DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND SYLLABUS

IIITUGCSE19

2019-2020

SCHOOL OF COMPUTING

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA

HIMACHAL PRADESH

B. Tech. Curriculum and Syllabus

Computer Science and Engineering

Batch 2019-2023

IIITUGCSE19

SCHOOL OF COMPUTING

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA, HIMACHAL PRADESH

Personal Details

Name:

Batch:

Roll Number:

Residential Address:

Mobile Number:

Email ID:

Twitter ID:

Skype ID:

Blood Group:

Height:

Weight:

Driving License No.:

Vehicle No.:

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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 60 in 2017.
UG in B.Tech. (Information Technology)	Started with 40 seats in 2017.

Institute Vision and Mission

Institute Vision:

- To provide valuable resources for industry and society through excellence in technical education and research.

Institute Mission:

- To offer state-of-the-art undergraduate programs in CSE, IT and ECE streams.
- To undertake collaborative projects for a longer period of time with academia and industries in the form of internships.
- To develop human intellectual capabilities to its fullest potential.

School of Computing Vision and Mission

School of Computing Vision:

- To produce and promote Innovation in Technology.

School of Computing Mission:

- To impart knowledge in the state of art in Computer Science and Information Technology with more emphasis on Practical Knowledge.
- To participate in research and development in industries and research establishments.
- To promote specialization in the respective streams.

Design of Curriculum

The B.Tech. Course Curriculum has been designed conforming to the recommendations of Senate and guidelines of AICTE.
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 10 theory courses out of which 7 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.

10. Grading Criteria

1. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades. All assessment of a course will be done on the basis of marks.
2. The students shall be placed in any of the bands with letter grades: 'S', 'A', 'B', 'C', 'D', 'E' and 'I' with the credit points of '10', '9', '8', '7', '6', '5', '0', respectively.
3. The cut-off mark for completion of a course shall be calculated as $\frac{\overline{X}}{2}$ or $\frac{X_{max}}{3}$, whichever is less, where $\overline{X}$ is the mean of the class and X_{max} is the maximum scored mark in 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 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	20
2.	Program Core Theory (PC-T)	35	22
3.	Program Elective Theory (PE-T)	12	8
4.	General Institute Requirements Lab (GIR-L)	14	9
5.	Program Core Lab (PC-L)	14	9
6.	Program Elective Lab (PE-L)	6	4
7.	Stream Electives (SE)	15	9
8.	Practicum (PM)	12	8
9.	Internship (IN)	0	0
10.	Project Work (PW)	18	11
	Total	**157**	**100**

The curriculum consists of 59% of Theory and 41% 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 System Design*
5.	Automata and Formal Languages
6.	Operating Systems*
7.	Object Oriented Programming*
8.	Database Management System*
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
	Transaction Processing Systems and Concurrency Control

* 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.	Signal Processing and Communication	ECE
6.	VLSI and Electronic 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	Natural Language Processing	Linear Algebra, Probability, Programming language (Any High Level)
2.	CSSE12	Artificial Intelligence	--
3.	CSSE13	Soft Computing	Linear Algebra, Probability, Programming language (Any High Level), Algorithms
4.	CSSE14	Machine Learning	Linear Algebra, Probability, Programming language (Any High Level)
5.	CSSE15	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: Signal Processing and Communication			
S. No.	**Course Code**	**Course Name**	**Expected Prior Study**
1.	ECSE11	Information Theory and Coding	Probability and Random Processes
2.	ECSE12	Digital Speech Processing	Signals and Systems
3.	ECSE13	Wireless Communication	Analog and Digital Communication
4.	ECSE14	Biomedical Signal Processing	Signals and Systems
5.	ECSE15	Satellite Communication	Analog and Digital Communication

STREAM ELECTIVE–VI: VLSI and Electronic Systems			
S. No.	**Course Code**	**Course Name**	**Expected Prior Study**
1.	ECSE21	Digital VLSI Design	Digital Circuits and Systems
2.	ECSE22	Embedded Systems	Microprocessors and Microcontrollers
3.	ECSE23	MEMS and Sensor Design	Digital VLSI Design
4.	ECSE24	Introduction to Robotics	Microprocessors and Microcontrollers
5.	ECSE25	Introduction to Nano-Electronics	Electronic Devices and Circuits

Semester-wise Stream Electives

Stream Elective–I (V Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE11	Mobile Applications Development	Applications
2.	CSSE11	Natural Language Processing	AI and Machine Learning
3.	CSSE21	Relational Database Management Systems	Database and Networking
4.	ITSE21	Information Security	Security
5.	ECSE11	Information Theory and Coding	Signal Processing and Communication
6.	ECSE21	Digital VLSI Design	VLSI and Electronics Systems

Stream Elective–II (VII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE12	Cloud Computing	Applications
2.	CSSE12	Artificial Intelligence	AI and Machine Learning
3.	CSSE22	Advanced Database Management Systems	Database and Networking
4.	ITSE22	Principles of Cryptography	Security
5.	ECSE12	Digital Speech Processing	Signal Processing and Communication
6.	ECSE22	Embedded Systems	VLSI and Electronics 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	Soft Computing	AI and Machine Learning
3.	CSSE23	Database Security	Database and Networking
4.	ITSE23	Network Security	Security
5.	ECSE13	Wireless Communication	Signal Processing and Communication
6.	ECSE23	MEMS and Sensor Design	VLSI and Electronics Systems

Stream Elective–IV (VIII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE14	Big Data Analytics	Applications
2.	CSSE14	Machine Learning	AI and Machine Learning
3.	CSSE24	Mobile Computing and Communication	Database and Networking
4.	ITSE24	Applied Cryptography	Security
5.	ECSE14	Biomedical Signal Processing	Signal Processing and Communication
6.	ECSE24	Introduction to Robotics	VLSI and Electronics Systems

Stream Elective–V (VIII Semester)			
S. No.	**Course Code**	**Course Name**	**Stream**
1.	ITSE15	Computer Vision	Applications
2.	CSSE15	Deep Learning	AI and Machine Learning
3.	CSSE25	Wireless Sensor Networks	Database and Networking
4.	ITSE25	Cyber Physical Systems	Security
5.	ECSE15	Satellite Communication	Signal Processing and Communication
6.	ECSE25	Introduction to Nano-electronics	VLSI and Electronics Systems

Semester-wise Curriculum

I Semester						
S. No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	MAC101	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.	MAC201	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.	ENL501	Professional Communication and Soft Skills	0	0	4	2
5.	CSL502	Project Phase-I	0	0	6	3
6.	CSO503	Honors Online Course-I*	5	1	0	3
		Optional Online Course-I*	5	1	0	0-3
Total			**9**	**0**	**18**	**18**
Total Hours			**27**			

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**			

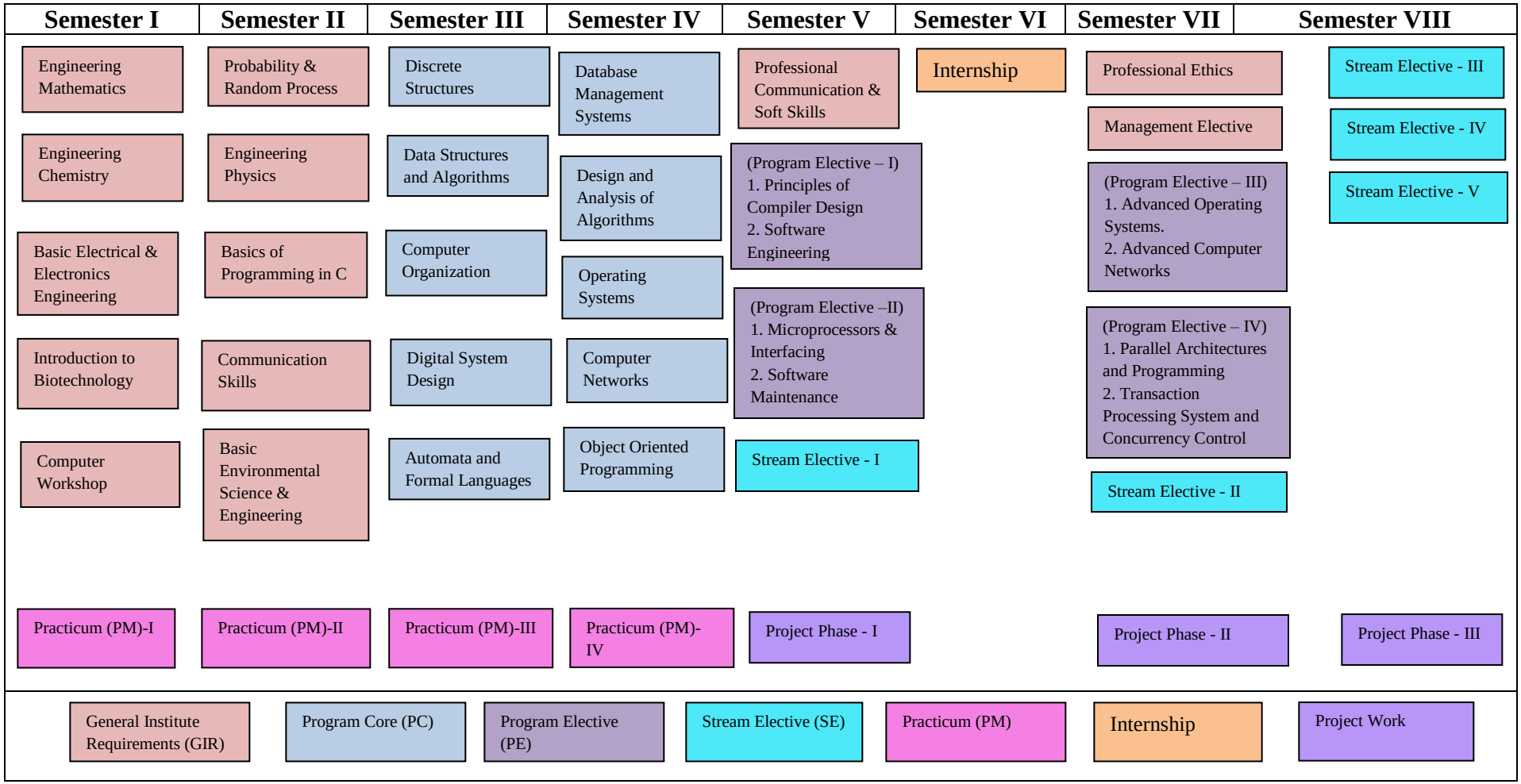
VIII Semester						
S.No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	XXXXXX	Stream Elective-III	3	0	0	3
2.	XXXXXX	Stream Elective-IV	3	0	0	3
3.	XXXXXX	Stream Elective-V	3	0	0	3
4.	CSL801	Project Phase-III	0	0	18	9
5.	CSO802	Honors Online Course-IV*	5	1	0	3
		Optional Online Course-IV*	5	1	0	0-3
Total			**9**	**0**	**18**	**18**
Total Hours			**27**			

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

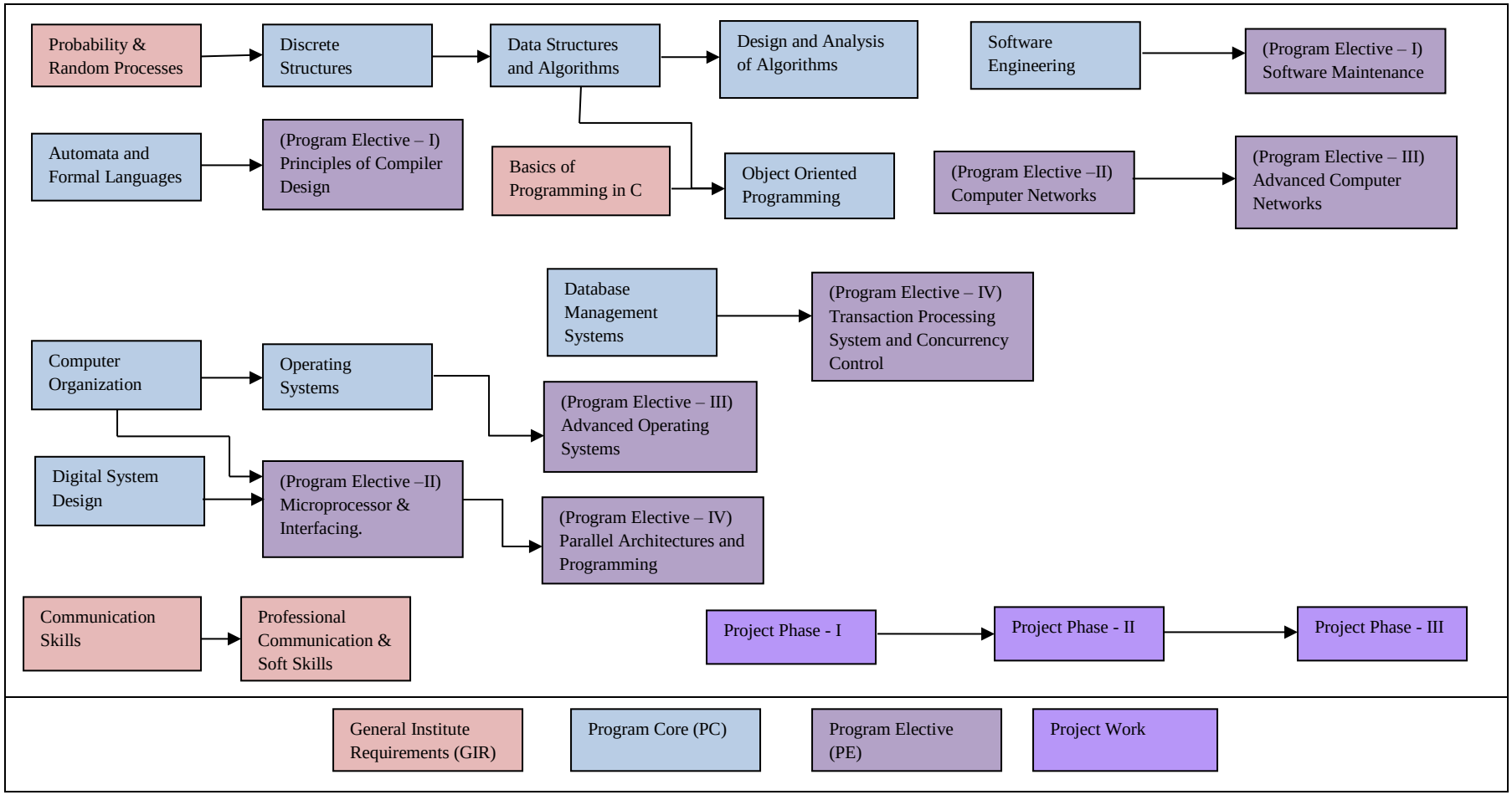
Summary

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	21	25	27	28	18	00	20	18	**157**

STUDY CHART


Semester I
Engineering Mathematics
Engineering Chemistry
Basic Electrical & Electronics Engineering
Introduction to Biotechnology
Computer Workshop
Practicum (PM)-I
Semester II
Probability & Random Process
Engineering Physics
Basics of Programming in C
Communication Skills
Basic Environmental Science & Engineering
Practicum (PM)-II
Semester III
Discrete Structures
Data Structures and Algorithms
Computer Organization
Digital System Design
Automata and Formal Languages
Practicum (PM)-III
Semester IV
Database Management Systems
Design and Analysis of Algorithms
Operating Systems
Computer Networks
Object Oriented Programming
Practicum (PM)-IV
Semester V
Professional Communication & Soft Skills
(Program Elective – I)
1. Principles of Compiler Design
2. Software Engineering
(Program Elective –II)
1. Microprocessors & Interfacing
2. Software Maintenance
Stream Elective - I
Project Phase - I
Semester VI
Internship
Semester VII
Professional Ethics
Management Elective
(Program Elective – III)
1. Advanced Operating Systems.
2. Advanced Computer Networks
(Program Elective – IV)
1. Parallel Architectures and Programming
2. Transaction Processing System and Concurrency Control
Stream Elective - II
Project Phase - II
Semester VIII
Stream Elective - III
Stream Elective - IV
Stream Elective - V
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	**MAC101**
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: 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: 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: Zeno's Paradox, Limit, Continuity and Differentiability, Uniform continuity, Maxima and Minima, Mean value theorem, Partial Derivatives, Integration.

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

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

Course Outcomes

- Ability to solve curriculum problems
- Ability to solve industrially applicable problems.

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.
4. G.Strang, "*Linear Algebra and its Applications*", 4th Edition, Thomson, 2006.

Reference Books

1. Wilfred Kaplan, "*Advanced Calculus*", Pearson, 2003.
2. Wylie, C.R. and Barrett, L.C., "*Advanced Engineering Mathematics, 6th edition*", McGraw-Hill Inc.US, 1995.

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

Course Objectives

- To learn the fundamentals and applications of chemical sciences in the field of Engineering.
- To explore and understand and apply the concepts of chemical science to solve daily life problems

Course Content

Unit-I Water and its Treatment: Sources, hard & soft water, estimation of hardness by EDTA method, softening of water, boiler feed water, treatment methods, specifications for drinking water, BIS & WHO standards, desalination processes.

Unit-II Polymer and Composites: Introduction, functionality, classification, mechanism of polymerization, molecular weight, structure property relationship, moulding techniques, synthesis, properties and application of commercially important polymers, conducting polymers; Composites: Introduction classification, constituents, advantages and applications.

Unit-III Engineering Materials: Introduction to nanochemistry, synthesis, characteristics and applications of carbon nanostructures; Fuels- Classification, types of coal, determination of calorific value of solid fuels, Bomb calorimeter, theoretical oxygen, proximate & ultimate analysis of coal, manufacture of metallurgical coke, flue gas analysis; Lubricants-Definition, theories, characteristics, additives to lubricants, solid lubricants.

Unit-IV Characterization Techniques: 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.

Course Outcomes

- Ability to apply the fundamentals to the applications of chemical science in daily life.
- Ability to implement the principles of chemistry for solving different problems of the complementary engineering fields.

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.

References 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 & Sons, 2009.

Engineering Chemistry Lab

Lab Objectives

- To enhance and develop scientific and analytical skills
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments, demonstrate safe and proper use of standard chemistry glassware and equipment.

List of Experiments

Volumetric analysis (Titrations): To determine the total hardness of the given hard water using EDTA titration method; To estimate of total; To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method; To determine the strength of given solution of Mohr's salt; To estimate amount of chlorine present in given sample of bleaching powder; To determine free residual chlorine in sample water by iodometric titration; To determine the Cu present in given brass sample by iodometrically; To determine the iron content in the given salt by using external indicator.

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

Physical Chemistry: To determine the strength of an acid by pH –metric method; To determine the strength of hydrochloric acid solution by titrating against sodium hydroxide solution conductometrically; To identify given unknown liquid by surface tension measurement using Stalgmometer; To identify given unknown liquid by viscosity using Ostwald viscometer; To determine the viscosity coefficient of the given polymer PEG and find out the composition of unknown solution.

Chromatography: To separate the mixture of amino acids by thin layer chromatography.

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

Organic synthesis: To prepare polymer of Bakelite; To prepare urea formaldehyde resin; To prepare a pure sample of Aspirin

Lab Outcomes

- Apply the concepts learned in chemistry and engineering to the real-world situations.
- Enhanced ability to identify, analyse and interpret the results from the experiments.

Reference Books

1. Engineering Chemistry Lab Manual, IIIT Una, 2019.
2. Selvaraj, S., "*Practical Engineering Chemistry: Laboratory Manual*", LAP LAMBERT Academic Publishing, 2016.
3. Tiwari, S., "*Engineering Chemistry Lab Manual*", Scitech Publications (India) Pvt. Ltd., 2013.

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

Course Objectives

- Ability to understand electrical and electronics circuits along with basic concepts of electrical machines.
- Analyze different semiconductor devices, their operation and characteristics.

Course Content

Unit-I Electrical circuits: Delta to wye and Wye to delta transformations, RL, RC & RLC circuits, Sinusoids, AC fundamentals, Balanced three-phase circuits, Power measurement, Power factor correction. Self and mutual inductances, Energy in coupled circuit, Introduction to domestic wiring.

Unit-II Electrical machines: Introduction to alternating current and direct current machines.

Unit-III Semiconductor Diodes: Operation of p-n junction diodes, Rectifier circuits, Zener diode and its characteristics, Zener diode as voltage regulator.

Unit-IV Bipolar Junction Transistors (BJTs): 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): Structure, Basic operation, Drain and Transfer Characteristics, JFET as an Amplifier and as a Switch. Comparison of BJT and FET.

Course Outcomes

- Ability to solve problems in electrical circuits and electrical machines.
- Knowledge on semiconductor devices and their applications in different areas.

Text Books

1. Charles, K.A. and Sadiku, N.O., "*Fundamental of Electric Circuits"*, Tata Mc-Graw Hill, Sixth Edition, 2018.

2. Kothari, D.P. and Nagrath, I.J., "*Electrical Machines*", Tata Mc-Graw Hill, Fifth Edition, 2017.

3. Boylestad, R. L. and Nashelsky, L., "*Electronic Devices and Circuits theory"*, Pearson Education, Tenth Edition, 2013.

Reference Books

1. Hughes, E., "*Electrical and Electronic Technology*", Dorling Kindersley, Tenth Edition, 2016.

2. Sedra and Smith K. C., *"Microelectronics Circuits"*, Oxford University, Fifth Edition, 2009.

Basic Electrical and Electronics Engineering Lab

Lab Objectives

- To design and analyze various circuits.
- Ability to understand the practical aspects of basic electrical and electronics.

List of Experiments

- To calibrate a given wattmeter by direct loading; verifying ohm's law for BPLL element; calibration of a voltmeter & ammeter; calibration of a single-phase energy meter by direct loading.
- To find minimum fusing current and fuse constant of a given fuse wire; finding voltage current relationship in R-L series circuit and to determine the power factor of the circuit.
- Verification of Kirchoff's laws, network theorems; polarity test, voltage ratio test, open circuit test, short circuit test, load test on single phase transformer; To find for a filament lamp (i) Variation of resistance with voltage (ii) Variation of power with voltage.
- Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency.
- V-I characteristics of PN Junction and Zener diodes, and determining its DC and AC resistance.
- Studies on half-wave and full-wave rectifier circuits without and with capacitor filter.
- I-V characteristic of an n-p-n and p-n-p transistors, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
- Transfer and Drain Characteristics of JFET (Find gm, rd and μ from characteristics).

Course Outcome

- Memorize schematic symbol and Recognize basic concepts of electrical and electronic components and circuits.

Reference Book

1. Basic Electrical and Electronics Engineering Laboratory Manual, School of Basic Sciences, Indian Institute of Information Technology Una, 2019.

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

Course Objectives

- To give an introduction to Bio-technology and its applications in our daily life.
- To get familiarized with various techniques that are used routinely towards this.

Course Content

Unit-I Introduction to Biotechnology: History of biotechnological developments with major milestones. Basic biology: Brief introduction to genes and genomes.
Unit-II DNA Technology: Introduction to recombinant DNA technology and its application to genomics. Introduction to proteins and their products.
Unit-III Microbial biotechnology, Plant biotechnology and Animal biotechnology.
Unit-IV Bioremediation and environmental biotechnology. Medical biotechnology.
Unit-V Biotechnology regulations and ethics.

Course Outcomes

- Determine the protein function from sequence through analyzing data.
- Analysis and development of models for better interpretation of biological data to extract knowledge.

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.

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

Lab Objective

- The main objective of the lab is to provide the students the knowledge of computer hardware and other peripherals, impart knowledge about the troubleshooting and fault finding the computers.

List of Experiments

- 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.
- To study and demonstrate the working of Chip Set, BIOS chip, Capacitors, Inductors, Resistors, Hub and Switch, Repeater and Bridges, Router and NIC.
- To assemble a PC.
- Dual Booting (Warm Booting and cold booting)
- Installation process of Windows, Linux operating system
- Study of Device Drivers and Installation process of Device Drivers
- Hardware Troubleshooting (Demonstration):
- 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.
- Software Troubleshooting (Demonstration): Students have to be given a malfunctioning CPU due to system software problems
- Introduction to MS Word, MS Excel, Power Point Presentation, MS Outlook, Latex.
- Exposure to Basic commands and system administration in Linux.
- Exposure on file, directory handling, security, file permissions, pipes, quotes, aliases, variables and filters in linux.
- Orientation & Connectivity Boot Camp and surfing the Web using Web Browsers, Search Engines &Netiquette, Cyber Hygiene.
- Introduction to Cyber Security.

Course Outcomes

- Ability to perform a step by step assembly of a desktop computer system.
- Ability to perform preventive maintenance and identify the elements of the troubleshooting process.

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 trouble shooting and maintenance, 2nd Edition*", Tata McGraw-Hill, New Delhi, (13th reprint) 2008.

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

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

SECOND SEMESTER

Course Code	**MAC201**
Course Title	**Probability and Random Process**
Number of Credits	**3-1-0-4**
Course Type	**GIR**

Course Objectives

- To learn mathematical concepts and methods
- To apply concepts of probability in engineering disciplines.

Course Content

Unit-I Probability and Random Variable: 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: 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-II Two Dimensional Random Variables: Joint distributions – Marginal and conditional distribution – Covariance – Correlation and regression – Transformation of random variables- Central limit theorem.

Unit-IV Random Processes and Markov Chains: Classification – Stationary process – Markov process –Poisson process- Birth and death process – Markov chains- transition probabilities – Limiting distributions.

Unit-V Introduction to Queueing Theory: 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.

Course Outcomes

- Ability to solve curriculum problems
- Ability to solve industrially applicable problems.

Text Books

1. Ross, S., "*A first course in probability, 10th Edition*", Pearson Education, Delhi 2018.
2. Taha, H.A., "*Operations Research-An introduction*, 10th e*dition*, Pearson Education Edition Asia, Delhi 2017.
3. Castañeda, B.L, Arunachalam, Viswanathan and Dharmaraja, Selvamuthu, *"Introduction to Probability and Stochastic Processes with Applications"*, Asia Edition, Wiley-Blackwell, 2016.
4. Medhi, J., "*Stochastic Processes, 3rd revised edition*", New Age Publishers, New Delhi 2009.

Reference Books

1. Veerarajan, T., "*Probability, Statistics and Random. Processes, 3rd edition*", Tata McGraw-Hill Education Pvt. Ltd., 2017.
2. Gross D. and Harris C.M., "*Fundamentals of Queuing theory, 4th edition*", John Wiley and Sons, New York, 2008.
3. Allen, A.O., "*Probability, Statistics and Queuing Theory, 2nd* Edition", Academic press, New Delhi, 1990.

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

Course Objectives

- To equip students with a deeper understanding of fundamental laws and principles of Physics.
- To introduce students to the advance level Physics i.e. Quantum Mechanics, Quantum Computing.

Course Content

Unit-I Classical Mechanics: Review of Newtonian Mechanics in Rectilinear Coordinate System, Motion in Plane Polar Coordinates, Conservation Principles. Introductory ideas about Lagrangian and Hamiltonian and their simple applications.

Unit-II Special Theory of Relativity: Michelson-Morley Experiment Postulates of STR, Galilean Transformation, Lorentz Transformation, Length Contraction, Time Dilation, Relativistic Addition of Velocities, Mass-Energy Equivalence.

Unit-III Modern Physics: Basics of Quantum Physics: Origin of Quantum Theory, Wave-Particle Duality, Group and Phase Velocity, Heisenberg's Uncertainty Principle, Schrödinger Wave Equation and its application, Physical interpretation of Wave Function, Elementary Idea of Operators, Particle in a three-Dimensional Box, Degenerate States. Quantum Statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Density of States. Applications of B-E statistics: LASER Systems, Free Electron Model of electrons in metals. Concept of Fermi Energy. Band Theory of Solids (Bloch Theorem, Kronig-Penney Model), Quantum Computing.

Unit-IV Physics of Materials: 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.

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

Unit-V Fiber Optics: 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.

Course Outcomes

- Ability to understand the concept of Special Theory of Relativity and Technologies based on LASER and Optical Fibers.
- The Student will appreciate Quantum Mechanical concepts as well as Quantum Computing.

Text Books

1. Kleppner, D., and Kolenkow, R. J., *"An Introduction to Mechanics, 2nd Edition"*, Tata McGraw-Hill, New Delhi, 2017.
2. Griffiths, David J., *"Introduction to Quantum Mechanics,* 2nd Edition", Pearson Education Ltd, 2016.
3. Zettili, Nouredine "*Quantum Mechanics*", 2nd Edition, John Wiley & Sons Ltd., 2009.
4. Kaye, Phillip, Laflamme, R. and Mosca M. "*Introduction to Quantum Computing*", Oxford University Press, New York, 2007.
5. Kittel, Charles "*Introduction to Solid State Physics, 8th Edition*", John Wiley & Sons, Inc, USA, 2005.

Reference Books

1. Puri, R. K. and Babbar V. K. "*Solid State Physics*", S. Chand & Co. Pvt. Ltd, New Delhi, 2000.
2. Beiser, Arthur "*Concepts of Modern Physics*", Tata McGraw- Hill, New Delhi, 1995.
3. Goldstein, Herbert, Poole, Charles and Safko, John *"Classical Mechanics"*, 2nd Edition", Narosa, 1985.

Engineering Physics Lab

Lab Objectives

- The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.

List of Experiments

Fly Wheel, Hall Effect, Planck's Constant, Michelson Interferometer, Newton's Ring, Magnetic Field along the Axis of a Coil, Young's Double Slit Experiment, B-H Hysteresis Curve, Superconductivity- Measurement of Transition Temperature, Resonance in LCR Circuit, Radiation from a Black Body, Charging and Discharging of a Capacitor, I-V Characteristic of a Solar Cell, Polarization of Light, Time Constant of an R-C Circuit, Energy Gap of a Material of P-N Junction, Compton Scattering of Gamma-ray using 137Cs Source, Rutherford Scattering of Alpha Particles in Gold, Dielectric Constant, Frank-Hertz Experiment, Determination of e/m of Electron, Wavelength of LASER using Diffraction Grating, GM Counter Experiment.

Lab Outcomes

- Develop skills to impart practical knowledge in real time solution.
- Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
- Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
- Understand measurement technology, usage of new instruments and real time applications.

References

1. Physics Laboratory Manual, School of Basic Sciences, Indian Institute of Information Technology Una, 2019.
2. Shukla, R. K. and Srivastava, Anchal, "*Practical Physics*", New age international, 2011.

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

Course Objectives

- To learn the fundamentals of computers,
- To learn the syntax and semantics for C programming language.

Course Content

Unit-I Introduction to computers and Basic of Programming:
Computer Organization, Characteristics, Hardware and Software, Modes of operation, Types of programming languages, developing a program. Basic of Programming, 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: 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 and Arrays: Control Statements branching, if-else, and looping: while do-while for, Nested control structures, switch statement, break statement, continue statement, comma operator, goto statement. Modular Programming. 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 and String Handling: Defining a function, accessing a function, Function prototypes, passing arguments to a function, passing arrays to a function, Passing pointers to a function, Recursion. Functions and Procedures, Examples, Parameter passing methods. String Handling, Introduction to Strings, Sample Program, Standard String Library Functions, Array of String.

Unit-V Structures, Unions and Files: 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

Course Outcomes

- Ability to write algorithms for problems.
- Ability to code a given logic in C language.

Text Books

1. Gottfried, Byron. "*Programming with C", 4th Edition*. Tata McGraw Hill Education New Delhi 2018.
2. Dromey, R.G. "*How to solve it By Computers"* Prentice Hall London 2006.

Reference Book

1. Deital, Paul and Deital, Harvey. *C, "How to Program 7th Edition"*. Prentice Hall London 2012.

Basics of Programming in C Lab

Lab Objectives

- To the field of programming using C language.
- Ability to enhance their analyzing
- Problem solving skills and use the same for writing programs in C

List of Experiments

- Sequence construct
- Selection construct
- Iterative construct
- Nested for loops
- Functions with Pass by value
- Functions with Pass by reference
- Recursive functions
- One dimensional and two-dimensional arrays.
- Pointers and functions
- Pointers and Arrays
- Structure and Union.
- File Processing.

Lab Outcomes

- Implementation of basic programming constructs.

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

Course Objectives

- Develop the awareness of forms of communication & social behavior.
- Understand and explore the typical problems arise during communication and learn the skills to overcome these.

Course Contents

Unit-I The Process of Communication: Introduction, Barriers to communication, Different types, Written vs. oral communication, Face-to-Face interactions, characteristics and conventions Conversational problems of second foreign language users, difference between conversation and other speech events, Synonyms and Antonyms; Homophones, Homonyms & Declamation. Telephone Techniques**:** Speaking and listening commonly used phrases, Vocabulary, Writing and Listening, Leaving a message, grammar and usage: the perfect tense.
Unit-II Job Applications and Interviews: Reading, vocabulary, apply for a job, curriculum vitae, language focus: study skills: preparing for an interview, listening, speaking, writing. Group Discussions: Reading, writing skills, listening: how to be successful in a group discussion, language facts, vocabulary, pronunciation and one-word substitutes.
Unit-III Managing Organizational Structure: Warm up, value to influence and lead, reading: the role of a manager, vocabulary: leadership. Speaking and listening, language focus, degree of probability Grammar: modals, writing reports, pronunciation. Meetings: Reading, speaking: one to one meeting, language focus: opening, middle and close, study skills, editing, listening, criteria for successful meetings, vocabulary, grammar, reporting verbs, writing: memos, pronunciation, stress.
Unit-IV Taking Notes and Preparing Minutes: Taking notes, the note-taking skill: the essential components, the note-taking skill: an example preparing minutes, format of minutes, language and style of minutes, grammar, using the passive voice.
Unit-V Presentation Skills: Reading, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation, language focus, podium panic, pronunciation, Negotiation Skills-Language focus, idiomatic expressions, process of negotiation, grammar: phrasal verbs, listening effective negotiations, speaking, writing.

Course Outcomes

- Understand and apply knowledge of human communication and language processes.
- Understand and evaluate key theoretical approaches used in the interdisciplinary field of communication.

Text books

1. Mohan, Krishan, "*Developing Communication Skills"*, Mac Millan India Limited 2009.
2. Rizvi, Ashraf, "*Effective Technical Communication"*, Tata McGraw Hill 2008.

Reference Books

1. Bhatacharya, Indrajit, "*An Approach to Communication Skills"*, Dhanpat Rai Co. Pvt Ltd. 2007.
2. Wright, Chrissie, "*Handbook of Practical Communication Skills"*, Jaico Publishing House 2007.

Communication Skills Lab

Lab Objectives

- Enable learners to develop their communicative competence.
- Facilitate them to hone communicative skills.
- Equip them with the ability to enhance their prospect of placement.
- Enable students to use language appropriately for interviews, group discussions and public speaking.

List of Experiments

- Introduction to Phonetics
- The Phonemic Alphabet in English
- Introduction to Speech Sounds; Vowels
- Introduction to Speech Sounds; Consonants
- Structure of Syllables
- Extempore; Public Speaking
- Words and Phrasal Stress
- Stress and Rhythm
- Rhythms from Mainland
- Telephonic Conversation
- Resume and Presentation Skills
- Group Discussion
- Interview Skills

Lab Outcomes

- Usage of the appropriate language for group discussion, interview and public speaking.
- Sensitization of the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- Enhancement of the independent language learning.
- Amelioration in the fluency of spoken English and neutralization of the mother tongue influence

References Books

1. Thorpe, E and Thorpe, S., "*Objective English"*, Pearson Education, New Delhi, 2007.
2. Fisher, Dalmar. "*Communication in Organizations"*, Jaico Publishing House, 2004.
3. D, Evans, "*Decisionmaker*", Cambridge University Press, 1997.

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

Course Objectives

- To teach the principal renewable energy systems.
- To explore the environmental impact of various energy sources and the effects of different types of pollutants.

Unit-I 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.

Unit-II Basics of Solar Energy: Solar Thermal Energy, Solar Photovoltaic, Advantages and Disadvantages, Environmental impacts and safety, Power and energy from wind turbines, India's wind energy potential, Types of wind turbines, Off shore Wind energy, Environmental benefits and impacts.

Unit-III Biomass resources: Biomass conversion Technologies, Feedstock pre-processing and treatment methods, Bioenergy program in India, Environmental benefits and impacts, Geothermal Energy resources, Ocean Thermal Energy Conversion, Tidal.

Unit-IV Pollution and its control: Sources, effects, control, air quality standards, air pollution act, air pollution measurement, Water pollution: Sources and impacts, Soil pollution: Sources and impacts, disposal of solid waste. Greenhouse gases: Effect, acid rain, Noise pollution, Pollution aspects of various power plants, Fossil fuels and impacts, Industrial and transport emissions: impacts

Unit-V Electronic Waste Management: E-Waste Management in India, Recycling of E-Waste, Exposure pathways of pollutants, Quantification of Pollutants in Dust, Air and Water, Risk Assessment (USEPA method), Recovery of Valuable Rare-Earth metals, Rules & regulations, Socio-Economic Life Cycle Analysis (SLCA) of E-Waste Management in Developing countries. Life Cycle Analysis and Sustainable Engineering (from an Electrical and Electronics Industry Perspectives)

Course Outcomes

- Ability to understand the environmental impact of various energy sources.
- Ability to understand the effects of different types of pollutants.

Text Books

1. G. D. Rai, *"Non Conventional Energy Sources"*, Khanna Publishers, 2006.
2. B H Khan, *"Non Conventional Energy Resources"*, McGraw Hill, Second Edition, 2004.

Reference Books

1. Boyle, G., *"Renewable Energy: Power for a Sustainable Future",* Oxford University Press, 2004.
2. Pant, D., "*Electronic Waste Management*", LAP Lambert Academic Publishing, 2010.

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

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

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 those, 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: 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: 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: Basic concepts of graph theory, multigraphs and weighted graphs, Biparite 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: Introduction, complete and extended binary tree, traversing binary tree, binary search tree, Minimum spanning trees, Heaps, Huffman's algorithm.

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

Course Outcomes

- Ability to solve problems using Logic Sets, Functions, graph and trees.
- Ability to use mathematical reasoning techniques including induction and recursion

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, II Edition (28 February 1994).

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

Course Objectives

- To introduce first level topics covering basics in Algorithms and Data Structures
- To identify the basic properties of graphs and trees and model simple applications

Course Content

Unit-I Complexity of algorithms and Algorithmic paradigms: 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: 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: 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: 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: Sorting and Searching techniques with analysis, Greedy algorithms, divide & conquer, dynamic programming and Introduction to hashing.

Course Outcomes

- Develop knowledge of basic data structures for storage and retrieval of ordered or unordered data.
- Learn to analyze and compare algorithms for efficiency using asymptotic notation.

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.

Data Structures and Algorithms Lab

Lab Objectives

- To learn various data structures and algorithms.
- To gain practical knowledge by writing and executing programs.

List of Experiments

- Implementation and Operations on Arrays.
- Implementation of ADT of Stacks.
- Implementation of Applications of Stacks.
- Implementation of ADT of Queues.
- Implementation of Applications of Queues.
- Implementation of ADT of Lists.
- Implementation of Applications of Lists.
- Implementation of Binary Trees.
- Implementation of Search Trees.
- Implementation of Heaps.
- Implementation of Applications of Heaps.
- Implementation of algorithms of Graphs.
- Implementation of Sorting algorithms.

Lab Outcomes

- Compare different implementations of data structures and to recognize the advantages and disadvantages of them.
- Design and analyze the time and space efficiency of the data structure.
- Understand and apply fundamental algorithmic problems including Tree traversals, Graph traversals.

Reference books

1. Balagurusamy, E. "*Data Structures Using C*" TATA McGraw Hill Edition, 2013.
2. Kruse, Tondo and Leung, "*Data Structures and Program Design in C, 2nd edition*", Prentice-Hall, 1997.

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

Course Objectives

- To understand the basic hardware and software issues of computer organization.
- To provide an overview on the design principles of digital computing systems.
- To understand the representation of data at machine level.

Course Content

Unit-I General System Architecture: 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 & I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic & 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: Arithmetic & 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: Addition & Subtraction, Multiplication Algorithms (Booth"s Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations. Control Design: Microprogrammed& 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 & I/O Organization: Memory Hierarchy, need for Memory Hierarchy, locality of reference principle, cache memory, main & secondary, Memory parameters, access cycle time, cost per unit, concpt of virtal memory.

Programmed, Interrupt driven I/O, Direct Memory Access, Synchronous and asynchronous data transfer.

Unit-V Introduction to Parallelism: Goals of parallelism, Instruction level parallelism, pipelining, superscaling, Processor level parallelism, Multiprocessor system overview.

Course Outcomes

- Ability to analyze the abstraction of various components of a computer.
- Ability to apply performance metrics to find the performance of systems.
- Ability to identify high performance architecture design.

Text Books

1. Hayes J.P, *"Computer architecture & Organization"*, Third Edition, McGraw Hill, 2017.
2. Hamacher, C., Vranesic, Z. and Zaky, S., "*Computer Orgnization*", McGraw Hill Education; 5th Edition (4 November 2011).

Reference Books

1. Patterson, David A and Hennessy, John. L, *"Computer Organization and Design",* Morgan Kaufmann; 3rd Edition (27 July 2007).
2. Stallings, William, *"Computer Organization and Architecture Designing for Performance",* Sixth Edition, Pearson Education Asia, 2003.

Computer Organization Lab

Lab Objectives

- Learn how to write simple programs in the assembly language
- Understand the different forms of addressing and implement them

List of Experiments

- Introduction to gates
- Ripple Carry Adder
- Carry-look-ahead adder
- Registers and Counters
- Wallace Tree Adder
- Combinational Multipliers
- Booth's Multiplier
- Arithmetic Logic Unit
- Memory Design
- Associative cache Design
- Direct Mapped Cache Design
- CPU Design
- Mathematical expressions
- File operations-1
- File operations-2
- PROJECT-Select any project of your choice

Lab Outcomes

- To expose the students to the various key aspects of Computer Organization & Architecture.
- Prototyping of experiments with support of a virtual environment.

Reference Book

1. Brey Berry B., "*The Intel Microprocessor 80x86, Pentium, Pentium Pro processor, Pentium II Pentium III, Pentium IV Architecture, Programming, and Interfacing, 8th Edition*", Prentice Hall, 2009.

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

Course Objectives

- Foundation in design and analysis of the operation of digital gates.
- Design and implementation of combinational and sequential logic circuits.

Course Content

Unit-I Number System: 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: 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: 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: 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: Defining Modules in VHDL, Structural Modelling, Learning VHDL. CMOS Logic Circuits: NOT Function in CMOS, Complex Logic Gates in CMOS.

Course Outcomes

- Design methodologies for combinational and sequential digital systems.
- Basic knowledge of VHDL for system modelling.
- Implementation of digital systems on reconfigurable programmable logic devices.

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.

Digital Systems Design Lab

Lab Objectives

- To know the concepts of Combinational circuits,
- To understand the concepts of flip-flops, registers and counter.

List of Experiments

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

Lab Outcomes

- Construct basic combinational circuits and verify their functionalities.
- Apply the design procedures to design basic sequential circuits.
- Learn about counters and Shift registers.

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

Course Objectives

- To introduce concepts in automata theory and theory of computation.
- To identify different formal language classes and their relationships.
- To design grammars and recognizers for different formal languages.

Course Content

Unit-I Machines: 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): 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): 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): 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): 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)

Course Outcomes

- Ability to relate practical problems to languages, automata, and computability
- Ability to demonstrate an increased level of mathematical sophistication. Ability to apply mathematical and formal techniques for solving problems

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, Peter, "*An Introduction to Formal Language and Automata*", Narosa Pub House, 2011.

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

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

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

Course Outcomes

- Ability to Install, configure, and interact with a relational database management system
- Ability to master the basics of SQL and construct queries using SQL
- Ability to design and develop a large database with optimal query processing

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.

Database Management Systems Lab

Lab Objectives

- To give a good formal foundation on the relational model of data
- To present SQL and procedural interfaces to SQL comprehensively

List of Experiments

- Introduction to SQL and installation of SQL server/oracle.
- Data Definition Language (DDL) commands in RDBMS
- Data Manipulation Language (DML) and Data Control Language (DCL)
- High level language extensions with cursors
- Data types and create a database and write the program to carry out the following operation.
- Create tables department and employee with required constraints.
- Working with null values, matching the pattern from the table.
- Aggregate functions: grouping the result of a query.
- Set operators, Nested Queries, Joins and Sequences.
- Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
- PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
- Triggers and Cursor Management in PL/SQL.
- Procedures and Functions
- Automatic Backup of Files and Recovery of Files.
- As a designer identify the views that may have to be supported and create views.

Lab Outcomes

- Design and implement a database schema for a given problem-domain
- Normalize a database
- Populate and query a database using SQL DML/DDL commands.

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

Course Objectives

- To understand the importance of algorithm and its complexity.
- To design and implement various programming paradigms and their complexity.

Course Content

Unit-I Algorithm Design paradigms: 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: Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm & Kruskal's algorithm, Huffman codes.

Unit-III Dynamic programming: 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: Complexity measures, Polynomial Vs non-polynomial time complexity; NP-hard and NP-complete classes, examples.

Course Outcomes

- Ability to analyze the time and space complexity, given an algorithm.
- Ability to apply the techniques of algorithm in solving real world problems.
- Ability to develop systematically an algorithm for solving a problem.

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.

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

Course Objectives

- To provide knowledge about the services rendered by operating systems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues

Course Content

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

Unit-II Process Management: Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks

Unit-III Memory Management: Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies

Unit-IV File System: 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: Introduction, distributed operating systems, distributed file systems, Distributed Synchronization.

Course Outcomes

- Ability to comprehend the techniques used to implement the process manager
- Ability to comprehend virtual memory abstractions in operating systems
- Ability to design and develop file system interfaces, etc.

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.

References Book

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

Operating System Lab

Lab Objectives

- To understand and appreciate the principles in the design and implementation of operating systems software.
- To provide a detailed discussion of the various memory management techniques

List of Experiments

- Implementation of different system calls of UNIX operating system.
- Implementation of I/O system calls of UNIX OS.
- Implementation different CPU scheduling algorithms to find turnaround time and waiting time.
- Simulation of multi-level queue scheduling algorithm.
- 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
- Implementation of following file allocation strategies. a) Sequential b) Indexed c) Linked
- Simulation of MVT and MFT memory management techniques.
- Simulation of the contiguous memory allocation for Worst-fit, Best-fit, First-fit technique.
- Implementation of different file organization techniques.
- Implementation of Deadlock avoidance algorithm.
- Implementation of different disk scheduling algorithms.
- Implementation of different page replacement algorithms.
- Implementation of producer-consumer problem using semaphores.

Lab Outcomes

- Understand the design approaches of advanced operating systems.
- Analyze the design issues of distributed operating systems.
- Evaluate design issues of multi-processor operating systems.

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

Course Objectives

- To implement a simple LAN with hubs, bridges and switches.
- To describe how computer networks are organized with the concept of layered approach.

Course Content

Unit-I Layered Network Architecture: 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: 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: 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: 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: 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.

Course Outcomes

- Ability to master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
- Ability to be familiar with network tools and network programming.

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 Book

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).

Computer Networks Lab

Lab Objectives

- To describe how computer networks are organized with the concept of layered approach.
- To implement a simple LAN with hubs, bridges and switches.

List of Experiments

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

Lab Outcomes

- Understand fundamental underlying principles of computer networking.
- Understand details and functionality of layered network architecture.
- Analyze performance of various communication protocols.

Text Books

1. Forouzan, A., "*Data Communication and Networking, 4th Edition*", McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., "*Computer Networks, 5thEdition*", Prentice Hall, India, 2013.

Reference Book

1. Olifer, Natalia, *"Computer Network"*, Wiley India Publication, India, 2006.

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

Course Objectives

- To learn the basics of Object-Oriented Concepts and Design.
- To get accustomed to Object oriented programming.

Course Content

Unit-I Introduction to Object Oriented Programming: 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: 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: 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: 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: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, Container Classes, General Theory of Operation, Vectors.

Course Outcomes

- Ability to understand the features of object oriented programming.
- Ability to design and develop object-oriented software.
- Ability to understand how to apply the major object oriented concepts and advanced features.

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 Book

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.

Object Oriented Programming Lab

Labs Objectives

- To understand the object oriented principles.
- To construct the robust and maintainable programs.
- To design, write, compile, test and execute programs using high level language.

List of Experiments

- Implementation of array and pointers.
- Implementation of functions.
- Implementation of function overloading.
- Implementation of classes and objects.
- Implementation of functions in classes.
- Implementation of operator overloading.
- Implementation of different types of inheritance.
- Implementation of Streams.
- Implementation of various operations on files.
- Implementation of exception handling.
- Implementation of STL.

Lab Outcomes

- Ability to develop applications using Object Oriented Programming Concepts.
- Ability to implement features of object oriented programming to solve real world problems.

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

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

FIFTH SEMESTER

Course Code	**ENL501**
Course Title	**Professional Communication and Soft Skills**
Number of Credits	**0-0-4-2**
Course Type	**GIR**

Course Objective

- To enhance the holistic development of students and improve their employability skills.

Course Content

Unit-I Introduction to Soft Skills & Professional ethics: Aspects of Soft Skills, Effective Communication Skills, Personality Development, Importance of Professional Ethics.

Unit-II Team Building: To know the nature of the team, To understand personal as well as professional goals of the members of the group, To work effectively in a team through building relation and interpersonal communication.

Unit-III Art of Negotiation: What is negotiation, Ways of negotiating, To understand the power of language and non-verbal communication.

Unit-IV Organizing Meetings: How to call the meeting, How to organize a meeting, How to design the agenda and prepare minutes of the meeting.

Unit-V Presentation Skills: Reading, 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 & Time Management: Kinds of stress, Identify the right reason/s 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 & Public Speaking: Nature of discussion, Ways to form and present the arguments. To learn the skills of appearing in an interview and being successful in it.

Course Outcomes

- Understand and recognize the importance of interpersonal skills.
- Understand the realistic perspective of work and work expectations.

Text books

1. Rizvi, Ashraf., "*Effective Technical Communication"*, Tata McGraw Hill ,2008.
2. Mohan, Krishan., "*Developing Communication Skills"*, Mac Millan India Limited, 2009.

Reference Books

1. Dale, Carnegie., "*How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
2. Coleman, Daniel. "*Emotional Intelligence"*. Bantam Book, 2006.

Course Code	**CSL502**
Course Title	**Project Phase-I**
Number of Credits	**0-0-6-3**
Course Type:	**GIR**

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 Code	**CSO503**
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 grade must be submitted for the award of suitable letter grade in this course.

Course Code	**CSO503**
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 understand the various phases of compiler and its use.

Course Content

Unit-I Introduction to Compilers and Lexical Analysis: 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: 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: Intermediate languages, declarations, assignment statements, boolean expressions, case statements, back patching, procedure calls.

Unit-IV Code Optimization and Run Time Environments: 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: 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.

Course Outcomes

- Ability to apply the knowledge of lex tool & yacc tool to develop a scanner & parser
- Ability to design and develop software system for backend of the compiler

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.

Principles of Compiler Design Lab

Lab Objectives

- The lab course provides the complete description about inner working of a compiler.
- The main focus is on the design of compilers and optimization techniques.

List of Experiments

- Implementation of symbol table.
- Implementation of Lexical analysis.
- Conversion of infix notation to postfix notation.
- Implementation of type checking.
- Implementation of lexical analyzer.
- Computation of FIRST AND FOLLOW set.
- Construction of LL (1) parsing.
- Constructing recursive descent parsing.
- Implementation of Predictive Parsing Table.
- Implementation of Shift Reduce Parsing.
- Implementation of Operator Precedence Parsing.
- Implementation of LR Parsing.
- Write a program to implement LALR parsing.
- Implementation of generate abstract syntax tree for the given mini language.
- Construction of machine code.
- Construction of DAG.
- Implementation of Simple code optimization and generation procedure.

Course Outcomes

- Construct small compiler for any language
- Building various parsing techniques

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

Course Objectives

- To understand the Software Engineering Practice & Process Models
- To design and develop a software product in accordance with SE principles

Course Content

Unit-I Introduction to Software Engineering: 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: 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: Quality concepts, Review techniques, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks.

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

Course Outcomes

- Assessment in each module gives the overall Software engineering practice.
- Ability to enhance the software project management skills.
- Ability to comprehend the systematic methodologies involved in SE.

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 Pankaj, "*Software Project Management in practice"*, Pearson Education, New Delhi, 2002.

Software Engineering Lab

Labs Objectives

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real life problems.

List of Experiments

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

Lab Outcomes

- Can produce the requirements and use cases the client wants for the software being produced.
- Create and specify such a software design based on the requirement specification that the software can be implemented based on the design.

PROGRAM ELECTIVE-II

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

Course Objectives

- To understand interfacing of 16-bit microprocessor with memory and peripheral chips involving system design.
- To understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.

Course Content

Unit-I Introduction to Microprocessor: 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: 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: 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: 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: 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

Course Outcomes

- Identify various addressing modes Perform various microprocessor based programs.
- Interpret & Solve various automation based problems using microprocessor.

Text Books

1. Gaonkar, Ramesh S, "*Microprocessor architecture, Programming and applications with 8085"*, 6thEdition, Prentice Hall, 2013.
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 2012.

Reference Book

1. Ufferbeck John, "*The 8080/85 Family: Design, Programming & Interfacing"*, PHI India, 2014.

Microprocessors and Interfacing Lab

Lab Objectives

- To become familiar with the architecture and Instruction set of Intel 8085 microprocessor.
- To provide practical hands on experience with Assembly Language Programming.
- To familiarize the students with interfacing of various peripheral devices with 8085 microprocessor.

List of Experiments

- Introduction of microprocessor 8085 trainer kit – 85AD
- The addition of two 8-bit numbers.
- The subtraction of two 8-bit numbers.
- The addition with carry of two 8-bit numbers.
- The subtraction with barrow of two 8-bit numbers.
- The addition of two BCD numbers.
- The subtraction of two BCD numbers.
- The multiplication of two 8-bit numbers by repeated addition method.
- The multiplication of two 8-bit numbers by bit Rotation method.
- The division of two 8-bit numbers by repeated addition method.
- The division of two 8-bit numbers by bit rotation method.
- The square of given numbers in array.
- To find largest number in an array.
- Study of 8086 microprocessor kit
- The addition of two 16-bit numbers.

Course Outcomes

- Explain the architecture, pin configuration of various microprocessors.
- Identify various addressing modes.
- Perform various microprocessor-based programs.

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

Course Objectives

- This course objective is to provide an overview of software maintenance and software reengineering.
- The primary objective is to introduce student to the fundamental principles and methodologies of software maintenance and reengineering.

Course Content

Unit-I Software Maintenance: 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: Maintenance Cost issues using COCOMO II model, Bohem's Maintenance Cost Model,

Unit-III System Evolution and Re- engineering in Maintenance: The Re- Engineering Process Definition, Advantages, Reverse engineering: Reverse Engineering Vs Forward Engineering

Unit-IV Software Reuse and Reuse Landscape: 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: Software Quality Measures, Types of measures: Size –Oriented Metrics, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance,

Course Outcomes

- Ability to understand the re-engineering.
- Software Maintenance after software product release.

Text Books

1. Sommerville, I. "*Software Engineering, 10th Edition*", Addison Wesley, 2016.
2. Tripathy, P.i 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.

Software Maintenance Lab

Lab Objective

- To provide an overview of software maintenance and software reengineering.

List of Experiments

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

Lab Outcomes

- Software Maintenance after software product release.
- Implementation of practical software maintenance skills.

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

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 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 Objective

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

Unit-IV Safety, Responsibilities and Rights: 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), Plagiarism, Discrimination.

Unit-V Global Issues: 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.

Course Outcome

- Students will be able to apply ethics in society, discuss the ethical issues related to engineering and realise the responsibilities and rights in the society.

Text Books

1. Martin Mike W., Schinzinger Roland, "*Ethics in engineering*", Tata Mc Graw Hill, 4th Editin,2005.
2. Govindarajan M., Natarajan S., Senthilkumar V.S., "*Engineering Ethics"*, Prentice Hall of India, 2013.

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

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 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 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 System**
Number of Credits	**3-0-4-5**
Course Type	**PE**

Course Objective

- To study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems).

Course Content

Unit-I Overview of Advanced Operating Systems: Introduction, Functions of OS, Design approaches, Types of advances OS.

Unit-II Architecture of Distributed OS: Introduction, Motivations, System Architecture Types, Distributed OS, and Issues in distributed OS, Communication Networks and Primitives.

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

Unit-IV Distributed File Systems: 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: 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.

Course Outcomes

- Differentiate the issues that arise in designing real-time systems
- Analyse a variety of real-time scheduling techniques, prove correctness of the resulting schedule

Text Books

1. Coulouris G., Dollimore J., and Kindberg T., "*Distributed Systems: Concepts and Design*", Pearson Education, 5th edition, 2017.
2. Signal M. & Shivaratri N., "*Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems"*, McGraw Hill International Edition, 1994.

Reference Book

1. Sinha R.K., "*Distributed Operating Systems*", Prentice Hall, 1998.

Advanced Operating System Lab

Lab Objective

- To get familiarize with advanced topics of the operating systems

List of Experiments

- Managing users
- Managing systems
- File managements
- Useful commands
- Shell Scripting: Shell Syntax
- Executing shell scripts.
- Creating new process.
- Counting maximum number of processes, a system can handle at a time.
- Handling system calls; inter process communication through pipes and message passing, Zombie process, orphan process.
- Handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.
- Study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).
- Multiple sleeping barber problem.
- Semaphores in multiprocessor operating systems.
- Multithreading in multiprocessor operating systems.

Lab Outcomes

- Ability to design multiprocessor operating system.
- Handling threads, semaphores in distributed environment.

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

Course Objectives

- To uncover and understand the current directions of computer networks from literature readings.
- To encourage a performance perspective towards analysis of computer and communications networks.

Course Content

Unit-I Introduction: History and Context, IPV6, Packet switching. Internetworking: Architectural Principles, Names, Addresses. Interdomain Routing.

Unit-II Resource Management: 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: 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: 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: Data-oriented networking and DTNs, Multicast, Datacenter Networking.

Course Outcomes

- Ability to master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
- Ability to be familiar with wireless networking concepts.
- Ability to be familiar with contemporary issues in networking technologies.
- Ability to be familiar with network tools and network programming.

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. Tanenbaum, Prentice-Hall, 2013.

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.

Advanced Computer Networks Lab

Lab Objectives

- Familiarize with principles, architectures, and protocols used in modern networked systems
- Build basic networking and understanding of the tradeoffs and existing technology in building large, complex networked systems, and provide concrete experience of the challenges through a series of lab exercises

List of Experiments

- Configuration and logging to a CISCO Router and firewall and introduction to the basic user Interfaces.
- Introduction to the basic router configuration and basic commands.
- Configuration of IP addressing for a given scenario for a given set of topologies.
- 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.
- Configure, implement and debug the following: Use open source tools for debugging and diagnostics.
    a. ARP/RARP protocols
    b. RIP routing protocols
    c. BGP routing
    d. OSPF routing protocols
    e. Static routes (check using netstat)
- 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.
- 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.
- Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
- 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).
- Extend this to serve a windows client using SMB. Characterize the NAS traffic using wireshark

Lab Outcomes

- Ability to construct basic networking
- Understanding of the tradeoffs and existing technology in building large, complex networked systems

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 understand the fundamental principles and engineering trade-offs involved in designing modern parallel computers.
- To develop programming skills to effectively implement parallel architecture.

Course Content

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

Course Outcomes

- Ability to comprehend parallel architecture and its importance in solving engineering problems.
- Ability to design parallel programs to enhance machine performance in parallel hardware environment.

Text Books

1. Balasubramonian, Rajeev, Jouppi, Norman P., and Muralimanohar, Naveen, "*Multi-Core Cache Hierarchies*", Morgan & Claypool Publishers, 2019.
2. Culler, D. E., Singh, J. P., and Gupta, A., "*Parallel Computer Architecture*", Morgan-Kaufmann, 2004.

Reference Books:

1. Kirk, David B., Wen-mei, W. Hwu, "*Programming Massively Parallel Processors: A Hands-on Approach*", 2010.
2. Larus, James R. and Rajwar, Ravi, "*Transactional Memory*", Morgan & Claypool Publishers, 2007.

Course Code	CSPE42
Course Title	Transaction Processing System and Concurrency Control
Number of Credits	3-0-0-3
Course Type	PE

Course Objectives

- To know how in processing data generated by and about transactions that maintain high degree of accuracy and integrity.
- To understand and recognize fraudulent transactions and produce timely user responses and reports.

Course Content

Unit-I Introduction: Consistency, Atomicity, Durability, Isolation, Flat Transactions, Providing Structure within a Transaction, Structuring an Application as Multiple Transactions.
Unit-II Concurrency Control: Schedules and Schedule Equivalence, Recoverability, Cascaded Aborts and Strictness, Models for Concurrency Control, A Strategy for Immediate-Update Pessimistic Concurrency Controls, Design of an Immediate-Update Pessimistic Concurrency Control, Objects and Semantic Commutativity, Atomicity, Recoverability and Compensating Operations, Locking and SQL Isolation Levels, Granular Locking: Intention Locks and Index Locks, Tuning Transactions, Multiversion Concurrency Controls.
Unit-III Failure Management: Crash, Abort and Media Failure, Immediate-Update Systems and Write-Ahead Logs, Recovery in Deferred-Update Systems, Recovery from Media Failure.
Unit-IV Transaction Processing and Communication: Transaction Processing in a Centralized System, Transaction Processing in a Distributed System, Global Atomicity and the Transaction Manager, Remote Procedure Call, Pear-to-Pear Communication, Event Communication, Storage Architectures, Transaction Processing on the Internet, Implementing the ACID Properties, Distributed Deadlock, Global Serialization.
Unit-V Authentication and Authorization: Authentication, Authorization and Encryption, Digital Signatures, Key Distribution and Authentication, Authorization, Authenticated RPC, Electronic Commerce, Certificates, Passport: SSO, SET Protocol: Dual Signatures, Goods Atomicity, Certified Delivery, and Escrow.

Course Outcomes

- Ability to develop solutions that addresses all of the information processes.
- Ability to design and develop techniques where information systems shall meet emerging needs.
- Ability to analyze situations, identify needs, propose and develop solutions.

Text Book

1. Michael, Kifer, Arthur, Bernstein and Lewis, Philip M., "*Database Systems: An Application-Oriented Approach*", Addison Wesley, 2006.

Reference Book

1. Bernstein, Philip A. and Newcomer, Eric, "*Principles of Transaction Processing*", 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2009.

EIGHTH SEMESTER

Course Code	**CSL801**
Course Title	**Project Phase-II**
Number of Credits	**0-0-18-09**
Course Type	**GIR**

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% has to 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 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 grade must be submitted for the award of 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 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.

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 mobile application development.
- To get accustomed to Android platform.
- To develop skills in developing basic Android applications.

Course Content

Unit–I Introduction to Android: 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: 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: 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: Action Bar; Menus and Action Bar Items; Settings; Dialogs; Customizing Toast; Notifications; Search; Drag and Drop.

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

Course Outcomes

- Ability to comprehend Android platform and its usefulness in application development.
- Ability to acquire skill set to execute applications in Android based devices.
- Ability to design and develop deployable Android applications.

Text Books

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

Reference Book

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

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

Course Objectives

- To understand the basics of Cloud Computing.
- To understand the movement from a traditional network infrastructure to a Cloud solution.

Course Content

Unit-I Cloud Computing Basics: 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: Hardware and Infrastructure: Clients, Security, Network, Services. Accessing the Cloud: Platforms, Web Applications, Web APIs, Web Browsers.

Unit-III Cloud Storage and Standards: Cloud Storage Overview, Cloud Storage Providers. Standards: Application, Client, Infrastructure, Service.

Unit-IV Cloud Computing at Work: 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: Cloud Computing with the Titans: Google, EMC, NetApp, Microsoft, Amazon, IBM, Partnerships, The Business case for going to the Cloud.

Course Outcomes

- Ability to gain insight about basic technology behind the Cloud.
- Ability to comprehend the Cloud computing applications.
- Completing a Business case for going to the Cloud.

Text Books

1. Sosinsky Barrie, "*Cloud Computing: Bible*", Wiley Publication, 2011.
2. Velte Anthony T., Velte Toby J. and Elsenpeter Robert, "*Cloud Computing: A Practical Approach*", McGraw Hill, Indian edition, 2010.

Reference Books

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

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

Course Objectives

- To learn the basic issues, policy and challenges in the Internet.
- To get an idea of the application areas where Internet of Things can be applied.
- To understand the cloud and internet environment and various modes of communications with Internet.

Course Content

Unit-I Introduction: Definition, Foundations, Challenges and Issues, Identification, Security. Components in Internet of Things: Control Units, Sensors, Communication modules, Power Sources, Communication Technologies, RFID, Bluetooth, Zigbee, Wifi, Rflinks, Mobile Internet, Wired Communication, IoT Platform Overview, Raspberry pi-Arduino boards.

Unit-II IoT Protocols: Protocol Standardization for IoT-M2M and WSN Protocols, SCADA, RFID Protocols, Issues with IoT Standardization, Protocols: IEEE 802.15.4, BACNet Protocol, Zigbee Architecture, Network layer, APS Layer, Security.

Unit-III Resource Management in Internet of Things: Clustering, Software Agents, Data Synchronization, Clustering Principles in an Internet of Things Architecture, The Role of Context, Design Guidelines, Software Agents for Object, Data Synchronization, Types of Network Architectures, Fundamental Concepts of Agility and Autonomy, Enabling Autonomy and Agility by the Internet of Things, The Evolution from the RFID-based EPC Network to an Agent based Internet of Things, Agents for the Behaviour of Objects.

Unit-IV Case Study and IoT Application Development: IoT applications in home infrastructures security, Industries IoT electronic equipments, Use of Big Data and Visualization in IoT, Industry 4.0 concepts.

Unit-V Web of Things: Web of Things versus Internet of Things, Architecture Standardization for WoT, Platform Middleware for WoT, WoT Portals and Business Intelligence, Cloud of Things: Grid/SOA, Cloud of Things Architecture, Open Source e-Health sensor platform.

Course Outcomes

- Identify and analyze the components and protocols of IoT.
- Ability to design portable IoT using appropriate boards.
- Ability to develop schemes for the applications of IoT in real time scenarios.

Text Book

1. Zhou Honbo, "*The Internet of Things in the Cloud: A Middleware Perspective*", CRC Press, 2013.

Reference Book

1. Uckelmann Dieter, Harrison Mark and Michahelles Florian, "*Architecting the Internet of Things*", Springer, 2011.

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 know about the techniques that requires the integration of large amounts of data.

Course Content

Unit-I Introduction to Big Data: 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: 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: 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 Itemsets and Clustering: Mining frequent itemsets: Market based model, Apriori algorithm, handling large data sets in main memory, Limited Pass algorithm, counting frequent itemsets in a stream, Clustering techniques: Hierarchical, k-Means, Clustering high dimensional data.

Unit-V NoSQL Data Management for Big Data: 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.

Course Outcomes

- Work with big data tools and its analysis techniques.
- Analyze data by utilizing regression and classification algorithms.
- Apply different mining algorithms and clustering techniques on big data.

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.

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

Course Objectives

- To develop understanding of basic principles and techniques of image processing and image understanding.
- To develop skills in the design and implementation of computer vision software.

Course Content

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

Unit-V Optical Flow: 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.

Course Outcomes

- To demonstrate knowledge and understanding of human and computer vision systems.
- To understand current approaches to image formation, image modelling, image processing and computer vision.

Text Books

1. Forsyth and Ponce, "*Computer Vision: A Modern Approach"*, Pearson Education, Second 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.

STREAM ELECTIVE –II
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Offered by Department of CSE)

Course Code	CSSE11
Course Title	Natural Language Processing
Number of Credits	3-0-0-3
Course Type	SE

Course Objectives

- To understand the application of computational methods in linguists.
- To apply statistical and probabilistic methods for parameter estimation and inference.
- To know how the computational methods, give insight into observed human language phenomena.

Course Content

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

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

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

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

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

Course Outcomes

- Ability to compare and contrast approaches to natural language processing
- Ability to comprehend and analyze the various elements of speech processing
- Ability to design and develop machine learning techniques in the area of NLP

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.

Course Code	**CSSE12**
Course Title	**Artificial Intelligence**
Number of Credits	**3-0-0-3**
Course Type	**SE**

Course Objectives

- To learn the concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of machine learning.

Course Content

Unit-I Introduction to AI: 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 Breath first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

Unit-II Knowledge Representation: 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: 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: Overview, MinMax search procedure, Alpha-beta cutoffs, 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: Introduction to Understanding, Understanding as constraint satisfaction, Introduction to NLP, Syntactic and Sematic analysis, Statistical NLP and Spell Checking.

Course Outcomes

- Ability to comprehend AI & ES to analyze and map real world activities to digital world.
- Ability to identify problems that are amenably solved by AI methods
- Ability to design and carry out an empirical evaluation of different AI algorithms

Text Books

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, 1st Edition, 2017.

Course Code	**CSSE13**
Course Title	**Soft Computing**
Number of Credits	**3-0-0-3**
Course Type	**SE**

Course Objectives

- To understand the concepts of feed forward & feedback neural networks.
- To provide adequate knowledge about of FLC and NN toolbox.

Course Content

Unit-I Introduction of soft computing: 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: 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: 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: 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: 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, Multifeature pattern recognition and Image processing.

Course Outcomes

- Ability to design and develop ML techniques.
- Ability to visualize and analyze behavioral pattern to develop evolutionary algorithm.

Text Books

1. Deepa, S.N. and Sivanandam, S.N., "*Principles of Soft Computing, 2nd Edition*", Wiley India, 2011.
2. Timothy, J. Ross, *"Fuzzy Logic with Engineering Applications, 3rd Edition",* Wiley India, 2010.

Reference Book

1. Zimmermann H. J. "*Fuzzy set theory and its Applications*" Springer international edition, 2011.

Course Code	CSSE14
Course Title	Machine Learning
Number of Credits	3-0-0-3
Course Type	SE

Course Objective

- To understand the basic building blocks and general principles those allow one to design machine learning algorithms

Course Content

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

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

Course Outcomes

- Ability to implement and apply machine learning algorithms to real-world applications.
- Ability to identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
- Ability to understand how to perform evaluation of learning algorithms and model selection.

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. H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, 2000.
3. Bishop, Christopher, *"Pattern Recognition and Machine Learning"*, Springer, 2006.
4. Duda, R.O., Hart, P.E. and Stork, D.G., "*Pattern Classification*", Wiley-Interscience, 2nd Edition November, 2000.

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

Course Objectives

- To learn the fundamentals of deep learning.

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Course Content

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

Course Outcome

- Ability to implement the concepts of deep learning.

Text Book

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

Reference Book

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

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 lay a strong foundation into the basic principles using relational databases.
- To lay the foundation for the study and use of relational databases

Course Content

Unit-I Query Processing and Optimization: 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: Locking Techniques for concurrency control Techniques Based on Time Stamp Ordering, Multiversion 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: Introduction to Database Security Issues, Discretionary Access Control Based on Privileges, Mandatory Access Control for Multilevel Security, Statistical Database Security. Advanced Data Modeling Concepts: Enhanced – ER (ERR)-to-Relational Mapping, Data Abstraction and Knowledge Representation Concepts, Integrity Constraints in data modeling, EER Update Operations and Transaction Specification.

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

Unit-V Deductive Databases: 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.

Course Outcomes

- Ability to develop relational tables.
- Ability to normalize the tables as per specific normalization forms.

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.

Reference Book

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

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 database models and language queries to access databases
- To understand the normalization forms in building an effective database table.

Course Content

Unit-I Relational Model Issues: ER Model, Normalization**,** Query Processing**,** Query Optimization, Transaction Processing, Concurrency Control, Recovery, Database Tuning.

Unit-II Distributed Databases: 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: 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: 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: Rules, Knowledge Bases, Active and Deductive Databases, Multimedia Databases Multimedia Data Structures, Multimedia Query languages, Spatial Databases.

Course Outcomes

- Ability to comprehend the complex query processing techniques
- Ability to design and implement multimedia databases and writing query structure
- Ability to develop skill set in file organization, Query Optimization, Transaction management, and database administration techniques

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.

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

Course Objective

- Provides an up-to-date overview of data security models, techniques, and architectures in a variety of data management applications and settings

Course Content

Unit-I Access Control in XML: Basic structure of XML, characteristics of access control models, models for XML documents, security policies and policy framework for XML, policy modeling and generation, secure data outsourcing.

Unit-II Encrypted Data: Management of encrypted data, Database as a Service, techniques for querying encrypted data, SQL queries over encrypted relational data.

Unit-III Security: Security techniques for data in data warehouses, security of data in OLAP systems, Security for workflow systems.

Unit-IV Database Watermarking: Database watermarking for copyright protection, Information Hiding, Classification of database watermarking approaches, open issues.

Unit-V Privacy: Privacy preserving data mining, privacy in database publishing, Privacy-enhanced Location-based Access Control.

Course Outcomes

- To secure the database.
- Able to provide security and privacy to database.

Text Book

1. Gertz, M. and Jajodia, S. *"Handbook of Database Security*", Springer, 2008.

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

Course Objectives

- To understand the fundamentals of mobile communication.
- To understand the architecture of various Wireless Communication Networks.
- To understand the significance of different layers in mobile system

Course Content

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

Unit-II Medium Access Control: 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: Infrared Vs Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

Unit-IV Mobile Network Layer: 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: 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.

Course Outcomes

- Ability to develop a strong grounding in the fundamentals of mobile Networks
- Ability to apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Ability to comprehend, design, and develop a lightweight network stack

Text Book

1. Jochen, Schiller, "*Mobile Communication*", 2nd Edition, Pearson Education, 2008.

Reference Book

1. Theodore and S. Rappaport, "*Wireless Communications, Principles, Practice*", 2nd Ed, PHI, 2002.

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 and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.

Course Content

Unit-I Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet, Wireless Sensors.

Unit-II Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

Unit-III MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Unit-IV Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

Unit-V QoS and Energy Management: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Course Outcomes

- Technical knowhow in building a WSN network.
- Analysis of various critical parameters in deploying a WSN.

Text Book

1. Ram Murthy, C. Siva, and Manoj, B. S., "*AdHoc Wireless networks*", Pearson Education, 2008.

Reference Books

1. Feng, Zhao and Leonides, Guibas, "*Wireless sensor networks*", Elsevier publication - 2004.
2. William, Stallings, "*Wireless Communications and Networks*", Pearson Education, 2004.
3. Jochen, Schiller, "*Mobile Communications*", Pearson Education, 2nd Edition, 2003.

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 Objective

- To provide understanding of principal concepts, issues and approaches of security.

Course Content

Unit-I Overview: Computer Security Concepts, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy.

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

Unit–IV Authentication and Authorization: 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 Firewalls and Intrusion Detection and Prevention Systems: Firewall Characteristics and Access Policy, Types of Firewall, Firewall Biasing, Firewall Location and Configuration, Intrusion Detection Systems, Intrusion Prevention Systems, Unified Threat Management Products.

Course Outcome

- Acquire a practical overview of the issues involved in the field of information security and assurance.

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.

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

Course Objectives

- To gain knowledge about the mathematics of the cryptographic algorithms.
- To get an insight into the working of different existing cryptographic algorithms.
- To learn how to use cryptographic algorithms in security.

Course Content

Unit-I Classical Cryptography: 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: 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: 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 Cryptosystems: The basic setup, Diffie-Hellman Key exchange, Massy-Omura Encryption, ElGama Public key encryption.

Unit-V Digital Signature Schemes: 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.

Course Outcomes

- Ability to understand the basic concepts of classical cryptosystem, public key cryptosystem and digital signature scheme.
- Ability to break the cryptosystems that are not secure.

Text Books

1. Stinston Douglas R. and Paterson Maura B., "*Cryptography: Theory and Practice*", Fourth Edition, Chapman & Hall/CRC, 2018.
2. Rosen Kenneth H., "*Elliptic Curves: Number Theory and Cryptography"*, second Edition, Chapman and Hall/CRC, 2008
3. Stallings W., "*Cryptography and Network Security: Principles and Practice*", Seventh Edition, Pearson Education Asia, 2017.

Reference Book

1. Forouzan Behrouz A. and Mukhopadhyay Debdeep, "*Cryptography and Network Security*", Third Edition, Tata McGraw Hill, 2016.

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

Course Objectives

- To understand the network security, services, attacks, mechanisms, types of attacks.
- To comprehend and apply authentication services, authentication algorithms.
- To comprehend and apply network layer security protocols, Transport layer security protocols, Web security protocols.

Course Content

Unit –I Overview of Network Security: 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: 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 Security and Standards: 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 Applications: Kerberos, X.509, Public Key Infrastructure.

Unit-V Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Firewall security.

Course Outcomes

- Ability to determine appropriate mechanisms for protecting the network.
- Ability to design and develop security solutions for a given application or system.
- Ability to develop a secure network stack.

Text Book

1. Stallings William and Brown Lowrie, *"Computer Security: Principles and Practice",* Pearson, Fourth Edition, 2018.
2. Stallings W., *"Cryptography and Network Security: Principles and Practice"*, Seventh Edition, Pearson, 2017.

Reference Book

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

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

Course Objectives

- To understand the application of cryptographic techniques in real world applications.
- To comprehend the notion of provable security and its implication with improved security.

Course Content

Unit-I Foundations: 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: 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: Key Management: Generating Keys, Non-linear Keyspaces, 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 Communicatrions Channels, Encrypting Data for Storage, Hardware vs Software Encryption, Detecting Encryption, Hiding Ciphertext in Ciphertext, Destroying Information.

Unit-IV Cryptographic Algorithms: Block Ciphers: Lucifer, Madryga, NewDES, FEAL, REDOC, LOKI, Khufu and Khafre, RC2, IDEA, MMB, CA-1.1, Skipjack. Combining Block Ciphers: Double and Triple Encryption, Doubling the Block Length, Other Multiple Encryption Schemes, CDMF Key Shortening, Whitening, Cascading Multiple Block Algorithms, Combining Multiple Block Algorithms.

Unit-V The Real World: Example Implementation: IBM Secret-Key Management Protocol, Kerberos, Privacy-Enhanced Mail, Pretty Good Privacy, Smart Cards, Universal Electronic Payment System.

Course Outcomes

- Ability to derive simple provable security proofs for cryptographic schemes.
- Ability to design and implement cryptographic protocols.

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.

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

Course Objectives

- To gain knowledge about the mathematics of the Cyber-Physical Systems.
- To get an insight into the working of different existing Cyber-Physical Systems.
- To learn the basics of Distributed Cyber-Physical Systems and their security challenges.

Course Content

Unit-I Symbolic Synthesis for Cyber-Physical Systems: 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: 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 Systems: Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches.

Unit-IV Synchronization in Distributed Cyber –Physical Systems: Challenges in Cyber-Physical Systems, A Complexity Reduction Technique for Synchronization, Basic Techniques.

Unit-V Cyber Physical Systems Application Domain: Medical Cyber-Physical Systems, Energy Cyber-Physical Systems, Cyber-Physical Systems Built on Wireless Sensor Networks.

Course Outcome

- Ability to understand the Cyber Physical Systems in real world problems and their applications.

Text Book

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

STREAM – V

SIGNAL PROCESSING AND COMMUNICATION

(Offered by Department of ECE)

Course Code	ECSE11
Course Title	Information Theory and Coding
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To introduce the principles and applications of information theory
- To calculate the capacity of a communication channel with and without noise.

Course Contents

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

Unit-II Channel Capacity: Uniform Dispersive Channel, Uniform Focusing Channel, Strongly Symmetric Channel, Binary Symmetric Channel, Binary Erasure Channel. Channel Capacity of the all these channels, Channel Coding Theorem, Shannon-Hartley Theorem.

Unit-III Data Compression: Kraft inequality, Huffman codes, Shannon-Fano coding, Arithmetic Coding.

Unit-IV Linear Block Codes: Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the Mac-Williams identities; Perfect codes. Cyclic Codes, BCH codes; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes

Unit-V Convolution codes: Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm, Turbo Codes, Concatenated Codes.

Course Outcomes

- Able to measure information in terms of probability and entropy.
- Analyzed the capacity of a communication channel with and without noise.
- Studied various data compression techniques.

Text Books

1. Saha, A., Manna, N., and Mandal, S., "*Information Theory, Coding and Cryptography*", 1st edition, Pearson Education, 2013.
2. Bose, R., "*Information Theory, Coding and Cryptography*", 3rd edition, Mc-Graw Hill Education, 2017.

Reference Books

1. Cover, T. M. and Thomas, J. A., "*Elements of Information Theory*", 2nd edition, Wiley, 2013.
2. Jones, G. A., "*Information and Coding Theory*", Springer, 2004.

Course Code	ECSE12
Course Title	Digital Speech Processing
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To learn speech production, related parameters of speech and different speech modeling procedures and their implementation issues.

Course Contents

Unit-I Basic concepts: Speech fundamentals: articulatory phonetics – production and classification of speech sounds; acoustic phonetics – acoustics of speech production; review of digital signal processing concepts; short-time Fourier transform, filter-bank and LPC methods.

Unit-II Speech analysis: Features, feature extraction and pattern comparison techniques: speech distortion measures– mathematical and perceptual – log–spectral distance, cepstral distances, weighted cepstral distances and filtering, likelihood distortions, spectral distortion using a warped frequency scale, LPC, PLP and MFCC coefficients, time alignment and normalization – dynamic time warping, multiple time – alignment paths.

Unit-III Speech modeling: Hidden Markov models: markov processes, HMMS–2 evaluation, optimal state sequence – viterbi search, Baum-Welch parameter re-estimation, implementation issues.

Unit-IV Speech recognition: Large vocabulary continuous speech recognition: architecture of a large vocabulary continuous speech recognition system – acoustics and language models – N-grams, context dependent sub-word units; applications and present status.

Unit-V Speech synthesis: Text-to-speech synthesis: concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, applications and present status.

Course Outcomes

- To model speech production system.
- To extract and compare different speech parameters.

Text Books

1. Rabiner, L. and Schafer, R., "*Theory and Applications of Digital Speech Processing*", 1st edition, Pearson Education, 2010.
2. Rabiner, L. R., Juang, B. H., and Yegnararayana, B., "*Fundamentals of Speech Recognition*", 1st edition, Pearson Education, 2008.

Reference Book

1. Jurafsky, D. and Martin, J. H., "*Speech and Language Processing*", 2nd edition, Pearson Education, 2013.

Course Code	ECSE13
Course Title	Wireless Communication
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To get an understanding of mobile radio communication principles,
- To study the recent trends adopted in cellular and wireless systems and standards.

Course Contents

Unit-I Introduction to Wireless Communication System: Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. 2G, 3G, WLL, WLAN, Bluetooth and PAN.

Unit-II The Cellular Concept System Design Fundamentals: Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Cochannel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.

Unit-III Mobile Radio Propagation Model, Small Scale Fading and Diversity: Large scale path loss:-Free Space Propagation loss equation, Pathloss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and rician distribution, Statistical for models multipath fading channels and diversity techniques in brief.

Unit-IV Multiple Access Techniques: Introduction, Comparisons of multiple Access Strategies TDMA, CDMA, FDMA, OFDM.

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

Course Outcomes

- Able to apply the knowledge of basic wireless communication systems
- Able to analyze and examine the multiple access techniques and its application.

Text Book

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

Reference Books

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

Course Code	ECSE14
Course Title	Biomedical Signal Processing
Number of Credits	3-0-0-3
Type of Course	SE

Course Objective

- To understand for performing signal processing of common signals derived from the human body.

Course Contents

Unit-I Basic neurology: Nervous System, neuron, Resting potential, Nernst equation, electrical equivalents.

Unit-II Electrical activity of heart: Introduction to ECG Lead system and recording, ECG wave component detection and analysis, Vector cardio-graphy, Inverse cardiography, Signal conditioning & processing.

Unit-III Electrical activity of neuromuscular system: Muscular system, Electrical signals of motor unit and gross muscle, Human motor coordination system, Electrodes, Correlation of force and work; EMG integrators, Signals conditioning & processing.

Unit-IV Electrical activity of brain: Sources of brain potentials, Generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, EEG under normal, Grand mal and Petit mal seizures, Signal conditioning & processing.

Unit-V Electrical signals from visual system: Sources of electrical signals in eye, Generation of signals, Electro-retinogram, Electro-occulogram, Analysis of signals. Electrical signals from Auditory System: Generation of cochlear potentials and nature; Evoked responses, Auditory nerves, Signal conditioning & processing.

Course Outcome

- Ability to understand and apply filtering and spectral analysis to evaluate the electroencephalographic bio-signals and heart rate variability.

Text Books

1. Rangayyan, R. M., "*Biomedical Signal Analysis*", 2nd edition, Wiley, 2016.
2. Tompkins, W. J., "*Biomedical Digital Signal Processing: C Language Examples and Laboratory Experiments for the IBM PC*", Prentice-Hall India, 1998.

Reference Books

1. Bruce, E. N., "*Biomedical Signal Processing and Signal Modeling*", Wiley, 2007.
2. Semmlow, J. L. and Griffel, B., "*Biosignal and Medical Image Processing*", 3rd edition, CRC press, 2014.

Course Code	ECSE15
Course Title	Satellite Communication
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To introduce the fundamentals of satellite communication.
- To understand the analog and digital technologies used for satellite communication.

Course Contents

Unit-I Satellite Orbits: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and Non Geo-stationary orbits, Look Angle Determination, Limits of visibility, eclipse-Sub satellite point, Sun transit outage, Launching Procedures, launch vehicles and propulsion.

Unit-II Space Segment and Satellite Link Design: Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

Unit-III Earth Segment: Introduction, Receive, Only home TV systems, Outdoor unit, Indoor unit for analog (FM). TV: Master antenna TV system, Community antenna TV system, Transmit, Receive earth stations, Problems, Equivalent isotropic radiated power. Transmission losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, Link power budget equation, System noise, Antenna noise, Amplifier noise temperature, Amplifiers in cascade, Noise factor, Noise temperature of absorptive networks, Overall system noise temperature, Carrierto- Noise ratio, Uplink, Saturation flux density, Input back off. The earth station, HPA, Downlink, Output back off, Satellite TWTA output, Effects of rain, Uplink rain, Fade margin, Downlink rain, Fade margin, Combined uplink and downlink C/N ratio.

Unit-IV Satellite Access: Modulation and Multiplexing: Voice, Data, Video, Analog, digital transmission system, video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression, encryption.

Unit-V Satellite Applications: INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. DBS, DTH, DAB, World space services, BTV, GRAMSAT, Specialized services, E –mail, Video conferencing, Internet.

Course Outcomes

- Able to analyze the satellite orbits.
- Able to apply various modulation techniques, coding, multiple access techniques.

Text Books

1. Roddy, D., "*Satellite Communications*", 4th edition, McGraw Hill Education, 2017.
2. Pratt, T., Bostian, C., and Allnutt, J., "*Satellite Communication*", 2nd edition, Wiley, 2006.

Reference Books

1. Maral, G. and Bousquet, M., "*Satellite Communication Systems: Systems, Techniques and Technology*", 5th edition, Wiley, 2014.
2. Martin, D. H., "*Communication satellites*", 4th edition, Aerospace Press, 2000.

STREAM – VI

VLSI AND ELECTRONIC SYSTEMS

(Offered by Department of ECE)

Course Code	ECSE21
Course Title	Digital VLSI Design
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To understand theory and to learn design of digital systems at transistor level.
- The course will involve design, layout and simulation of digital VLSI circuits.

Course Contents

Unit-I Introduction to VLSI: Design Flow, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology. Fabrication of MOSFETs, Basic Concepts the CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

Unit-II MOS Transistor: Structure, Structure and Operation of MOS Transistor (MOSFET), Current-Voltage Characteristics, MOSFET Scaling, MOSFET Capacitance. MOS Inverters, Resistive-Load Inverters, CMOS Inverter.

Unit-III MOS Inverters: Switching Characteristics and Interconnect Effects, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters. Combinational MOS Logic Circuits, CMOS Transmission Gates (Pass Gates).

Unit-IV Sequential MOS Logic Circuits: Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop.Dynamic Logic Circuits, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High Performance Dynamic CMOS Circuits.

Unit-V Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test Techniques, Current Monitoring IDDQ Test. Semiconductor Memories: Dynamic Random Access Memory, Static Random Access Memory, Non-volatile Memory, Flash Memory.

Course Outcomes

- Silicon technology and transistors are introduced and described from a digital point of view, and the performance of various circuits is derived and estimated.
- CMOS digital circuits will be designed and analyzed.

Text Books

1. Kang, S. M., Leblebici, Y., and Kim, C., "*CMOS Digital Integrated Circuits: Analysis and Design"*, 4th edition, McGraw Hill Education, 2016.
2. Rabaey, J. M., Chandrakasan, A., and Nikolic, B., "*Digital Integrated Circuits: A Design Perspective"*, 2nd edition, Pearson Education, 2016.

Reference Books

1. Uyemura, J. P., "Circuit Design for *CMOS VLSI"*, 1st edition, Springer, 2011.
2. West, N. H. E. and Eshraghian, K., "*Principles of CMOS VLSI Design: A Systems Perspective"*, 2nd edition, Pearson Education, 1993.

Course Code	**ECSE22**
Course Title	**Embedded Systems**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

Course Objectives

- To introduce students to the modern embedded system concepts.
- To make the students to understand and program modern embedded systems using modern embedded processors.

Course Contents

Unit-I Introduction to Embedded Computing: Characteristics of Embedding Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process.

Unit-II Embedded System Architecture: Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller.

Unit-III Designing Embedded Computing Platform: Bus Protocols, Memory Devices and their Characteristics, Memory mapped I/O, I/O Devices, I/O mapped I/O, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, Mixed Signals Processing.

Unit-IV Programming Embedded Systems: Basic Features of an Operating System, Kernel Features, Real-time Kernels, Processes and Threads, Dynamic Allocation, Device Drivers, Real-time Transactions and Files, Real-time OS.

Unit-V Network Based Embedded Applications: Embedded Networking Fundamentals, IoT overview and architecture. Various wireless protocols and its applications: NFC, Zig-Bee, Bluetooth, Bluetooth Low Energy, Wi-Fi. CAN. Overview of wireless sensor networks and design examples.

Course Outcomes

- Upon completion of this course, students will be able to get an insight into the overall landscape and characteristics of embedded systems.
- Become familiar with the architecture and programming aspects of the embedded processor (ATOM).
- Develop application software for embedded systems using the RTOS functions.

Text Books

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

Reference Books

1. Hermann, K., "*Real Time Systems: Design Principles for Distributed Embedded Applications"*, 2nd edition, Springer, 2013.
2. Hohl, W., and Hinds, C., "*ARM Assembly Language: Fundamentals and Techniques*", 2nd edition, CRC Press, 2014.

Course Code	**ECSE23**
Course Title	**MEMS and Sensor Design**
Number of Credits	**3-0-0-3**
Type of Course	**SE**

Course Objectives

- To learn Introduction to MEMS and micro fabrication.
- To study the essential material properties.
- To study various sensing and transduction technique.

Course Contents

Unit-I Introduction to MEMS: Introduction to MEMS and Microsystems, Materials and Substrates for MEMS, Sensors/Transducers, Sensors characterization and classifications, Micro-actuators, Application of MEMS.

Unit-II Material Properties: MEMS materials, Structural and sacrificial materials, Properties of silicon: mechanical, electrical and thermal, Basic modeling of elements in electrical and mechanical systems.

Unit-III MEMS Fabrication: MEMS Fabrication Technologies, Single crystal growth, Micro-maching, Photolithography, Micro-stero lithography, Thin film deposition, Impurity doping, Diffusion, Etching, Bulk and surface micro-maching, Etch stop technique and microstructure, LIGA.

Unit-IV Mechanical Sensors & Actuators: Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures, Cantilever, Pressure sensors, Piezo-resistance Effect, Piezoelectricity, Piezo-resistive Sensor, capacitive sensors, Inductive sensors, MEMS inertial sensors, micro-machine micro-accelerometer for MEMS, Parallel-plate Actuator, Piezo-actuators.

Unit-V Magnetic and Thermal Sensors: Magnetic material for MEMS, Magnetic sensing and detection, Magneto-resistive sensors, Hall effect, Magneto-diode, Megneto-transitors, MEMS magnetic sensors, RF MEMS. Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors, Heat pump, micro-machined thermocouple probe, Thermal flow sensors, Shape memory alloy.

Course Outcomes

- Demonstrate a clear understanding of concepts of MEMS, and their fabrication.
- To be fluent with the design, analysis and testing of MEMS. To use knowledge of MEMS for different applications.

Text Books

1. Liu, C., "*Foundations of MEMS*", Pearson Education, 2011.
2. Senturia, S. D., "*Microsystem Design*", 1st edition, Springer, 2013.

Reference Book

1. Rebiz, G. M., "*RF MEMS Theory, Design, and Technology*", Wiley, 2010.

Course Code	ECSE24
Course Title	Introduction to Robotics
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To understand the functions of the basic components of a robot effectors and sensors.
- To impart knowledge in robot kinematics and programming.

Course Contents

Unit-I Fundamentals of Robots: Robot definition, Robot anatomy, Co-ordinate systems, Work envelope types and classification, Yaw, Roll, Joint notations, Speed of motion, pay load-Robot parts and their functions, Need for Robots, with applications.

Unit-II Robot Drive Systems and End Effectors: Pneumatic drives, Hydraulic drives, Mechanical drives, Electrical drives, D.C. servo motors, Stepper motors, A.C. servo motors, Salient features, Applications and comparison of all these drives, Grippers such as End effectors, Mechanical, Pneumatic and hydraulic, Magnetic, Vacuum; Two fingered; Internal and external Grippers; Selection and design considerations.

Unit-III Sensors and Machine Vision: Requirements of a sensor, Principles and applications of the following types of sensors, LVDT, Resolvers, Optical encoders, Pneumatic position sensors, Range sensors triangulations principles, Structured, Lighting approach, Time of flight, Range finders, Laser range meters, Frame grabber, Sensing and digitizing image data-signal conversion, Image storage, visual serving and navigation.

Unit-IV Robot Kinematics and Robot Programming: Forward kinematics, Inverse kinematics and difference, Forward kinematics and reverse kinematics of manipulators with two, Three degrees of freedom, Four degrees of freedom Jacobians, Velocity and forces manipulator dynamics, Trajectory generator, Manipulator mechanism design, Lead through programming, Robot programming languages, and simple programs.

Unit-V Implementation and Robot Economics: RGV, AGV, Implementation of robots in industries, Various steps, Safety considerations for Robot operations, Economic analysis of Robots.

Course Outcome

- Able to apply the basic engineering knowledge for the design of robot.

Text Books

1. Craig, J. J., "*Introduction to Robotics: Mechanics and Control*", 3rd edition, Pearson Education, 2008.
2. Lynch, K. M. and Park, F. C., "*Modern Robotics: Mechanics, Planning, and Control"*, 1st edition, Cambridge University Press, 2017.

Reference Book

1. Klafter, R. D., Chmielewski, T. A., and Negin, M. "*Robotic Engineering: An Integrated Approach*", Prentice Hall India, 1993.

Course Code	ECSE25
Course Title	Introduction to Nano-electronics
Number of Credits	3-0-0-3
Type of Course	SE

Course Objectives

- To learn and understand basic concepts of Nano-electronics.
- To know the techniques of fabrication and measurement.

Course Contents

Unit-I Introduction To Nanoelectronics: Microelectronics towards bio-molecule electronics, Particles and waves, Wave-particle duality, Wave mechanics, Schrödinger wave equation, Wave mechanics of particles: Atoms and atomic orbitals, Materials for nanoelectronics, Semiconductors, Crystal lattices: Bonding in crystals, Electron energy bands, Semiconductor hetero-structures, Lattice-matched and pseudo-morphic hetero structures, Inorganic-organic hetero-structures, Carbon nanomaterials: nanotubes and fullerenes.

Unit-II Material Properties: Dielectrics, ferroelectrics and electronic properties, Quantum Effects, Magneto-electronics, Electronic structures, Molecular basis of their electrical excitability, Circuit and system design, Analysis by diffraction and fluorescence methods.

Unit-III Fabrication and Measurement Techniques: Growth, fabrication and measurement techniques for nanostructures, Bulk crystal and heterostructure growth, Nanolithography, Methods of nano-tube growth, Chemical and biological methods for nano-scale fabrication, Fabrication of nano-electromechanical systems, Scanning probe techniques.

Unit-IV Nano-Structure Devices: Electron transport in semiconductors and nanostructures, Electrons in quantum wells and wires, Electrons in quantum dots, Nanostructure devices, Resonant-tunneling diodes, Field-effect transistors, Single electron transfer devices, Potential effect transistors.

Unit-V Nanoelectronics Applications: Nano-electromechanical system, Quantum-dot cellular automata, Superconductor digital electronics, Quantum computing, Carbon nanotubes, Molecular electronics.

Course Outcomes

- Ability to demonstrate distinct phenomena that are important in nano-electronic devices.
- Ability to understand principles, merits, demerits and challenges of some of the futuristic nano-electronic devices.

Text Books

1. Datta, S., "*Lessons from Nanoelectronics: A New Perspective on Transport*", 2nd edition, World Scientific, 2018.
2. Ranier, W., "*Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices*", 3rd edition, Wiley, 2012.

Reference Book

1. Hanson, G. W., "*Fundamentals of Nanoelectronics*", 1st edition, Pearson Education, 2009.

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

Unit-II Individual behavior: 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 behavior: 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 Meaning – Importance – Leadership styles – Theories – Leaders versus Managers – Sources of power – Power centers – Power and Politics.

Unit-V Dynamics of organizational behavior 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.

Course Outcomes

- Application of organizational behavior concepts, models and theories to real life management situations through case analysis.
- Effective communication in oral and written forms about organizational behavior theories and their application using appropriate concepts, logic and rhetorical conventions.

Text Books

1. Robins, S.P., "*Organizational Behavior"*, PHI Learning / Pearson Education, 11th edition, 2008.
2. Luthans, F., "*Organisational Behavior"*, McGraw Hill, 11th edition, 2001.

Reference Book

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

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

Course Objective

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

Course Content

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

Unit-II motivation 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: 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: 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: 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.

Course Outcome

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

Text Books

1. Khanka. S.S., "*Entrepreneurial Development*" S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "*Entreprenuership – Theory, Process and Practice*", 9th Edition, Cengage Learning 2014.

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: 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: 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: work Flow, Automation Customization and internal Commerce, Supply chain Management.

Unit-IV Digital Marketing: Introduction, email marketing, social media marketing-Facebook, Twitter, LinkedIn, mobile marketing, web analytics.

Unit-V Search Engine Optimization: Introduction, SEO- white hat, black hat, tools for SEO, Pay per click.

Course Outcomes

- Identification of the business relationships between the organizations and their customers.
- Performance of various transactions like payment, data transfer and etc.

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.
3. Dodson, Ian, "*The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns*", Wiley, 1st edition, 2016.

Reference Book

1. Kalakata, "*Frontiers of electronic commerce",* Pearson, 1st edition, 2002.

Course Code	**HME734**
Course Title	**Usability Analysis**
Number of Credits	**3-0-0-3**
Type of Course	**GIR**

Syllabus To Be Designed

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 ECE 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	

IIITUGCSE19