Microprogrammed and Hard-wired control options, Hard-wired design methods, State table method, Multiplier control, CPU control unit. Microprogrammed, Basic concepts, control Memory, Address Sequencing.

Unit-IV Memory Hierarchy and I/O Organization **8**

Memory Hierarchy, need for Memory Hierarchy, locality of reference principle, cache memory, main and secondary, Memory parameters, access cycle time, cost per unit, concept of virtual memory. Programmed, Interrupt driven I/O, Direct Memory Access, Synchronous and asynchronous data transfer.

Unit-V Introduction to Parallelism **8**

Goals of parallelism, Instruction level parallelism, pipelining, super scaling, Processor level parallelism, Multiprocessor system overview.

LAB EXPERIMENTS

1. Introduction to gates.
2. Ripple Carry Adder.
3. Carry-look-ahead adder.
4. Registers and Counters.
5. Wallace Tree Adder.
6. Combinational Multipliers.
7. Booth's Multiplier.
8. Arithmetic Logic Unit.
9. Memory Design.
10. Associative cache Design.
11. Direct Mapped Cache Design.
12. CPU Design.
13. Mathematical expressions.
14. File operations-1
15. File operations-2
16. PROJECT-Select any project of your choice.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Explain the concepts of Computer Architecture such as Principles, Instructions Set, Addressing Modes, etc.	(K2)
CO2	:	Outline the principles of Processor design.	(K2)
CO3	:	Explain and demonstrate the various approaches followed in performing Computer Arithmetic.	(K3)
CO4	:	Interpret the organization and working of various memories in Computer Systems.	(K2)
CO5	:	Explain the relevance of Parallelism in Computer Systems.	(K2)

Text Books

1. Hayes J.P, *"Computer architecture and Organization"*, Third Edition, McGraw Hill, 2017.
2. Hamacher, C., Vranesic, Z. and Zaky, S., "*Computer Orgnization*", McGraw Hill Education, 5th Edition, 2011.

Reference Books

1. Patterson, David A and Hennessy, John. L, *"Computer Organization and Design",* Morgan Kaufmann, 3rd Edition, 2007.
2. Stallings, William, *"Computer Organization and Architecture Designing for Performance", S*ixth Edition, Pearson Education Asia, 2003.

CO to PO/PSO Mapping

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

Course Code	CSC304
Course Title	Digital Systems Design
Number of Credits	3-1-4-6
Course Type	PC

Course Objectives

- To learn the structure of number systems and perform the conversion among different number systems.
- To learn reduction of logical expressions using Boolean algebra, k-map and tabulation method and implement the functions using logic gates
- To impart knowledge for design and implementation of combinational logic circuits.
- To impart knowledge for design and implementation of sequential logic circuits.
- To learn basics of VHDL for system modelling.

Course Content:

Unit-I Number System **8**

Introduction to various number systems and their Conversion. Boolean Algebra and Logic Gates: Basic Logic Operations, Basic Identities, Algebraic Laws, Useful Boolean Identities, Algebraic Reductions, Complete Logic Sets, IEEE Logic Gate Symbols.

Unit-II Combinational Logic Design **8**

Canonical Logic Forms, Logic Arrays, BCD and 7 Segment Displays, Karnaugh Maps. Digital Hardware: Voltages as Logic Variables, Digital Integrated Circuits, Logic Delay Times, Transmission Lines, Logic Families, the Hardware Designer.

Unit-III Logic Components **8**

Concept of a Digital Component, BCD Validity Detector, Line Decoders, Multiplexers, Demultiplexers, Binary Adders, Subtraction, Multiplication, Transmission Gate Logic. Memory Elements and Arrays: General Properties, Latches, Clock and Synchronization, Master-Slave and Edge-Triggered Flip-Flops, Registers, RAM, ROM.

Unit-IV Sequential Logic Networks **8**

Concept of a Sequential Network, Sequential Network Design, Binary Counters, The Importance of State Machines. Shift registers: Principle of 4-bit shift resistors. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO resistors.

Unit-V First Concepts in VHDL **8**

Defining Modules in VHDL, Structural Modelling, Learning VHDL. CMOS Logic Circuits: NOT Function in CMOS, Complex Logic Gates in CMOS.

LAB 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 and 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.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Describe the basic principles of digital circuits and different number system.	(K2)
CO2	:	Solve logic expressions and circuits using Boolean laws and K-map	(K3)
CO3	:	Develop competence in combinational Logic problem formulation and logic optimization	(K3)
CO4	:	Develop competence in analysis of synchronous and asynchronous sequential circuits	(K3)
CO5	:	Demonstrate knowledge of VHDL for system Modeling.	(K2)

Text Books

1. Mano, M. M. and Ciletti, M. D. “Digital Design: With an Introduction to the Verilog HDL, 5th Edition”, Pearson Education, 2013.
2. Uyemura, J. P. “A First Course in Digital Systems Design: An Integrated Approach, 1st Edition”, Nelson Engineering, 1999.

Reference Books

1. Roth, C. H. and John, L. K., "Digital System Design Using VHDL, 2nd Edition", Cengage Learning, 2008.
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	2	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	10	15	-	-	-	-	-	-	-	-	-	-	10
COM	3	2	2	3	-	-	-	-	-	-	-	-	-	-	2

Course Code	**CSC305**
Course Title	**Automata and Formal Languages**
Number of Credits	**3-1-0-4**
Course Type	**PC**

Course Objectives

- To learn fundamentals of different models of computations.
- To understand regular languages, context free languages and their properties.
- To learn regular languages.
- To learn and understand context sensitive languages.
- To understand various model of Turing machines.

Course Content:

Unit-I Machines **8**

Introduction: Alphabets, Strings and Languages, Automata and Grammars, Deterministic finite Automata (DFA), State transition graph, Transition table, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Moore and Mealy machine, Minimization of Finite Automata.

Unit-II Regular Expression (RE) **8**

Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non-Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages.

Unit-III Context Free Grammar (CFG) and Context Free Languages (CFL) **8**

Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs.

Unit-IV Push Down Automata (PDA) **8**

Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

Unit-V Turing machines (TM) **8**

Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, Recursive and recursively enumerable languages, Halting problem, Introduction to Un-decidability, Undecidable problems about TMs. Post correspondence problem (PCP).

Total Periods:40

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of automata theory and build finite state machines for real world problems. (K2)

CO2 : Construct a deterministic finite state machines for the given regular expression. (K3)

CO3 : Illustrate context free grammar and context free languages. (K2)

CO4 : Design a push down automata for real world problems. (K3)

CO5 : Compare various Turing machine models. (K4)

Text Books

1. Hopcroft, John E., Motvani, Rajeev and Ullman, Jaffrey D. "*Introduction to Automata Theory, Languages and Computation 3rd edition*". Pearson Education, 2014.
2. Linz P., "*An Introduction to Formal Language and Automata*", Narosa Pub House, 2011.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	3	-	-	-	-	-	3	-	-	3	-	3
CO2	2	2	-	-	3	-	-	-	-	-	-	-	3	-	3
CO3	2	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	3	3	-	-	-	3	-	-	-	-	-	-
CO5	2	3	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	10	11	1	9	8	-	-	-	3	3	-	-	6	-	9
COM	2	3	1	3	2	-	-	-	3	3	-	-	3	-	3

Course Code	**CSL306**
Course Title	**Practicum-III**
Number of Credits	**0-0-6-3**
Course Type	**GIR**

Course Content

This practical course constitutes a minor project work based on the studied theory till this semester. This course is designed to give students supervised practical application of the courses that they have learnt till this semester.

COURSE OUTCOMES:

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

CO1 : Demonstrate a sound technical knowledge of the selected domain. (K3)

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	0	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

FOURTH SEMESTER

Course Code	**CSC401**
Course Title	**Database Management Systems**
Number of Credits	**3-1-4-6**
Course Type	**PC**

Course Objectives

- To learn data models, conceptualize and depict a database system using ER diagram.
- To understand the internal storage structures in a physical DB design.
- To know the fundamental concepts of transaction processing techniques.

Course Content:

Unit-I Introduction **8**

Purpose of Database System, Views of data**,** data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model, Conceptual data modeling, motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.

Unit-II Relational Model **8**

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.

Unit-III Database Design **8**

Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF.

Unit-IV Transactions **8**

Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Unit-V Implementation Techniques **8**

Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

LAB EXPERIMENTS

1. Introduction to SQL and installation of SQL server/oracle.
2. Data Definition Language (DDL) commands in RDBMS.
3. Data Manipulation Language (DML) and Data Control Language (DCL).
4. High level language extensions with cursors.
5. Data types and create a database and write the program to carry out the following operation.
6. Create tables department and employee with required constraints.
7. Working with null values, matching the pattern from the table.
8. Aggregate functions: grouping the result of a query.
9. Set operators, Nested Queries, Joins and Sequences.

10. Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
11. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
12. Triggers and Cursor Management in PL/SQL.
13. Procedures and Functions
14. Automatic Backup of Files and Recovery of Files.
15. As a designer identify the views that may have to be supported and create views.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of DBMS and build conceptual models of real-world problems. (K3)

CO2 : Design database schema for real world problems and construct complex SQL queries. (K6)

CO3 : Develop a database using normalization for real world applications. (K6)

CO4 : Illustrate transaction processing, concurrency control and recovery techniques. (K2)

CO5 : Analyze file structures and indexing techniques and select the suitable one for a given application. (K5)

Text Books

1. Silberschatz A., Korth, Henry F., and Sudharshan, S., "*Database System Concepts, 5th Edition"*, Tata McGraw Hill, 2016.
2. Elmasri, Ramez and Navathe, Shamkant B., "*Fundamentals of Database Systems 7th Edition"*, Pearson, 2015.

Reference Book

1. Date C. J, Kannan, A. and Swamynathan, S., "*An Introduction to Database Systems, 8th edition"*, Pearson Education, 2012.

CO to PO/PSO Mapping

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

Course Code	**CSC402**
Course Title	**Design and Analysis of Algorithms**
Number of Credits	**3-1-0-4**
Course Type	**PC**

Course Objectives

- To design algorithms for a given problem.
- To write simple and rigorous proof of the correctness of algorithms.
- To understand the asymptotic performance of algorithms.
- To apply important algorithmic design paradigms for solving real world problems.
- To understand several complexity classes.

Course Content:

Unit-I Algorithm Design paradigms **8**

Motivation, concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations.

Structure of divide-and-conquer algorithms: sets and disjoint sets, Union and Find algorithms, quick sort, Finding the maximum and minimum, Quick Sort, Merge sort, Heap and heap sort.

Unit-II Greedy Algorithms **8**

Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm, Huffman codes.

Unit-III Dynamic programming **8**

Overview, difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, 0/1 knapsack.

Unit-IV Backtracking **8**

Queen Problem, Sum of subsets, graph coloring, Hamiltonian cycles. Branch and bound: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Traveling Salesman Problem.

Unit-V Computational Complexity **8**

Complexity measures, Polynomial Vs non-polynomial time complexity, NP-hard and NP-complete classes, examples.

Total Periods:40

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of algorithms and design efficient algorithms for real world problems. (K6)

CO2 : Construct greedy paradigm for a given problem. (K3)

CO3 : Illustrate dynamic programming concepts. (K2)

CO4 : Design backtracking algorithms for real world problems. (K6)

CO5 : Compare complexity classes for a given problem (K5)

Text Books

1. E. Horowitz, S. Sahni and Rajasekaran, *"Fundamentals of Computer Algorithms"*, Universities Press, 2008.
2. Cormen T. H., Leiserson C. E. and Rivest R. L. and Stein Clifford, *"Introduction to Algorithms",* Prentice Hall of India, Third Edition, 2010.
3. Skiena Steven S., "*The Algorithm Design Manual*", Springer, 2nd edition, 2008.

Reference Book

1. A.V. Aho, J.E. Hopcroft and J.D. Ullman, *"The Design and Analysis of Computer Algorithms"*, Addison Wesley, 2009.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-	3	-	3
CO3	3	3	3	3	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	1	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-	-	-	3
Score	15	13	9	13	9	-	-	-	-	-	-	-	8	-	6
COM	3	3	2	3	2	-	-	-	-	-	-	-	3	-	3

Course Code	**CSC403**
Course Title	**Operating Systems**
Number of Credits	**3-0-4-5**
Course Type	**PC**

Course Objectives

- To introduce the major concepts and components of Operating Systems.
- To provide knowledge about the services rendered by Operating Systems.
- To enrich the knowledge in designing and implementing Operating Systems.
- To understand the principles in the design and implementation of Operating System software.

Course Content:

Unit-I Introduction **8**

Operating Systems, Definition, Types, Functions, Abstract view of OS, System Structures, System Calls, Virtual Machines, Process Concepts, Threads, Multithreading.

Unit-II Process Management **8**

Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks.

Unit-III Memory Management **8**

Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies.

Unit-IV File System **8**

Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

Unit-V Distributed Systems **8**

Introduction, Distributed operating systems, Distributed file systems, Distributed Synchronization.

LAB EXPERIMENTS

1. Implementation of different system calls of UNIX operating system.
2. Implementation of I/O system calls of UNIX OS.
3. Implementation different CPU scheduling algorithms to find turnaround time and waiting time.
4. Simulation of multi-level queue scheduling algorithm.
5. Implementation of I/O system calls of UNIX operating system a) Process Creation b) Executing a command c) Sleep command d) Sleep command using getpid e) Signal handling using kill k) Wait command
6. Implementation of following file allocation strategies. a) Sequential b) Indexed c) Linked
7. Simulation of MVT and MFT memory management techniques.
8. Simulation of the contiguous memory allocation for Worst-fit, Best-fit, First-fit technique.
9. Implementation of different file organization techniques.

10. Implementation of Deadlock avoidance algorithm.
11. Implementation of different disk scheduling algorithms.
12. Implementation of different page replacement algorithms.
13. Implementation of producer-consumer problem using semaphores.
14. Implementation of different system calls of UNIX operating system.
15. Implementation of I/O system calls of UNIX OS.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1 : Illustrate functions of Operating Systems. (K2)

CO2 : Analyse and Compare performances for different CPU scheduling algorithms, synchronization approaches, deadlock management techniques. (K4)

CO3 : Analyse different memory management and device management approaches for better data access. (K4)

CO4 : Make use of various file-system designs and identify the implementation issues. (K3)

CO5 : Analyse the design issues of distributed operating systems, and identify the limitations of traditional Operating systems and motivations for advancements. (K4)

Text Books

1. Galvin, Silberschatz and Gagne, "*Operating System Concepts*", 10th edition, John Wiley and Sons, 2018.
2. Stallings, William, "*Operating Systems –Internals and Design Principles*", 8th Edition, Pearson Publications, 2014.

Reference Book

1. Tanenbaum, Andrew, "*Modern Operating Systems*", 4th Edition, Pearson Publications, 2014.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	-	1	-	-	-	-	-	-	-	2	-	2
CO2	3	3	3	3	1	2	-	3	-	-	-	3	3	2	2
CO3	3	3	-	3	1	2	-	3	-	-	-	3	3	2	2
CO4	3	3	3	-	1	-	-	-	-	-	-	3	2	2	2
CO5	3	2	2	-	1	2	-	-	-	-	-	3	3	2	2
Score	15	16	11	6	5	6	-	6	-	-	-	12	13	8	10
COM	3	3	3	3	2	2	-	3	-	-	-	3	3	2	3

Course Code	**CSC404**
Course Title	**Computer Networks**
Number of Credits	**3-0-4-5**
Course Type	**PC**

Course Objectives

- To understand the concept of layering and various data communication techniques.
- To learn the basic MAC protocols in Computer Networks.
- To learn and implement the addressing schemes and routing protocols for a given scenario in Computer Networks.
- To learn the role and working of TCP and UDP protocols.
- To understand various application layer protocols.

Course Content:

Unit-I Layered Network Architecture **8**

ISO-OSI Model, TCP/IP, Data Communication Techniques: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes.

Unit-II Data Link Protocols **8**

Stop and Wait protocols, Noise free and Noisy Channels, Performance and Efficiency, Sliding Window protocols, MAC Sublayer: The Channel Allocation Problem, Carrier Sense multiple Access Protocols, Collision Free Protocols, FDDI protocol, Distributed Queue Dual Bus (DQDB) protocol, Virtual LAN.

Unit-III Network Layer protocols **8**

Design Issues: Virtual Circuits and Datagrams, Routing Algorithms, Optimality principle, Shortest path routing Algorithms, Flooding and Broadcasting, Distance Vector Routing, Link State Routing, Flow Based Routing, Multicast Routing, Flow and Congestion Control: General Principles, Congestion control in datagram subnets, Choke Packets, Load Shedding, Jitter Control, RSVP. Interworking: Bridges, Routers and Gateways, IP packet, IP routing

Unit-IV Transport Layer Protocols **8**

Design Issues, Quality of Services, Introduction to sockets, Connection Management: Addressing, Connection Establishment and Releases, Use of Timers, Flow Control and Buffering, Multiplexing, The internet Transport Protocols: User Datagram protocol UDP/TCP Layering, Segment Format, Checks Sum, Timeout Connection Management.

Unit-V Session Layer protocol **8**

Dialog Management, Synchronization, OSI Session primitives, Connection Establishment. Introduction to network management: Remote Monitoring Techniques: polling, Traps performance management, Class of service, Quality of service, Security Management, Firewalls.

LAB 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 of 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. Programs using RPC remote procedure call
13. Study of Socket Programming and Client – Server Model
14. Configure a Network Topology using packet tracer software.
15. Configure a Network using Distance 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	:	Explain the role of various layers of ISO/OSI model and various data communication techniques.	(K2)
CO2	:	Explain the basic MAC protocols and various design issues in Computer Networks.	(K2)
CO3	:	Implement a suitable IP addressing scheme, subnetting/VLAN and routing protocol implementation for a given scenario.	(K4)
CO4	:	Explain the role and working of TCP and UDP protocols.	(K3)
CO5	:	Experiment with various Application Layer protocols and build an application using the same.	(K4)

Text Books

1. Forouzan, A., "*Data Communication and Networking",* Fourth Edition, McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., "C*omputer Networks",* Fifth Edition, Prentice Hall, India, 2013.

Reference Books

1. Olifer, Natalia and Olifer Victor, "*Computer Network: Principles, Technologies and Protocols for network design",* Wiley India Publication, 2006.
2. Kurose, James F. and Ross, Keith W., "*Computer Networking: A Top-Down Approach*", Pearson Education, Sixth edition (30 June 2017).

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	3	3	-	-	-	3	3	-	-	-	-	3
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Score	11	-	-	7	3	-	-	-	6	6	-	-	3	-	3
COM	3	-	-	3	3	-	-	-	3	3	-	-	3	-	3

Course Code	**CSC405**
Course Title	**Object Oriented Programming**
Number of Credits	**3-0-4-5**
Course Type	**PC**

Course Objectives

- To learn algorithmic problem-solving techniques.
- To learn the fundamentals of object-oriented programming.
- To compose programs in C++ using conditions, iterations and decompose a problem into function.
- To design, write, compile, test and execute programs using high level language.

Course Content:

Unit-I Introduction to Object Oriented Programming **8**

Basic concepts of OOP, Benefits of OOP, Introduction to object-oriented design and development, Design steps, Design example, Object oriented languages, Comparison of structured and object-oriented programming languages. Arrays, Pointers and Functions: Arrays, Storage of arrays in memory, Initializing Arrays, Multi-Dimensional Arrays, Pointers, accessing array elements through pointers, passing pointers as function arguments, Arrays of pointers, Pointers to pointers, Functions, Arguments, Inline functions, Function Overloading Polymorphism.

Unit-II Classes and Objects **8**

Data types, operators, expressions, control structures, arrays, strings, Classes and objects, access specifiers, constructors, destructors, operator overloading, type conversion. Storage classes: Fixed vs Automatic declaration, Scope, Global variables, register specifier, Dynamic memory allocation.

Unit – III Inheritance **8**

Inheritance, single Inheritance, Multiple Inheritance, Multi-level inheritance, hierarchical inheritance, hybrid inheritance, Virtual functions and Polymorphism. Exception Handling: List of exceptions, catching exception, handling exception.

Unit-IV Streams and Files **8**

Opening and closing a file, File pointers and their manipulations, Sequential Input and output operations, multi-file programs, Random Access, command line argument, string class, Date class, Array class, List class, Queue class, User defined class, Generic Class.

Unit-V Standard Template Library **8**

Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, Container Classes, General Theory of Operation, Vectors.

LAB EXPERIMENTS

1. Implementation of array and pointers.
2. Implementation of functions.
3. Implementation of function overloading.

4. Implementation of classes and objects.
5. Implementation of functions in classes.
6. Implementation of operator overloading.
7. Implementation of different types of inheritance.
8. Implementation of Streams.
9. Implementation of various operations on files.
10. Implementation of exception handling.
11. Implementation of STL.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1 : Explain the basics of object-oriented programming and develop programs solving basic programming concepts. (K3)

CO2 : Experiment with classes, objects and different techniques for solving problems. (K3)

CO3 : Evaluate the best inheritance method and apply exception handling. (K5)

CO4 : Make use of operations on files. (K3)

CO5 : Develop the standard template library for user applications. (K3)

Text Books

1. Dietel, Paul J. and Dietel, Harvey M., "*C++ for Programmers*", Prentice Hall, 10th Edition, 2016.
2. Bjarne, Strustrup,*"The C++ programming Language",* Addison Wesley 2013.

Reference Books

1. Lafore, Robert, *"Object Oriented Programming in Turbo C++",* Galgotia Publications 2001.
2. Booch, *"Object Oriented Analysis and Design with Applications",* Addison Wesley, 2007.
3. Balagurusamy, *"Object Oriented programming with C++",* Tata McGraw Hill, 2017.

CO to PO/PSO Mapping

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

Course Code	**CSL406**
Course Title	**Practicum-IV**
Number of Credits	**0-0-6-3**
Course Type	**GIR**

Course Content

This practical course constitutes a minor project work based on the concurrently studied theory till this semester. This course is designed to give students supervised practical application of the courses that they have learned till this semester.

COURSE OUTCOMES:

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

CO1 : Demonstrate a sound technical knowledge of the selected domain. (K3)
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

FIFTH SEMESTER

Course Code	**ENL511**
Course Title	**Professional Communication and Soft Skills**
Number of Credits	**0-0-4-2**
Course Type	**GIR**

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 and social behavior.
- 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 Content:

Unit-I Introduction to Soft Skills and Professional Ethics **5**

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

Unit-II Team Building **5**

Understanding nature of team: Mapping personal and professional goals of team members, Working effectively in a team through building relations and interpersonal communication.

Unit-III Art of Negotiation **5**

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

Unit-IV Organizing Meetings **5**

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

Unit-V Presentation Skills **6**

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-VI Stress Management and Time Management **5**

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-VII Group Discussion and Public Speaking **5**

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 behavior and professional ethics. (K3)

CO2 : Understand and recognize 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 : Develop coherence, cohesion and competence essential for presentation deliveries. (K3)

CO7 : Develop coherence, cohesion and competence essential for presentation deliveries. (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", New York: Simon and 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

Course Code	**CSL502**
Course Title	**Computational Tools and Techniques**
Number of Credits	**0-0-4-2**
Course Type	**PC**

Course Objectives

- To develop a practical approach to mathematical problem solving.
- To understand the usage of network simulations.
- To understand many commonly used tools and techniques.

Course Content:

Unit-I Network Simulation Using NS2 and NS3 **8**

1. Study of Network simulation and analysis tool NS2.
2. Study of Network simulation and analysis tool NS3.

Unit-II Network Simulation Using Omnet++ **8**

Study of Network simulation and analysis tool OMNET++.

Unit-III Data Mining **8**

Study of Data Mining with Python.

Unit-IV MATLAB **8**

Study of Image Processing tool MATLAB.

Unit-V SCILAB **8**

Study of Image Processing tool SCILAB.

Total Periods: 40

COURSE OUTCOMES:

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

CO1 : Understand of a broad range of methods and techniques for analysis and problem solving within relevant fields of study. (K2)

CO2 : Apply theory to the development of methods and techniques for problem solving. (K5)

CO3 : Understand data mining using PYTHON. (K2)

CO4 : Implement image processing algorithms using MATLAB. (K3)

CO5 : To implement image processing algorithms using SCILAB. (K3)

Reference Books

1. Witten Ian H. et. al, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Fourth Edition, 2017.
2. Gilat Amos, "MATLAB: An Introduction with Applications", John Wiley and Sons, Third Edition, 2008.

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	-	-	-	-	-	3	-

Course Code	**CSL503**
Course Title	**Project Phase-I**
Number of Credits	**0-0-6-3**
Course Type:	**GIR**

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 Content:

The project work is designed for a total duration of three semesters as a single project involving detailed literature survey, implementation and experimentation plan.

At the end of the 5th semester, the work done will be evaluated. It is expected that approx. 20-30% of the overall project work should have been completed and demonstrated. The remaining 70-80% must be completed and demonstrated in 7th and 8th semesters as project phase-II and III as per the clause 10.3 of Academic rules and regulations.

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**	**PO**	**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	0	0	-	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	12	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	**CSO504**
Course Title	**Honors Online Course-I**
Number of Credits	**5-1-0-3**
Course Type	**OC**

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 marks/grade must be submitted for the award of suitable letter grade in this course.

Course Code	**CSO504**
Course Title	**Optional Online Course-I**
Number of Credits	**5-1-0-(1-3)**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfill 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.

PROGRAM ELECTIVE-I

Course Code	**CSPE11**
Course Title	**Principles of Complier Design**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objectives

- To introduce the major concepts of language translation and compiler design.
- To enrich the knowledge in designing and implementing compilers.
- To illustrate various parts of compiler and its use.
- To apply standard techniques to solve basic problems that arise in compiler construction.
- To implement the fundamental algorithms used in compiler construction.
- To provide practical programming skills, necessary for constructing a compiler.

Course Content:

Unit-I Introduction to Compilers and Lexical Analysis **8**

Introduction, Phases, Compiler construction tools, Simple one-pass compiler: overview, syntax definition, syntax direct translation, parsing, a translator for simple expressions. lexical analysis, input buffering, simplification and recognition of tokens, finite automata and regular expression, implementing transition diagrams, language for specifying lexical analyzers.

Unit-II Syntax Analysis **8**

Role of the parser, writing grammars, CFG, top-down parsing-recursive descent parsing, predictive parsing, bottom-up parsing-shift reduce parsing, operator precedent parsing, LR, SLR, canonical LR and LALR parser, syntax directed definition, construction of syntax trees, bottom-up evaluation of S-attributed definitions.

Unit-III Intermediate Code Generation **8**

Intermediate languages, declarations, assignment statements, Boolean expressions, case statements, back patching, procedure calls.

Unit-IV Code Optimization and Run Time Environment **8**

Introduction, principal sources of optimization, optimization of basic blocks, DAG representation, global data flow analysis, runtime environments, source language issues, storage organization and allocation strategies, access to non-local names, parameter passing, error detection and recovery.

Unit-V Code Generation **8**

Issues in the design of code generator, The target machine, runtime storage management, basic blocks and flow graphs, next-use information, a simple code generator, peephole optimization.

LAB EXPERIMENTS

1. Implementation of symbol table.
2. Implementation of Lexical analysis.
3. Conversion of infix notation to postfix notation.
4. Implementation of type checking.
5. Construction of DFA to simulate the given regular expression.
6. Implementation of lexical analyzer.
7. Computation of FIRST AND FOLLOW set.
8. Construction of LL (1) parsing.
9. Construction of recursive descent parsing.
10. Implementation of Predictive Parsing Table.
11. Implementation of Shift Reduce Parsing.
12. Implementation of Operator Precedence Parsing.
13. Implementation of LR Parsing.
14. Implementation LALR parsing.
15. Construction of abstract syntax tree for the given mini language.
16. Construction of machine code.
17. Construction of DAG.
18. Implementation of Simple code optimization and generation procedure.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Explain the principles and functions of compiler design.	(K2)
CO2	:	Apply Syntax Analysis techniques to comply with and transform input according to the grammar of the language.	(K3)
CO3	:	Construct machine alike codes by applying Intermediate Code generation techniques on syntax-directed transformed codes.	(K3)
CO4	:	Analyze different optimization techniques for code optimization.	(K4)
CO5	:	Design and Develop code generator and mini compiler for a language.	(K6)

Text Books

1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. "*Compilers Principles, Techniques and Tools"*. Pearson Education Limited Boston, 2014.
2. Hollub, Allen I. "*Compiler Design in C"*. Prentice-Hall Inc. New Jersey, 1990.

Reference Books

1. Louden, Kenneth C. "*Compiler Construction: Principles and Practice"*. Course Technology, 1997.
2. Bennet, J.P. "*Introduction to Compiler Techniques"*. Tata McGraw-Hill, 1990.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	1	-	-	-	-	-	-	-	2	-	2
CO2	2	3	3	3	1	-	-	-	-	-	-	3	3	-	2
CO3	2	3	3	3	1	-	-	-	-	-	-	3	3	-	2
CO4	2	3	3	3	1	-	-	-	-	-	-	3	3	-	-
CO5	2	2	3	3	1	-	-	-	-	-	-	3	3	2	3
Score	10	13	15	12	5	-	-	-	-	-	-	12	14	2	9
COM	2	3	3	3	1	-	-	-	-	-	-	3	3	2	3

Course Code	**CSPE12**
Course Title	**Software Engineering**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objectives

- To impart the knowledge of Software Engineering Practices and various Process Models such as waterfall and evolutionary models.
- To understand the software requirements and SRS document.
- To learn to design software products using the appropriate design methodologies and UML such as function oriented design and object-oriented design.
- To impart knowledge of software engineering approach to design and develop high quality software products.
- To provide the skill of software project management.
- To learn to develop, test software products using the appropriate theory, principles, tools and processes.

Course Content:

Unit-I Introduction to Software Engineering **8**

Role of software engineering, Software evolution, Legacy system structures, Legacy system design, Legacy System Assessment, Software development life cycle. Software Process Models: Software process models, Software Specification, Software design and implementation, Software validation, Automated process support, Prescriptive Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized process models, Extreme Programming, Agile Methodology, Scrum, The Unified Process.

Unit-II Software Requirement **8**

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Software Models, Data Flow Diagrams, Entity Relationship Diagrams, Designing the architecture.

Unit-III Quality **8**

Quality concepts, Review techniques, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks.

Unit-IV Testing **8**

Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing, Software Testing Strategies - Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Testing conventional applications, object oriented applications, and Web applications, Formal modelling and verification, Software configuration management, Product metrics.

Unit-V Project Management **8**

Project Management Concepts, Process and Project Metrics, Estimation for Software projects, Project Scheduling, Risk Management, Maintenance and Reengineering. Assessment: Preparation of risk mitigation plan.

LAB EXPERIMENTS

1. Develop requirements specification for a given problem (The requirements specification should include both functional and non-functional requirements).
2. Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem (Use of a CASE tool required).
3. Develop structured design for the DFD model developed.
4. Develop ER Diagrams for a sample problem.
5. Develop Use case model for a problem.
6. Develop Sequence Diagrams.
7. Develop Class diagrams.
8. Develop code for the developed class model.
9. Use testing tool such as Junit.
10. Use configuration management tool.
11. Use any one project management tool such as Microsoft Project or Gantt Project, etc.
12. Software development cost estimation by COCOMO I and II model.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Explain the Software Engineering Approach and various Process Models.	(K2)
CO2	:	Analyze and identify user requirements in SRS.	(K4)
CO3	:	Use UML and show designing of software products.	(K3)
CO4	:	Apply different Quality Standards and testing techniques to design and develop high quality software products.	(K3)
CO5	:	Apply software project planning and management skills to develop software products.	(K3)
CO6	:	Plan, Design, develop prototype and test small software products using software engineering principles, tools and process models.	(K6)

Text Books

1. Pressman, R. S., "*Software Engineering: A Practitioners Approach*", 7th edition, McGraw Hill, 2010.
2. Mall, Rajib, "*Fundamentals of Software Engineering*", 3rd edition, PHI Publication, 2009.

Reference Books

1. Sommerville, Ian, "*Software Engineering*", Addison-Wesley 9th Edition, 2011.
2. Jalote P., "*Software Project Management in practice*", Pearson Education, New Delhi, 2002.

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	3	-	-	3	-	-
CO3	3	2	2	-	-	-	-	-	3	2	-	-	2	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	3	-	3	-	-	-	-
CO6	3	3	3	3	-	-	-	-	3	3	3	-	3	-	-
Score	18	13	14	3	-	-	-	-	12	8	6	-	10	-	-
COM	3	3	3	3	-	-	-	-	3	3	3	-	3	-	-

PROGRAM ELECTIVE-II

Course Code	**CSPE21**
Course Title	**Microprocessors and Interfacing**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objectives

- To introduce the major concepts of language translation and compiler design.
- To enrich the knowledge in designing and implementing compilers.
- To illustrate various parts of compiler and its use.
- To apply standard techniques to solve basic problems that arise in compiler construction.
- To implement the fundamental algorithms used in compiler construction.
- To provide practical programming skills, necessary for constructing a compiler.

Course Content:

Unit-I Introduction to Microprocessor **8**

History and evolution, Types of microprocessors, Block diagram of 8085, Pin diagram of 8085, Addressing modes, Types of Instructions.

Unit-II Assembly Language Programming and Timing Diagram **8**

Assembly language programming in 8085, Macros, Labels and Directives, Microprocessor timings, Instruction cycle, Machine cycles, T states, Timing diagram for different machine cycles.

Unit-III Serial I/O and Interrupts **8**

Serial I/O using SID, SOD, Interrupts in 8085, Issues in implementing interrupts, multiple interrupts and priorities, Daisy chaining, Interrupt handling, Enabling, disabling and masking of interrupts.

Unit-IV Data transfer techniques **8**

Programmed data transfer, Parallel data transfer using 8155. Programmable parallel ports and handshake input/output, Programmable interrupt controller 8259A, DMA transfer, Cycle stealing and burst mode of DMA, 8257 DMA controller.

Unit-V Microprocessor Interfacing Techniques Interfacing memory and I/O devices 8

Addressing memory, interfacing static RAMs, Interfacing and refreshing dynamic RAMs, interfacing a keyboard, Interfacing a printer, Interfacing A/D converters, D/A converters. Architecture of 8086: Pin diagram of 8086, addressing modes, Comparison of 8086 and 8088, Minimum mode maximum mode, system timing, introduction to Pentium and further series of microprocessors.

LAB EXPERIMENTS

1. Introduction of microprocessor 8085 trainer kit – 85AD.
2. The addition of two 8-bit numbers.
3. The subtraction of two 8-bit numbers.
4. The addition with carry of two 8-bit numbers.
5. The subtraction with barrow of two 8-bit numbers.

6. The addition of two BCD numbers.
7. The subtraction of two BCD numbers.
8. The multiplication of two 8-bit numbers by repeated addition method.
9. The multiplication of two 8-bit numbers by bit Rotation method.
10. The division of two 8-bit numbers by repeated addition method.
11. The division of two 8-bit numbers by bit rotation method.
12. The square of given numbers in array.
13. To find largest number in an array.
14. Study of 8086 microprocessor kit.
15. The addition of two 16-bit numbers.

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 8085 microprocessor. (K2)

CO2 : Apply programming techniques in developing the assembly language program for microprocessor applications. (K3)

CO3 : Understand various types of interrupts and their working. (K3)

CO4 : Examine different types of data transfer techniques. (K4)

CO5 : Design and construct Microprocessor and Microcontroller based systems. (K6)

Text Books

1. Gaonkar, Ramesh S, "*Microprocessor architecture, Programming and applications with 8085*", 6th Edition, Prentice Hall, 2018.
2. Brey, Barry B., "*The Intel Microprocessor, 8086/8088, 8018/80188, 80286, 80386, 80486, Pentium and Pentium pro-processors – architecture, Programming and interfacing*", 8th Edition, Prentice Hall 2020.

Reference Book

1. Ufferbeck John, "*The 8080/85 Family: Design, Programming and Interfacing"*, PHI India, 2019.

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	-

Course Code	CSPE22
Course Title	Software Maintenance
Number of Credits	3-0-4-5
Course Type	PE

Course Objectives

- To impart the knowledge of Software Maintenance and various software maintenance process models.
- To impart the knowledge of Software Cost Computing models.
- To learn the fundamental principles and methodologies of software reengineering.
- To learn the Software Reusability approaches.
- To impart knowledge of different software Metrics for providing high quality software products.

Course Content:

Unit-I Software Maintenance **8**

The nature of Software maintenance, Software Maintenance types, Characteristics of maintainable software. Software Maintenance Process Models: The Software Maintenance Process Lifecycle, Change Request and Change Requests Management, The software maintenance process Models, Quick-and-Fix Model, Bohem's Model, Version Control.

Unit-II Software Cost Modeling and Software Cost Computing **8**

Maintenance Cost issues using COCOMO II model, Bohem's Maintenance Cost Model,

Unit-III System Evolution and Re- engineering in Maintenance **8**

The Re- Engineering Process Definition, Advantages, Reverse engineering: Reverse Engineering vs. Forward Engineering.

Unit-IV Software Reuse and Reuse Landscape **8**

Software Reusability Definition, Problems. Benefits, Approaches to Reuse, Software Reuse and Maintainability Issues Design Patterns, Frameworks, Program Generators, Reuse, Aspect-Oriented Development.

Unit-V Software Metrics **8**

Software Quality Measures, Types of measures: Size –Oriented Metrics, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

LAB EXPERIMENTS

1. Documenting existing software by both top-down and bottom-up approach.
2. Changing software and documenting the changes.
3. To diagnose the error and removal of defect.
4. Develop and prove the hypothesis for debugging.
5. Validating software changes.
6. Software maintenance cost computing with COCOMO-II model.
7. Software maintenance cost computing by Bohem's Maintenance Cost Model.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Explain the Software Maintenance and various software maintenance process Models.	(K2)
CO2	:	Analyze and apply different models for Computing the Software Cost.	(K4)
CO3	:	Apply software reengineering on various small software products.	(K3)
CO4	:	Make use of different approaches for Software Reuse.	(K3)
CO5	:	Apply software Metrics for yielding quality software products.	(K3)
CO6	:	Change, document, test and validate software changes using software maintenance and reengineering principles.	(K6)

Text Books

1. Sommerville, I. "*Software Engineering*", 10th Edition, Addison Wesley, 2016.
2. Tripathy P. and Naik K., "*Software Evolution and Maintenance: A Practitioner's Approach*", Wiley, 2015.

Reference Books

1. Pressman, Roger," *Software Engineering a Practitioner's Approach*", 7th edition, 2010.
2. Grubb, Penny and Takang, Armstrong, "*A Software Maintenance: Concepts and Practice,* 2nd Edition", World Scientific Publishing Co. Ltd., 2003.

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	3	-	-	3	-	-
CO3	3	2	2	-	-	-	-	-	3	2	-	-	2	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	3	-	3	-	-	-	-
CO6	3	3	3	3	-	-	-	-	3	3	3	-	3	-	-
Score	18	13	14	3	-	-	-	-	12	8	6	-	10	-	-
COM	3	3	3	3	-	-	-	-	3	3	3	-	3	-	-

SIXTH SEMESTER

Course Code	**CSL601**
Course Title	**Internship**
Number of Credits	**0-0-40-00**
Course Type	**GIR**

The curriculum has support for Industrial/Academic/RandD 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.

Course Code	**CSO602**
Course Title	**Honors Online Course-II**
Number of Credits	**5-1-0-3**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in Semester V 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.

Course Code	**CSO602**
Course Title	**Optional Online Course-II**
Number of Credits	**5-1-0-(0-3)**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfill 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.

SEVENTH SEMESTER

Course Code	**HMC701**
Course Title	**Professional Ethics**
Number of Credits	**1-0-0-0**
Course Type	**GIR**

Course Objectives

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

Course Content:

Unit-I Human Values **3**

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-II Engineering Ethics **3**

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-III Engineering as Social Experimentation **2**

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

Unit-IV Safety, Responsibilities and Rights **4**

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-V Global Issues **3**

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*", Prentice Hall of India, 2013.
2. Martin Mike W., Schinzinger Roland, "*Ethics in engineering*", Tata Mc Graw Hill, 4th Edition, 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	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Score	-	-	-	-	-	2	2	9	-	-	-	-	-	-	3
COM	-	-	-	-	-	2	2	3	-	-	-	-	-	-	3

Course Code	**CSL702**
Course Title	**Project Phase-II**
Number of Credits	**0-0-12-6**
Course Type	**GIR**

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 Content:

The project work is designed for a total duration of three semesters as a single project involving detailed literature survey, implementation and experimentation plan.
At the end of the 5th semester, the work done will be evaluated. It is expected that approx. 20- 30% of the overall project work should have been completed and demonstrated. The remaining 70-80% must be completed and demonstrated in 7th and 8th semester as project phase-II and III as per the clause 10.3 of Academic rules and regulations.

COURSE OUTCOMES:

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

CO1 : Illustrate a sound technical knowledge of the selected project domain. (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 : Demonstrate and compare the available solutions. (K4)
CO5 : Construct 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
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	12	12	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	**CSO703**
Course Title	**Honors Online Course-III**
Number of Credits	**5-1-0-3**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in Semester VI 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.

Course Code	**CSO703**
Course Title	**Optional Online Course-III**
Number of Credits	**5-1-0-(0-3)**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfill 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.

PROGRAM ELECTIVE-III

Course Code	**CSPE31**
Course Title	**Advanced Operating Systems**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objectives

- To introduce the advanced concepts of operating systems.
- To study a broad range of behaviors arising from complex system design, including: resource sharing and scheduling, low-level operating systems, separation of mutually distrusting parties on a common platform, network-protocol design and implementation.
- To enrich the knowledge in distributed systems.
- To develop the perspective for modern day computing applications.

Course Content:

Unit-I Overview of Advanced Operating Systems **8**

Introduction, Functions of OS, Design approaches, Types of advances OS.

Unit-II Architecture of Distributed OS **8**

Introduction, Motivations, System Architecture Types, Distributed OS, and Issues in distributed OS, Communication Networks and Primitives.

Unit-III Interproccess Communication **8**

APIs for Internet Protocols, External Data Representations, Client-Server Communication, Group Communication, Distributed Objects.

Unit-IV Distributed File Systems **8**

Introduction, Architecture, Design Issues, Case Studies: Sun Network File System, Andrew File System. Time and Global State: Physical and Logical Time, Internal and External Synchronization protocols like Cristian's Algorithm, Berkeley Algorithm, Network Time Protocol, Lamport's Logical Clocks, Vector Clocks, Casual Ordering of Message, Global State, Cuts of a Distributed Computation, Termination Detection.

Unit-V Distributed Mutual Exclusion and Election **8**

Simple and Multicast based Mutual Exclusion Algorithms: Centralized, Ring based, Ricart Agrawala's Algorithm, Maekawa's Algorithm, Election Algorithms: Ring based, Bully's Algorithm, Multicast Communication.

LAB EXPERIMENTS

1. Managing users.
2. Managing systems.
3. File management.
4. Shell Scripting: syntax and execution.
5. Creating new process.

6. Counting maximum number of processes, a system can handle at a time.
7. Handling system calls, inter process communication through pipes and message passing, Zombie process, orphan process.
8. Handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.
9. Study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).
10. Multiple sleeping barber problem.
11. Semaphores in multiprocessor operating systems.
12. Multithreading in multiprocessor operating systems.

Total Periods: 40 + 48 = 88

COURSE OUTCOMES:

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

CO1 : Explain functions, design approaches and advancements in Operating Systems. (K2)
CO2 : Illustrate the motivations, architectures and issues in Distributed Operating Systems. (K2)
CO3 : Construct External Data Representations and Inter-process Communication in Distributed Systems. (K3)
CO4 : Analyze design issues and performances of different Distributed File Systems and Timing approaches for Distributed Synchronization. (K4)
CO5 : Design and Develop a Distributed Computing facility and Analyze various Distributed Mutual Exclusion approaches. (K6)

Text Books

1. G. Coulouris, J. Dollimore, and T. Kindberg, "*Distributed Systems: Concepts and Design*", Pearson Education.
2. M. Signal and N. Shivaratri, "*Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems*", McGraw Hill International Edition.

Reference Book

1. R.K. Sinha, "*Distributed Operating Systems*", Prentice Hall.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	1	1	-	-	-	-	-	-	-	2	2	2
CO2	3	2	3	1	1	-	-	-	-	-	-	3	2	2	2
CO3	3	3	3	1	1	2	-	3	-	-	-	3	2	2	2
CO4	3	3	3	3	1	-	-	3	-	-	-	3	3	2	2
CO5	3	2	3	3	3	2	-	3	-	-	-	3	3	3	3
Score	15	12	15	9	7	4	-	9	-	-	-	12	12	11	11
COM	3	3	3	2	2	2	-	3	-	-	-	3	3	3	3

Course Code	**CSPE32**
Course Title	**Advanced Computer Networks**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objectives

- To understand the concept of IPV6 addressing and routing.
- To learn the principles of congestion control in networks.
- To learn and implement the routing protocols in WSN.
- To learn the role and working principle of Overlay networks.
- To understand and simulate the routing protocols in Delay Tolerant Networks.

Course Content:

Unit-I Introduction **8**

History and Context, IPv6, Packet switching. Internetworking: Architectural Principles, Names, Addresses. Interdomain Routing.

Unit-II Resource Management **8**

End-to-End Congestion Control, Fair Queuing, WFQ, CSFQ, Router congestion control, RED, XCP. Quality of Service, Future requirements and IntServ, Router Design.

Unit-III Wireless Networks **8**

Wireless Networks Overview and Architectures (MACAW, WTCP), Wireless Networks in the Real World, Roofnet, Routing in ad-hoc Networks, Sensor networks, topology.

Unit-IV Applications, Naming, and Overlays **8**

Overlay Networks, Distributed Hash Tables, DNS and the Web, Names, Identifiers, and Network Architecture Measurement and Tracing, Internet Measurement, X Trace.

Unit-V Delay Tolerant Networks **8**

Data-oriented networking and DTNs, Multicast, Datacenter Networking.

LAB EXPERIMENTS

1. Configuration and logging to a CISCO Router and firewall and introduction to the basic user Interfaces.
2. Introduction to the basic router configuration and basic commands.
3. Configuration of IP addressing for a given scenario for a given set of topologies.
4. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
5. Configure, implement and debug the following: Use open-source tools for debugging and diagnostics.
6. ARP/RARP protocols.
7. RIP routing protocols.
8. BGP routing.
9. OSPF routing protocols.
10. Static routes (check using netstat).

11. Configure DNS: Make a caching DNS client, and a DNS Proxy, implement reverse DNS and forward DNS, using TCP dump/Wireshark characterize traffic when the DNS server is up and when it is down.
12. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterize file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
13. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
14. Implement Open NMS+ SNMPD for checking Device status of devices in community MIB of a Linux PC. Using yellow pages and NIS/NFS protocols implement Network Attached Storage Controller (NAS).
15. Extend this to serve a windows client using SMB. Characterize the NAS traffic using Wireshark.

Total Periods:40 + 48 = 88

COURSE OUTCOMES:

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

CO1	:	Explain the structure of IPv6 addressing.	(K2)
CO2	:	Explain the common congestion controls algorithms and policies implemented by the routers.	(K2)
CO3	:	Explain the Wireless Network Architecture and routing in WSN.	(K2)
CO4	:	Explain the architecture of Overlay Networks.	(K3)
CO5	:	Experiment with various routing protocols in Delay Tolerant Network.	(K6)

Text Books

1. James, F. Kurose and Keith, W. Ross, "*Computer Networking: A Top-Down Approach Featuring the Internet"*, 7th Edition, 2014.
2. Larry, Peterson and Bruce, Davie, *"Computer Networks: A Systems Approach"*, 7th Edition A.

Reference Books

1. Comer, D.E., "*Computer Networks and Internets with Internet Applications*", Fourth Edition, Prentice-Hall, 2010.
2. Leon-Garcia A. and Wadjaja I., "*Communication Networks, Fundamental Concepts and Key Architecture*", McGraw-Hill, 2000.
3. Stallings, W.S., "*Data and Computer Communications*", 10th Edition, Prentice-Hall, 1993.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	3	3	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	3	3	-	-	3	3	3
Score	11	-	-	7	3	-	-	-	3	3	-	-	3	3	3
COM	3	-	-	3	3	-	-	-	3	3	-	-	3	3	3

PROGRAM ELECTIVE-IV

Course Code	**CSPE41**
Course Title	**Parallel Architectures and Programming**
Number of Credits	**3-0-0-3**
Course Type	**PE**

Course Objectives

- To learn the fundamentals of Parallel Architectures.
- To study and understand the working of cache.
- To understand the working of GPU.
- To learn parallel programming.
- To design parallel programming codes.

Course Content:

Unit-I Introduction **8**

The need for parallelism, Forms of parallelism (SISD, SIMD, MISD, MIMD), Moore's Law and Multi-cores, Fundamentals of Parallel Computers, Communication architecture, Message passing architecture, Data parallel architecture, Dataflow architecture, Systolic architecture.

Unit-II Large Cache Design **8**

Shared vs. Private Caches, centralized vs. Distributed Shared Caches, Snooping-based cache coherence protocol, directory-based cache coherence protocol, Uniform Cache Access, Non-Uniform Cache Access.

Unit-III Graphics Processing Unit **8**

GPUs as Parallel Computers, Architecture of a modern GPU, Evolution of Graphics Pipelines, GPGPUs, Scalable GPUs, Architectural characteristics of Future Systems, Implication of Technology and Architecture for users, CUDA programming.

Unit-IV Introduction to Parallel Programming **8**

Strategies, Mechanism, Performance theory, Parallel Programming Patterns: Nesting pattern, Parallel Control Pattern, Parallel Data Management, Map: Scaled Vector, Mandelbrot, Collative: Reduce.

Unit-V Parallel Programming Languages **8**

Distributed Memory Programming with MPI: trapezoidal rule in MPI, I/O handling, MPI derived datatype, Collective Communication.

Total Periods:40

COURSE OUTCOMES:

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

CO1 : Explain the fundamentals of parallelism. (K3)
CO2 : Examine the functionality of Cache. (K4)
CO3 : Analyze the working role of GPU. (K5)
CO4 : Analyze the working of various parallel programming patterns. (K4)
CO5 : Examine collective communication. (K4)
CO6 : Develop parallel programming codes. (K6)

Text Books

1. Balasubramonian, Rajeev, Jouppi, Norman P., and Muralimanohar, Naveen, "*Multi-Core Cache Hierarchies*", Morgan and Claypool Publishers, 2019.
2. Culler, D. E., Singh, J. P., and Gupta, A., "*Parallel Computer Architecture*", Morgan-Kaufmann, 2015.

Reference Books

1. Kirk, David B., Wen-mei, W. Hwu, "*Programming Massively Parallel Processors: A Hands-on Approach*", 2018.
2. Larus, James R. and Rajwar, Ravi, "*Transactional Memory*", Morgan and Claypool Publishers, 2017.

CO to PO/PSO Mapping

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

Course Code	**CSPE42**
Course Title	**Digital Image Processing**
Number of Credits	**3-0-0-3**
Course Type	**PE**

Course Objectives

- To learn the basics of image processing.
- To get familiarized with various routinely used digital image processing tools and techniques.
- To understand the role of image processing applications in our daily life.
- To comprehend and adapt the digital image processing techniques for application in different devices.
- To learn the frameworks and additional tools for the development of digital image processing applications aiming at improving human life.

Course Content:

Unit-I Introduction **8**

What is DIP, Fundamental: Digital Image Representation, Reading, Displaying and Writing images, Data Classes, Image Types, Converting between data classes and image types, array indexing, Some important standard arrays.

Unit-II Image Transformations and Spatial Filtering **8**

Intensity Transformation functions, Histogram processing and function plotting, Spatial filtering, Image processing toolbox, Standard spatial filters.

Unit-III Frequency Domain Processing **8**

The 2D discrete Fourier transform, Filtering in the frequency domain, obtaining frequency domain filters form spatial filters, generating filters directly in the frequency domain, Sharpening frequency domain filters.

Unit-IV Image Restoration **8**

A model of the image degradation/ Restoration process, Noise models, Restoration in the presence of noise only, Periodic noise reduction by frequency domain filtering, Modeling the degradation function, Direct Inverse Filtering, Wiener Filtering.

Unit-V Color Image Processing and Image Compression **8**

Color Image representation, converting to other color spaces, the basic of color image processing, Color transformations, Spatial Filtering of color images, working directly in RGB Vector Space. Image Compression: Coding redundancy, Inter pixel redundancy, Psychovisual redundancy, JPEG Compression.

Total Periods: 40

COURSE OUTCOMES:

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

CO1 : Demonstrate understanding of the fundamentals of digital image processing. (K2)

CO2 : Develop understanding and underlying techniques of Image transformations and filtering. (K3)

CO3 : Develop understanding of frequency domain processing techniques. (K3)

CO4 : Develop understanding of modelling techniques used to restore images. (K3)

CO5 : Develop understanding of color image processing and compressing techniques (K3)

Text Book

1. Gonzalez Rafael C., Woods Richard E. and Eddins Steven L., "*Digital Image Processing using MATLAB*", Gatesmark Publishing, Second Edition, 2009.

Reference Book

1. Acharya Tinku and Ray Ajoy K., "*Image Processing Principles and Applications*", John Wiley and Sons Publishers, 2005.

CO to PO/PSO Mapping

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

EIGHTH SEMESTER

Course Code	**CSL801**
Course Title	**Project Phase-III**
Number of Credits	**0-0-18-9**
Course Type	**GIR**

Course Objectives

- To explore the 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 Content:

The project work is designed for a total duration of three semesters as a single project involving a detailed literature survey, implementation and experimentation plan.
At the end of the 5th semester, the work done will be evaluated. It is expected that approx. 20- 30% of the overall project work should have been completed and demonstrated. The remaining 70-80% has to be completed and demonstrated in the 7th and 8th semesters as project phase-II and III as per clause 10.3 of Academic rules and regulations.

COURSE OUTCOMES:

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

CO1 : Demonstrate a sound technical knowledge of the selected project domain. (K2)
CO2 : Survey research studies, find research gaps, and formulate 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. (K4)
CO5 : Evaluate results using various performance metrics and compare it with the available solutions. (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	12	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	**CSO802**
Course Title	**Honors Online Course-IV**
Number of Credits	**5-1-0-3**
Course Type	**OC**

This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in Semester VII 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 a suitable letter grade in this course.

Course Code	**CSO802**
Course Title	**Optional Online Course-IV**
Number of Credits	**5-1-0-(0-3)**
Course Type	**OC**

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

STREAM ELECTIVE – I

APPLICATIONS

(Offered by Department of IT)

Course Code	ITSE11
Course Title	Mobile Applications Development
Number of Credits	3-0-0-3
Course Type	SE

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 Content:

Unit-I Introduction to Android **8**

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

Unit-II User Interface and Application Components **8**

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-III Files and Database Handling **8**

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-IV User Experience Enhancement **8**

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

Unit-V Multimedia Wireless Connectivity and Telephony **8**

Audio and Video Handling, Manipulating Raw Audio, Sound Effects, Camera Programming, Video Recording, Managing Wireless Connectivity: Wi-Fi, 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. G Meier R. and Lake I., "*Professional Android*", Wrox, Fourth Edition, 2018.
2. Gifford M., "*Phone Gap Mobile Application Development Cookbook*", PACKT, 2012.

Reference Book

1. Kosmaczewski Adrian, *"Mobile JavaScript Application Development"*, O'RELLY, First Edition, 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	3	1	2	2	2	2	-	-	-	-	2	-	2

Course Code	**ITSE12**
Course Title	**Cloud Computing**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 an efficient and reliable cloud environment.

Course Content:

Unit-I Cloud Computing Basics **8**

Cloud Computing overview, Applications, Internets and the Cloud, First moves in the Cloud, Benefits, Limitations and Security Concerns in the Cloud.

Unit-II Cloud Computing Technology **8**

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

Unit-III Cloud Storage and Standards **8**

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

Unit-IV Cloud Computing at Work **8**

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

Unit-V Organizations and Cloud Computing **8**

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 : Analyze the role and functioning of various cloud storage platforms. (K5)
CO4 : Analyze 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*", McGraw Hill, Indian edition, 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**
CO1	2	3	3	3	2	2	2	2	1	3	-	3	3	3	3
CO2	2	3	2	3	3	2	-	-	-	3	-	3	-	2	2
CO3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO4	2	3	3	3	3	-	-	-	-	3	-	3	-	2	2
CO5	2	3	3	1	-	-	-	-	-	3	-	3	-	2	2
CO6	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

Course Code	**ITSE13**
Course Title	**Internet of Things**
Number of Credits	**3-0-0-3**
Course Type	**SE**

Course Objectives

- To infer the basics of Internet of Things (IoT) and its architecture.
- To understand the architecture and networking in IoT.
- 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 Content:

Unit-I IoT Introduction and Fundamentals **8**

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-II IoT Architecture and Networking **8**

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-III IoT Communication Technologies **8**

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-IV Cloud and Fog Computing in IoT **8**

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-V IoT Applications and Data Analytics **8**

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 and Sons, 2018.
2. Hersent, O., Boswarthick D., and Elloumi, O., The Internet of Things: Key Applications and Protocols. John Wiley and Sons, 2011.

CO to PO/PSO Mapping

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

Course Code	ITSE14
Course Title	Big Data Analytics
Number of Credits	3-0-0-3
Type of Course	SE

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 Content:

Unit-I Introduction to Big Data **8**

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-II Regression and Classification **8**

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-III Data Stream Analysis **8**

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-IV Frequent Itemset and Clustering **8**

Mining frequent itemset: Market based model, Apriori algorithm, handling large data sets in main memory, Limited Pass algorithm, counting frequent itemset in a stream, Clustering techniques: Hierarchical, k-Means, Clustering high dimensional data. .

Unit-V NoSQL Data Management for Big Data **8**

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, 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**
CO1	2	2	3	1	1	-	-	3	-	-	-	-	1	3	2
CO2	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO3	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO4	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO5	2	2	3	3	1	-	-	3	-	-	-	3	3	3	3
Score	10	13	15	13	5	-	-	6	-	-	-	12	13	15	11
COM	2	3	3	3	1	-	-	3	-	-	-	3	3	3	3

Course Code	**ITSE15**
Course Title	**Computer Vision**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content:

Unit-I Camera Geometry **8**

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-II Image Alignment **8**

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-neighbor interpolation, Image alignment using image similarity measures: mean squared error, normalized cross-correlation, Monomodal and multimodal image alignment.

Unit-III Robust methods in Computer Vision **8**

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-IV Structure from Motion **8**

Motion as a cue to an 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-V Optical Flow **8**

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"*, Pearson Education, 2nd Edition, 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**
CO1	2	2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO2	2	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	3	3	2	2	-	-	-	-	-	-	2	-	2
CO4	2	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO5	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 ELECTIVE –II
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Offered by Department of CSE)

Course Code	**CSSE11**
Course Title	**Machine Learning**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Introduction to Machine Learning **8**

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

Unit-II Modeling **8**

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

Unit-III Decision Tree and Learning Rules **8**

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

Unit-IV Unsupervised Learning Techniques **8**

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-V Reinforcement Learning **8**

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. Tom, Mitchell, "*Machine Learning*", McGraw-Hill, 2017.
2. Shai, Shalev-Shwartz, Shai, Ben-David, "*Understanding Machine Learning from Theory to Algorithms*", Cambridge University Press, 2014.

Reference Books

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

Course Code	**CSSE12**
Course Title	**Deep Learning**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Basics **8**

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-II FeedForward Networks **8**

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-III Better Training of Neural Networks **8**

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-IV Convolutional Neural Networks **8**

Introduction to CNNs, Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Unit-V Recent Trends and Applications **8**

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 Book

1. Goodfellow I., Bengio, Yoshua and Courville, Aaron, "*Deep Learning*", MIT Press, 2017.

Reference Book

1. Bishop, Christopher, "*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**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	**CSSE13**
Course Title	**Artificial Intelligence**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Introduction to AI **8**

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, Constraint's satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

Unit-II Knowledge Representation **8**

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-III Reasoning **8**

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-IV Game Playing and Planning **8**

Overview, Min-Max 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 systems.

Unit-V Understanding and NLP **8**

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, Kevin and Rich, Elaine, Nair B., "*Artificial Intelligence (SIE)"*, 3rd Edition, McGraw Hill, 2017.

Reference Book

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

CO to PO/PSO Mapping

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

Course Code	**CSSE14**
Course Title	**Soft Computing**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Introduction of Soft Computing **8**

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-II Evolutionary Computation **8**

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-III Terminologies and Operators of GA **8**

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-IV Introduction to Fuzzy Logic **8**

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-V Automated Methods for Fuzzy Systems **8**

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, Multifeatured 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, Mitchell, "*Machine Learning*", McGraw-Hill, 2017.
3. Zimmermann H. J. "*Fuzzy set theory and its applications*" Springer international edition, 2011.

Reference Books

1. Timothy, J. Ross, "*Fuzzy Logic with Engineering Applications*", 3rd Edition, Wiley India, 2010.
2. Shai, Shalev-Shwartz, Shai, Ben-David, "*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**
CO1	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO2	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	10	4	-	-	6	-	-	-	-	-	-	9	-	-	-
COM	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-

Course Code	CSSE15
Course Title	NLP with Deep Learning
Number of Credits	3-0-0-3
Course Type	SE

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 Content:

Unit-I Vector Semantics and Embeddings **8**

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-II Neural Language Model **8**

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-III Machine Translation **8**

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-IV CNNs and Attention **8**

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-V Pre-Training and Transformers **8**

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, Dan and Martin, James, *"Speech and Language Processing, 2nd Edition"*, Prentice Hall, 2013.
2. Manning, Christopher and Heinrich, Schutze, "*Foundations of Statistical Natural Language Processing*", MIT Press, 1999.

Reference Books

1. Allen, James, "*Natural Language Understanding, 2nd edition*", Benjamin Cumming, 2002.
2. Charniack, Eugene, "*Statistical Language Learning*", MIT Press, 1996.

CO to PO/PSO Mapping

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

STREAM ELECTIVE - III

DATABASE AND NETWORKING

(Offered by Department of CSE)

Course Code	**CSSE21**
Course Title	**Relational Database Management Systems**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Query Processing and Optimization 8

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-II Concurrency Control Techniques 8

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-III Database Security and Authorization 8

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, EER-to-Relational Mapping, Data Abstraction and Knowledge Representation Concepts, Integrity Constraints in data modelling, EER Update Operations and Transaction Specification.

Unit-IV Object-Oriented Databases 8

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 OO concepts.

Unit-V Deductive Databases 8

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, Ramez, Navathe and Shamkant B, "*Fundamentals of Database Systems*" The Benjamin/Cummings Publishing company Narosa Spetial Edition, 2016.
2. Dabir, Himanshu and Meher, Dipali, "*Advanced RDBMS Using Oracle"*, Vision Publications, 2nd edition, 2014.
3. A. Silberschatz, Henry. F. Korth, S. Sudarshan, *"Data base System Concepts",* McGraw Hill Education (India) Private Limited, 6th edition, 2011.

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	-	-

Course Code	**CSSE22**
Course Title	**Advanced Database Management Systems**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Relational Model Issues **8**

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

Unit-II Distributed Databases **8**

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-III Object Oriented Databases **8**

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

Unit-IV Emerging Systems **8**

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

Unit-V Current Issues **8**

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	:	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, Thomas and Begg, Carlolyn, *"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**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	12	-	-	-	-	-	-	-	-	8	-	-
COM	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	**CSSE23**
Course Title	**Database Security**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Introduction and Security Models **8**

Introduction to Databases, Security Problems in Databases, 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-II Security Models and Mechanisms **8**

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 conclusion.

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-III Security Software Design **8**

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

Unit-IV Statistical Database Protection and Intrusion Detection System **8**

Introduction Statistics: Concepts and Definitions, Types of Attacks, Inference Controls, Evaluation Criteria for Control Comparison.

Introduction IDES System, RETISS System, ASES System Discovery.

Unit-V Models for Protection of New Generation Database System **8**

Models for The Protection of New Generation Database Systems -1: Introduction, A 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 -2: A Model 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 of database security and understand the basic security models. (K3)
CO2 : Able to understand the database security models and mechanisms. (K3)
CO3 : Identify security threats in database systems. (K3)
CO4 : Analyze and evaluate the different attacks on statistical databases. (K4)

CO5 : Test and evaluate secure database systems. (K5)

Text Books

1. Hassan A. Afyouni, "*Database Security and Auditing",* India Edition, CENGAGE Learning, 2013.
2. Castano S., Fugini M., Martella G., Samarati P., "*Database Security*", Second edition, Diane Pub Co., June 1996.

Reference Book

1. Alfred basta, melissa zgola, "*Database Security*", Delmar Cengage Learning, July 2011.

CO to PO/PSO Mapping

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

Course Code	**CSSE24**
Course Title	**Mobile Computing and Communication**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content:

Unit-I Wireless Transmission **8**

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-offs and their characteristics.

Unit-II Medium Access Control **8**

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-III Wireless LAN **8**

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

Unit-IV Mobile Network Layer **8**

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-V Mobility **8**

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 and 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. Jochen, Schiller, "*Mobile Communication*", 2nd Edition, Pearson Education, 2018.

Reference Books

1. Theodore and S. Rappaport, "*Wireless Communications, Principles, Practice*", PHI, 2015.
2. Andrew S. Tanenbaum, "Computer Networks",2013.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	2	2	2	2	1	3	-	3	3	3	3
CO2	2	3	2	3	3	2	-	-	-	3	-	3	-	2	2
CO3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO4	2	3	3	3	3	-	-	-	-	3	-	3	-	2	2
CO5	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	12	17	17	16	12	6	4	4	2	18	3	18	9	14	15
COM	2	3	3	3	3	2	2	2	1	3	3	3	3	3	3

Course Code	**CSSE25**
Course Title	**Wireless Sensor Networks**
Number of Credits	**3-0-0-3**
Course Type	**SE**

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 Content

Unit-I Introduction and Fundamentals **8**

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 WNS nodes, Operating systems and execution environments, Sensor network scenarios, Optimization goals in WSNs, Design principles of WSNs, Service interfaces and gateways in WSNs.

Unit-II WSN Communication Protocols **8**

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-III Localization and Positioning of WSN Nodes **8**

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 literation, Single-hop localization, Positing in multi-hop environments, Impacts of anchor placement.

Unit-IV Topology Control and Routing Protocols **8**

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-V Networking and QoS in WSN **8**

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. Karl, Holger, and Andreas Willig. Protocols and architectures for wireless sensor networks. John Wiley and Sons, 2007.
2. Ibnkahla, Mohamed. Wireless sensor networks: a cognitive perspective. CRC Press, 2012.

Reference Books

1. Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of Wireless Sensor Networks: theory and practice. John Wiley and Sons, 2010.
2. Rastko, R., Phoha Selmic, and Vir V. Serwadda. 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 ELECTIVE- IV

SECURITY

(Offered by Department of IT)

Course Code	**ITSE21**
Course Title	**Information Security**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Overview of Information Security **8**

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

Unit-II Access Control **8**

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-III Database Security **8**

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

Unit-IV Authentication and Authorization **8**

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-V Firewall and Intrusion Detection and Prevention Systems **8**

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

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 William and Brown Lowrie, "*Computer Security: Principles and Practice*", Pearson, Fourth Edition, 2018.
2. Stamp Mark, "*Information Security: Principles and Practices*", Wiley Publication, Second Edition, 2011.

Reference Book

1. Stallings William, "*Cryptography and Network Security: Principles and Practice*", Pearson, Seventh 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	2	1	2	2	2	2	-	-	-	-	2	-	2

Course Code	**ITSE22**
Course Title	**Principles of Cryptography**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Classical Cryptography **8**

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-II Advanced Encryption Standard **8**

Introduction to DES, Finite field arithmetic, AES Structure, AES Transformation functions, AES Key expansion, An AES Example, AES Implementation.

Unit-III The RSA System and Factoring **8**

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-IV Elliptic Curve Cryptosystem **8**

The basic setup, Diffie-Hellman Key exchange, Massy-Omura Encryption, ElGama Public key encryption.

Unit-V Digital Signature Scheme **8**

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 Bruce, *"Applied Cryptography: Protocols, Algorithms and Source Code in C"*, Wiley Publication, Second Edition, 2012.

Reference Book

1. Stallings William, "*Cryptography and Network Security: Principles and Practice*", Pearson, Seventh Edition, 2017.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	-	-	-	-	-	3	-	-	3	-	3
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	3
CO3	3	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	15	12	1	9	8	-	-	-	-	3	-	-	6	-	9
COM	3	3	1	3	2	-	-	-	-	3	-	-	3	-	3

Course Code	**ITSE23**
Course Title	**Network Security**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Overview of Network Security **8**

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-II Digital Signatures and Authentication **8**

Requirements, Authentication functions, Message Authentication Codes, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures.

Unit-III Internet Protocol and Security Standards **8**

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-IV Internet Authentication and Applications **8**

Kerberos, X.509, Public Key Infrastructure.

Unit-V Wireless Network Security **8**

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 : Analyze 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 William and Brown Lowrie, "*Computer Security: Principles and Practice*", Pearson, Fourth Edition, 2018.
2. Stamp Mark, "*Information Security: Principles and Practices*", Wiley Publication, Second Edition, 2011.
3. Stallings W., "*Cryptography and Network Security: Principles and Practice*", 7th edition, Pearson, 2017.

Reference Book

1. Kahate Atul, "Cryptography and Network Security", Tata McGraw-Hill, Third Edition, 2013.

CO to PO/PSO Mapping

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

Course Code	**ITSE24**
Course Title	**Applied Cryptography**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Foundations **8**

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-II Cryptographic Protocols **8**

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-III Cryptographic Techniques **8**

Key Management: Generating Keys, Non-linear Key spaces, 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-IV Cryptographic Algorithms **8**

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

Unit-V The Real world **8**

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 Bruce, *"Applied Cryptography: Protocols, Algorithms and Source Code in C"*, Wiley Publication, Second Edition, 2012.

Reference Book

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

CO to PO/PSO Mapping

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

Course Code	**ITSE25**
Course Title	**Cyber Physical Systems**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Symbolic Synthesis for Cyber-Physical Systems **8**

Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools.

Unit-II Software and Platform Issues in Feedback Control Systems **8**

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-III Security of Cyber Physical System **8**

Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches.

Unit-IV Synchronization in Distributed Cyber Physical System **8**

Challenges in Cyber-Physical Systems, A Complexity Reduction Technique for Synchronization, Basic Techniques.

Unit-V Cyber Physical Systems Application Domain **8**

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. R. Rajkumar, Dionisio de Niz and Mark Klein, "*Cyber-Physical Systems*", First Edition, Addison Wesley Professional, 2017.

Reference Books

1. Rajeev Alur, "*Principles of Cyber-Physical Systems*", MIT Press, 2015.
2. Sandip Roy and Sajal K. Das, "*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**
CO1	2	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	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)

Course Code	**ECSE11**
Course Title	**Introduction to IoT**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I IoT Introduction and Fundamentals **8**

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-II IoT Architecture and Networking **8**

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-III IoT communication Technologies **8**

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, Semantic protocols, IoT interoperability standards and frameworks.

Unit-IV Cloud and Fog Computing **8**

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

Unit-V IoT Applications and Data Analytics **8**

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 metrics 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, Sudip, Anandarup Mukherjee, and Arijit Roy, "*Introduction to IoT*", Cambridge University Press, 2021.
2. Serpanos, Dimitrios, and Marilyn Wolf, "*Internet-of-things (IoT) systems: architectures, algorithms, methodologies*", Springer, 2017.

Reference Books

1. Xiao, Perry, "*Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed*", John Wiley and Sons, 2018.
2. Hersent, Olivier, David Boswarthick, and Omar Elloumi, "*The internet of things: Key applications and protocols*", John Wiley and Sons, 2011.

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

Course Code	ECSE12
Course Title	Wireless Sensor Networks
Number of Credits	3-0-0-3
Type of Course	SE

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 Content

Unit-I WSN Introduction to Fundamentals 8

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 WNS nodes. Operating systems and execution environments. Sensor network scenarios. Optimization goals in WSNs. Design principles of WSNs. Service interfaces and gateways in WSNs.

Unit-II WSN Communication Protocols 8

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-III Localization and Positioning of WSN Nodes 8

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-IV Topology Control and Routing Protocols 8

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-V Networking and QoS in WSN 8

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 : Generalize the architecture of wireless sensor networks. (K2)
CO2 : Review the various WSN communication protocols. (K2)
CO3 : Acquire the concepts of localization and positioning of WSN nodes. (K3)
CO4 : Explore the concepts of routing and topology control in WSN (K3)
CO5 : Investigate the various routing protocols in WSN. (K3)

Text Books

1. Karl, Holger, and Andreas Willig, "*Protocols and architectures for wireless sensor networks*", John Wiley and Sons, 2007.
2. Ibnkahla, Mohamed, "*Wireless sensor networks: a cognitive perspective*", CRC Press, 2012.

Reference Book

1. Dargie, Waltenegus, and Poellabauer C., "*Fundamentals of wireless sensor networks: theory and practice",* John Wiley and Sons, 2010.

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	-	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	10	12	-	-	-	-	-	-	-	-	-	15	-	10
COM	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	**ECSE13**
Course Title	**Industrial IoT**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

Course Objectives

- To infer the basics of industry 4.0 and Industrial Internet of Things (IIoT).
- 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 Content

Unit-I Introduction to Industry 4.0 **8**

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-II Basics of IIoT **8**

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-III Key Technologies in IIoT **8**

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-IV Networking in IIoT **8**

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-V Machine Learning and Data Science in IIoT and Applications **8**

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. (K2)

CO4 : Acquire the concepts of networking in IIoT. (K3)

CO5 : Illustrate the applications of AI and data science in IIoT (K3)

Text Books

1. Misra, Sudip, 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. Mahmood, Zaigham, "*The Internet of Things in the Industrial Sector*", Springer International Publishing, 2019.
2. Veneri, Giacomo, 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

Course Code	**ECSE14**
Course Title	**Principles of Cyber Physical Systems**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Introduction to Cyber Physical Systems **8**

Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools. Open challenges in CPS.

Unit-II Classical Control and Hybrid Systems **8**

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-III Security and Synchronization in CPS **8**

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-IV Scheduling and Integration in CPS **8**

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-V Applications of Cyber Physical Systems **8**

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, Raj, Dionisio De Niz, and Mark Klein, "*Cyber-physical systems*" Addison-Wesley Professional, 2016.
2. Alur, Rajeev, "*Principles of cyber-physical systems*", MIT press, 2015.

Reference Books

1. Lee, Edward Ashford, and Sanjit Arunkumar Seshia, "*Introduction to embedded systems: A cyber-physical systems approach*", MIT Press, 2016.
2. Roy, Sandip, and Sajal K. Das, eds, "*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**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	13	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	ECSE15
Course Title	Communication in Cyber Physical Systems
Number of Credits	3-0-0-3
Type of Course	SE

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 Content

Unit-I Basics of CPS **8**

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-II Communication Capacity Requirements **8**

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-III Network Topology Design **8**

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-IV Communication Network Operation for CPS **8**

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-V Physical Layer Design for CPS **8**

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, Husheng, "*Communications for control in cyber physical systems: theory, design and applications in smart grids",* Morgan Kaufmann, 2016.
2. Ferrari, Silvia, and Thomas A, Wettergren, "*Information-driven Planning and Control*", MIT Press, 2021.

Reference Books

1. Hu, Fei., "*Cyber-physical systems: integrated computing and engineering design*", CRC Press, 2013.
2. Rodrigues, Joel JPC, and Amjad Gawanmeh, eds., "*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**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	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)

Course Code	**ECSE21**
Course Title	**Mobile Robots**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

Course Objectives

- To infer the basics of mobile robots.
- To understand the dynamic and kinematic modeling of mobile robots.
- To study the path and motion planning algorithms.
- To study the path and motion planning algorithms.
- To study the control aspects in mobile robots.

Course Content

Unit-I Mobile Robots: General Concepts and Sensors **8**

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-II Mobile Kinematics and Dynamics **8**

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 modeling: Newton-Euler method and Lagrange method. Differential-Drive WMR.

Unit-III Path and Motion Planning **8**

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-IV Localization and Mapping **8**

Basic concepts of robot localization. Stochastic modeling, 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-V Control of Mobile Robots **8**

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 robots. (K3)

Text Books

1. Tzafestas, Spyros G, "*Introduction to mobile robot control*", Elsevier, 2013.
2. Kagan, Eugene, Nir Shvalb, and Irad Ben-Gal, eds., "*Autonomous mobile robots and multi-robot systems: Motion-planning, communication, and swarming*", John Wiley and Sons, 2019.

Reference Books

1. Bräunl, Thomas, "*Embedded robotics: mobile robot design and applications with embedded systems*", Springer Science and Business Media, 2008.
2. Castellanos, Jose A., and Juan D. Tardos, "*Mobile robot localization and map building: A multisensor fusion approach*", Springer Science and Business Media, 2012.

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	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	14	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	ECSE22
Course Title	Machine Vision and Perception
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To infer the basics of 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 Content

Unit-I Robotic Vision Sensors **8**

Importance of robot vision. Classification of robotic sensors. Sensor Performance. Common sensors for mobile robots. Computer vision. Concepts of sensor fusion.

Unit-II Basics of Computer Vision **8**

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-III Position and Orientation **8**

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-IV Localization and Mapping **8**

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-V Recognition and Interpretations **8**

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. G. Dudek and M. Jenkin. "*Inertial Sensors, GPS, and Odometry*". In: Springer Handbook of Robotics. Springer, 2008.
2. Dahiya, Ravinder S., Valle, Maurizio, "*Robotic Tactile Sensing",* Springer, 2013.
3. S. R. Deb, Sankha Deb, *"Robotics Technology and Flexible Automation"*, 2nd edition, McGraw Hill Education, 2017.

Reference Books

1. Buduma N., "*Fundamentals of Deep Learning, Designing Next-Generation Artificial Intelligence Algorithms"*, O'Reilly Media, 2015
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision"*, Cengage, Third Edition, 2013.
3. Abdulmajeed Wael, Mansoor Revan, "*Visual Robot Slam of 2D and 3D Indoor Environment"*, LAP Lambert Academic Publishing, 2014.
4. D. A. Forsyth and J. Ponce, *"Computer Vision, A Modern Approach"*, Pearson Education, 2003.
5. D. H. Ballard and C. M. Brown, "*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**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	12	-	10
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	**ECSE23**
Course Title	**Pattern Recognition and Computational Intelligence**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 Content

Unit-I Introduction to Pattern recognition and CI **8**

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-II Uncertainty Based Information **8**

Information and 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 and Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

Unit-III Artificial Immune System **8**

Natural Immune System, Artificial Immune Models, Clonal Selection Theory Models, Network Theory Models, Network Theory Models.

Unit-IV Optimization Theory **8**

Basic Ingredients of Optimization Problems, Constrained Optimization, Unconstrained Optimization, Multi-Solution Problems, Multi-Objective Optimization, Dynamic Optimization Problems.

Unit-V Evolutionary Computing **8**

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 : Associate the basics of computational intelligence and pattern recognition. (K2)

CO2 : Express the fuzzy logic systems. (K2)

CO3 : Generalize the concepts of artificial immune systems (K3)

CO4 : Acquire the concepts of optimization. (K3)

CO5 : Relate 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.
3. G.J. Klir and B. Yuan, "*Fuzzy Sets and Fuzzy Logic*", 2nd Edition, PHI, 2015.

Reference Books

1. Craenen B., Eiben A., "*Computational Intelligence. In: Encyclopedia of Life Support Sciences",* EOLSS Publishers Co., 2003.
2. Russell S., Norwig P., "*Artificial Intelligence: A Modern Approach*", 3rd edition, Prentice Hall, 2010.
3. Melanie Mitchell, "*An Introduction to Genetic Algorithm*", PHI, 1998.

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	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	12	-	8
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	ECSE24
Course Title	Autonomous Mobile Robots
Number of Credits	3-0-0-3
Type of Course	SE

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 SLAM.
- To gain insights about swarm robotics.

Course Content

Unit-I Mobile Robot Kinematics **8**

Motion of robotic systems. Key challenges in robotic movement. Legged mobile robots. Wheeled mobile robots. Kinematic models of mobile robots. Mobile robot maneuverability. Mobile robot workspace. Motion control of mobile robots.

Unit-II Perception **8**

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-III Mobile Robot Localization **8**

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-IV Planning and Navigation **8**

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-V Swarm Robotics **8**

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, Roland, Illah Reza Nourbakhsh, and Davide Scaramuzza, "*Introduction to autonomous mobile robots*" MIT press, 2011.
2. Hamann, Heiko, "*Swarm robotics: A formal approach*", Springer. 2018.

Reference Books

1. Choset, Howie, et al., "*Principles of robot motion: theory, algorithms, and implementations*", MIT press, 2005.
2. Lozano-Perez, Tomás, *"Autonomous robot vehicles*", Springer Science and Business Media, 2012.

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	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	14	13	-	-	-	-	-	-	-	-	-	15	-	10
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

Course Code	**ECSE25**
Course Title	**Reinforcement Learning**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

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 RL.

Course Content

Unit-I Introduction to Reinforcement Learning **8**

Basics of neuroscience, Introduction to RL, RL Framework and applications, Immediate RL, Bandit optimalities, Value function-based methods, UCB-1, Concentration bounds, UCB-1 theorem, PAC bounds, Median elimination, Thompson sampling.

Unit-II MDP Modelling and Bellman Optimally **8**

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-III Eligibility Traces and Function Approximation **8**

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-IV Policy Gradient Approaches **8**

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-V Applications of RL and Case Studies **8**

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 : Characterize the basics of neuroscience and reinforcement learning. (K2)

CO2 : Estimate the bellman optimality and explore the concepts of dynamic programming and Monte Carlo methods. (K3)

CO3 : Explore the concepts of eligibility traces and function approximation. (K3)

CO4 : Acquire the concepts of policy gradient approaches (K3)

CO5 : Examine the applications of RL in various real-life examples. (K3)

Text Books

1. Richard S. Sutton and Andrew G. Barto, "*Reinforcement learning: An introduction"*, Second Edition, MIT Press, 2019.
2. Platt, Aske, "*Reinforcement learning: An introduction"*, Springer, 2020.

Reference Books

1. Platt, Aske, "*Deep reinforcement learning"*, Springer, 2022.
2. Sugiyama, Masashi, "*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**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2
Score	15	15	13	-	-	-	-	-	-	-	-	-	12	-	10
COM	3	3	3	-	-	-	-	-	-	-	-	-	3	-	2

MANAGEMENT ELECTIVE

Course Code	**HME731**
Course Title	**Organizational Behaviour**
Number of Credits	**3-0-0-3**
Type of Course	**GIR**

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 Content

Unit-I Focus and Purpose **8**

Definition, need and importance of organizational behavior, Nature and scope, Frame work, Organizational behavior models.

Unit-II Individual Behaviour **8**

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-III Group Behaviour **8**

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-IV Leadership and Power **8**

Meaning: Importance, Leadership styles, Theories, Leaders versus Managers. Sources of power: Power centers, Power and Politics.

Unit-V Dynamics of Organizational Behaviour **8**

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 working in team in an 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. Robins, S.P., "*Organizational Behavior"*, Pearson Education, 11th edition, 2008.
2. Luthans, F., "*Organisational Behavior"*, McGraw Hill, 11th edition, 2001.

Reference Book

1. Pareek, U., "*Understanding Organisational Behaviour"*, Oxford Higher Education, 2nd edition, 2004.

CO to PO/PSO Mapping

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

Course Code	HME732
Course Title	Entrepreneurship Development
Number of Credits	3-0-0-3
Type of Course	GIR

Course Objectives

- To develop and strengthen entrepreneurial quality and motivation in students
- To impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Course Content

Unit-I Entrepreneurship **8**

Entrepreneur: Types of Entrepreneurs, Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

Unit-II Motivation **8**

Major Motives, Influencing an entrepreneur, Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test, Stress Management, Entrepreneurship Development Programs: Need, Objectives.

Unit-III Business **8**

Small 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-IV Financing and Accounting **8**

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-V Support to Entrepreneurs **8**

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 and Co. Ltd.,Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "*Entreprenuership – 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
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Score	-	-	-	-	-	2	2	9	-	-	-	-	-	-	3
COM	-	-	-	-	-	2	2	3	-	-	-	-	-	-	3

Course Code	HME733
Course Title	E-Commerce and Digital Marketing
Number of Credits	3-0-0-3
Type of Course	GIR

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 Content

Unit-I Electronic Commerce **8**

Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications. Consumer Oriented Electronic commerce, Mercantile Process models.

Unit-II Electronic Payment Systems **8**

Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. Inter Organizational Commerce-EDI, EDI Implementation, Value added networks.

Unit-III Intra Organizational Commerce **8**

Work Flow, Automation Customization and internal Commerce, Supply chain Management.

Unit-IV Digital Marketing **8**

Introduction, email marketing, social media marketing: Facebook, Twitter, LinkedIn, mobile marketing, web analytics.

Unit-V Search Engine Optimization **8**

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. Dodson, Ian, *"The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns",* Wiley, 1st edition, 2016.
2. Kalakata, "*Frontiers of electronic commerce",* Pearson, 1st edition, 2002.

CO to PO/PSO Mapping

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

Course Code	**HME 734**
Course Title	**Usability Analysis**
Number of Credits	**3-0-0-3**
Type of Course	**GIR**

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 Content

Unit-I Usability Analysis **8**

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-II Usability and Customer Retention in E – Commerce **8**

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-III Web Usability **8**

Introduction, Dimensions of web usability, Web usability criteria, Principles and evaluation methods, Serviceability, Learnability, Simplicity, Efficiency, Control, Customer relationship management.

Unit-IV Web Design Optimization **8**

Web analytics, Web design errors, Web design conventions, Design features to promote usability, Search engine optimization.

Unit-V Usability Testing **8**

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 behaviors. (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, David, "*E-Commerce Usability: Tools and Techniques to Perfect the On-Line Experience*", Taylor and Francis, 2nd edition, 2017.
2. Steve, Krug, "*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**
CO1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	2
CO3	-	-	-	-	-	-	-	3	-	-	-	3	-	-	3
CO4	-	-	-	-	-	-	-	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Score	-	-	-	-	-	-	-	9	-	2	-	15	-	-	5
COM	-	-	-	-	-	-	-	3	-	2	-	3	-	-	3

Course Outcome Survey Form

Date:

Course Code :

Course Name :

Year/Semester:

Faculty :

Your satisfaction on the following statements	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Faculty has made the subject interesting				
Faculty is enthusiastic about what is taught				
Faculty is good at explain things				
The course is well organized				
The course is intellectually stimulating				
Any changes in the course or teaching have been communicated effectively				
The criteria used in assessment have been clearly stated in advance				
Assessment and marking have been fair				
I have been able to contact faculty when I needed to				
I have received detailed comments on my work				
I have received enough advice and support from the faculty for my studies				
I have been able to access general IT resources when I needed to				
My communication skills have improved				
Feedback on my work has been prompt				
Feedback on my work has helped me clarify things I did not understand				
As a result of the course, I feel confident in tackling problems related to this course				
Overall, I am satisfied with the quality of the course				

Signature of Student

B.Tech. (CSE) Program Survey Form

(By 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 programme.				
How helpful and accurate the academic advising is in your course?				
How helpful and accurate the career counselling is in your programme?				
How challenging the work is intellectually in most courses in your programme?				
The overall educational experience in your programme.				

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 extent 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 behaviour 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 Form

(Assessment of Outcomes - B. Tech. (CSE))

Date:

Name :
Year of Graduation:
Organization :
Address :
Phone : **Email:**

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 CSE problems.				
Broadly educated and will have an understanding of 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 Form

Date:

Name of the Company/Institution :
Name of the B.Tech. (CSE) IIITU Alumni: **Batch: 20__to 20__**
Designation of Alumni :
Job Specification of Alumni :
Name of the Assessor : **Designation:**

How do you rate the current potential of IIITU CSE 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

Course Registration Form

This form must 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: B.Tech. **Branch: CSE/ ECE/ IT**
AY: 20__to 20__ **Semester:**

S. No.	Subject Code and Title	Credit
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Fees Payment Details

Date of Payment	Bank	Transaction / DD Number	Amount	Is proof of payment attached

Encl.: Proof of Payment details

Signature of Student **Faculty In-charge**

TIME TABLE							
	16:10-17:00						
	15:20-16:10						
	Break						
	14:20-15:10						
	13:30-14:20						
	Lunch Break						
	11:20-12:10						
	10:30-11:20						
	Break						
	9:20-10:10						
	8:30-9:20						
	Day	Mon	Tue	Wed	Thur	Fri	


भारतीय सूचना प्रौद्योगिकी संस्थान, ऊना
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, UNA
विद्या सर्वज्ञ गौरवः