ASSAM UNIVERSITY, SILCHAR
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
UG PROGRAMME COURSE STRUCTURE & SYLLABUS

Chapter-1
General, Course structure & Theme
&
Semester-wise credit distribution A.

Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical/ Lab (L) per week	1 Credit

B. Range of credits: The total credit for the B.Tech programme is kept as **162** which is within AICTE proposed range.

C. Structure of Undergraduate Engineering programme:

Sl. No	Category	Credit Breakup	AICTE Proposed Credit
1.	Humanities and Social Sciences including Management courses	13	12
2.	Basic Science courses	25	24
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	29	29
4.	Professional core courses	51	49
5.	Professional Elective courses relevant to CSE	18	18
6.	Open subjects – Electives from other technical and /or emerging specialization/branch	09	12
7.	Project work, seminar and internship in industry or elsewhere	15	15

8.	Mandatory Courses Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)	
	Total Credit	160	159

D. Credit distribution in the First year of Undergraduate Engineering program:

	Lecture(L)	Tutorial(T)	Laboratory/Practical(P)	Total Credit(C)
Physics-I	3	1	4	6
Maths-I	3	1	0	4
Workshop/ Manufacturing Practices	1	0	4	3
Engineering Graphics & Design	1	0	4	3
English-I	2	0	0	2
Chemistry	3	1	4	6
Maths-II	3	1	0	4
Programming for Problem Solving	3	0	4	5
Basic Electrical Engineering	3	1	2	5
English-II	1	0	2	2

E. Category of Courses:

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		Physics	3	1	4	6	I
2.		Chemistry	3	1	4	6	II
3.		Mathematics-I	3	1	0	4	I
4.		Mathematics-II	3	1	0	4	II
5.		Mathematics-III	3	0	0	3	III
6.			2	0	0	2	V
		Total Credit				25	

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		Basic Electrical Engineering	3	1	2	5	II
2.		Engineering Graphics & Design	1	0	4	3	I
3.		Programming for Problem Solving	3	0	4	5	II
4.		Workshop/Manufacturing Practices	1	0	4	3	I
5.		Analog Electronic Circuits	3	0	4	5	III
6.		Digital Electronics	3	0	4	5	III
7.		Microprocessor	3	0	0	3	III
		Total Credit				29	

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		English-I	2	0	0	2	I
2.		English-II	1	0	2	2	II
3.		Value Education	3	0	0	3	III
4.		Organizational Behaviour	3	0	0	3	IV
5.		Effective Technical Communication	3	0	0	3	VII
		Total Credit				13	

PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 302	Data Structure	3	0	0	3	III
2.	CSE 308	Data Structure Lab	0	0	4	2	III
3.	CSE 401	Discrete Mathematics & Graph Theory	3	0	0	3	IV
4.	CSE 402	Computer Organization & Architecture	3	0	0	3	IV
5.	CSE 403	Database Management Systems	3	0	0	3	IV
6.	CSE 404	Object Oriented Programming	3	0	0	3	IV
7.	CSE 407	Computer Architecture & Microprocessor Lab	0	0	4	2	IV
8.	CSE 408	Database Management Systems Lab	0	0	4	2	IV
9.	CSE 409	Object Oriented Programming Lab	0	0	4	2	IV
10.	CSE 501	IT Workshop(Python)	0	0	4	2	V
11.	CSE 502	Design & Analysis of Algorithms	3	0	0	3	V
12.	CSE 503	Operating Systems	3	0	0	3	V
13.	CSE 504	Formal Language & Automata Theory	3	0	0	3	V
14.	CSE 507	Design & Analysis of Algorithms Lab	0	0	4	2	V
15.	CSE 508	Operating Systems Lab	0	0	4	2	V
16.	CSE 601	Compiler Design	3	0	0	3	VI
17.	CSE 602	Computer Networks	3	0	0	3	VI
18.	CSE 606	Compiler Design Lab	0	0	4	2	VI
19.	CSE 607	Computer Networks Lab	0	0	4	2	VI
		Total Credit				51	

PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 506	Elective – I	3	0	0	3	V
2.	CSE 603	Elective – II	3	0	0	3	VI
3.	CSE 604	Elective – III	3	0	0	3	VI
4.	CSE 701	Elective – IV	3	0	0	3	VII
5.	CSE 702	Elective – V	3	0	0	3	VII
6.	CSE 801	Elective – VI	3	0	0	3	VIII
		Total Credit				18	

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 703	Open Elective – I	3	0	0	3	III
2.	CSE 802	Open Elective – II	3	0	0	3	III
3.	CSE 803	Open Elective – III	3	0	0	3	IV
		Total Credit				09	

4 year Curriculum structure
B.Tech. in Computer Science and Engineering
Total credits (4 year course): 162
I. Mandatory Induction Program

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

II. Semester-wise structure of curriculum

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Semester-I (First Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Basic Science Course	ASH 101	Engineering Physics	3	1	0	4
2.	Basic Science Course	ASH 102	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4
3.	Engineering Science Course	ASH 103	Workshop/manufacturing Practices	1	0	4	3
4.	Engineering Science Course	ASH 104	Engineering Graphics	1	0	4	3
5.	Humanities & Social Sciences including Management courses	ASH 105	English	2	0	0	2
6.	Basic Science Course	ASH 106	Engineering Physics Lab	0	0	4	2
				Total Credits			**18**

Semester- II (First Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Basic Science Course	ASH 201	Engineering Chemistry	3	1	0	4
2.	Basic Science Course	ASH 202	Mathematics -II (Probability & Statistics)	3	1	0	4
3.	Engineering Science Course	ASH 203	Programming for problem Solving	3	0	0	3
4.	Engineering Science Course	ASH 204	Basic Electrical Engineering	3	1	0	4

5.	Humanities & Social Sciences including Management courses	ASH 205	English-II	1	0	2	2
6.	Basic Science Course	ASH 206	Engineering Chemistry Lab	0	0	2	2
7.	Engineering Science Course	ASH 207	Programming for problem Solving Lab	0	0	4	2
8.	Engineering Science Course	ASH 208	Basic Electrical Engineering Lab	0	0	2	1
				Total Credits			22

Semester-III (Second Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Engineering Science Course	CSE 301	Analog Electronic Circuits	3	0	0	3
2.	Professional Core Courses	CSE 302	Data Structure	3	0	0	3
3.	Engineering Science Course	CSE 303	Digital Electronics	3	0	0	3
4.	Engineering Science Course	CSE 304	Microprocessor	3	0	0	3
5.	Basic Science Course	ASH 301 A	Mathematics -III (Differential Calculus)	3	0	0	3
6.	Humanities & Social Sciences including Management courses	ASH 302	Humanities-I(Effective Technical Communication)	3	0	0	3
7.	Engineering Science Course	CSE 305	Analog Electronic Circuits Lab	0	0	4	2
8.	Professional Core Courses	CSE 306	Data Structure Lab	0	0	4	2
9.	Engineering Science Course	CSE 307	Digital Electronics	0	0	4	2
				Total Credits			24

Semester-IV (Second Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Core Courses	CSE 401	Discrete Mathematics & Graph Theory	3	0	0	3
2.	Professional Core Courses	CSE 402	Computer Organization & Architecture	3	0	0	3
3.	Professional Core Courses	CSE 403	Database Management Systems	3	0	0	3
4.	Professional Core Courses	CSE 404	Object Oriented Programming	3	0	0	3
5.	Humanities & Social Sciences including Management courses	ASH 401	Management-I (Organizational Behaviour)	3	0	0	3
6.	Mandatory courses	ASH 402	Environmental Science	-	-	-	0
7.	Professional Core Courses	CSE 405	Computer Architecture and Microprocessor Lab	0	0	4	2
8.	Professional Core Courses	CSE 406	Database Management Systems Lab	0	0	4	2
9.	Professional Core Courses	CSE 407	Object Oriented Programming Lab	0	0	4	2
				Total Credits			21

Semester-V (Third Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Core Courses	CSE 501	IT Workshop(Python)	0	0	4	2
2.	Professional Core Courses	CSE 502	Design & Analysis of Algorithms	3	0	0	3
3.	Professional Core Courses	CSE 503	Operating Systems	3	0	0	3

4.	Professional Core Courses	CSE 504	Formal Language & Automata Theory	3	0	0	3
5.	Professional Elective Courses	CSE 505	Elective-I	3	0	0	3
6.	Basic Science Course	ASH 501	Mathematics-IV Numerical Analysis	2	0	0	2
7.	Mandatory courses	ASH 503	Constitution of India	-	-	-	0
8.	Professional Core Courses	CSE 506	Design & Analysis of Algorithms Lab	0	0	4	2
9.	Professional Core Courses	CSE 507	Operating Systems Lab	0	0	4	2
10	Mandatory Course	CSE 508	Summer Training(Min 4 weeks)	-	-	-	0
				Total Credits			20

Semester-VI (Third Year) Curriculum

Sl. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1.	Professional Core Courses	CSE 601	Compiler Design	3	0	0	3
2.	Professional Core Courses	CSE 602	Computer Networks	3	0	0	3
3.	Professional Elective Courses	CSE 603	Elective-II	3	0	0	3
4.	Professional Core Courses	CSE 604	Engineering	3	0	0	3
5.	Humanities & Social Sciences including Management courses	ASH 601	Humanities-II Understanding Culture and Society through Literature	3	0	0	3
6.	Professional Core Courses	CSE 605	Compiler Design Lab	0	0	4	2
7.	Professional Core Courses	CSE 606	Computer Networks Lab	0	0	4	2
8.	Project	CSE 607	Project-I	0	0	6	3
				Total Credits			22

Semester-VII (Fourth Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Elective Courses	CSE 701	Elective-III	3	0	0	3
2.	Professional Elective Courses	CSE 702	Elective-IV	3	0	0	3
3.	Professional Elective Courses	CSE 703	Elective-V	3	0	0	3
4.	Open Elective Courses		Open Elective-I	3	0	0	3
5.	Project	CSE 704	Project-II	0	0	8	4
6.	Project	CSE 705	Internship(min 6 Weeks)	-	-	-	2
				Total Credits			18

Semester-VIII (Fourth Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Elective Courses	CSE 801	Elective-VI	3	0	0	3
2.	Open Elective Courses		Open Elective-II	3	0	0	3
3.	Open Elective Courses		Open Elective-III	3	0	0	3
4.	Project	CSE 802	Project-III	0	0	12	6
				Total Credits			15

List of Elective Papers

1. Artificial Intelligence.
2. Neural Network.
3. Deep Learning.
4. Soft Computing (Department / open).
5. Speech and Natural Language Processing.
6. Human Computer Interaction
7. Data Mining
8. Internet of Things
9. Mobile Computing (Department / Open).
10. Social Network Analysis.
11. Data Analytics.
12. Image Processing.
13. Computer Graphics.
14. Computational Complexity.
15. Basic Programming Concept (Open).
16. Software Engineering (Open)
17. Embedded Systems.
18. Advanced Operating Systems.
19. N.O.C.
20. Information Retrieval.
21. Advanced Java.
22. Machine Learning.
23. Web and Internet (Department / Open).
24. Python (Open).
25. Matlab (Open).
26. Cloud Computing.
27. Quantum Computing.

28. Advanced Computer Architecture.
29. Computational Geometry.
30. Distributed Systems.
31. Advanced Algorithms.
32. Formal Methods for System Verifications.
33. Cryptography and Network Security (Department / Open).
34. Theory of Computation.
35. Operations Research.

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Chapter-1
General, Course structure & Theme
&
Semester-wise credit distribution A.

Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical/ Lab (L) per week	1 Credit

B. Range of credits: The total credit for the B.Tech programme is kept as **162** which is within AICTE proposed range.

C. Structure of Undergraduate Engineering programme:

Sl. No	Category	Credit Breakup	AICTE Proposed Credit
1.	Humanities and Social Sciences including Management courses	13	12
2.	Basic Science courses	25	24
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	29	29
4.	Professional core courses	51	49
5.	Professional Elective courses relevant to CSE	18	18
6.	Open subjects – Electives from other technical and /or emerging specialization/branch	09	12
7.	Project work, seminar and internship in industry or elsewhere	15	15

8.	Mandatory Courses Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)	
	Total Credit	160	159

D. Credit distribution in the First year of Undergraduate Engineering program:

	Lecture(L)	Tutorial(T)	Laboratory/Practical(P)	Total Credit(C)
Physics-I	3	1	4	6
Maths-I	3	1	0	4
Workshop/ Manufacturing Practices	1	0	4	3
Engineering Graphics & Design	1	0	4	3
English-I	2	0	0	2
Chemistry	3	1	4	6
Maths-II	3	1	0	4
Programming for Problem Solving	3	0	4	5
Basic Electrical Engineering	3	1	2	5
English-II	1	0	2	2

E. Category of Courses:

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		Physics	3	1	4	6	I
2.		Chemistry	3	1	4	6	II
3.		Mathematics-I	3	1	0	4	I
4.		Mathematics-II	3	1	0	4	II
5.		Mathematics-III	3	0	0	3	III
6.			2	0	0	2	V
		Total Credit				25	

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		Basic Electrical Engineering	3	1	2	5	II
2.		Engineering Graphics & Design	1	0	4	3	I
3.		Programming for Problem Solving	3	0	4	5	II
4.		Workshop/Manufacturing Practices	1	0	4	3	I
5.		Analog Electronic Circuits	3	0	4	5	III
6.		Digital Electronics	3	0	4	5	III
7.		Microprocessor	3	0	0	3	III
		Total Credit				29	

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		English-I	2	0	0	2	I
2.		English-II	1	0	2	2	II
3.		Value Education	3	0	0	3	III
4.		Organizational Behaviour	3	0	0	3	IV
5.		Effective Technical Communication	3	0	0	3	VII
		Total Credit				13	

PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 302	Data Structure	3	0	0	3	III
2.	CSE 308	Data Structure Lab	0	0	4	2	III
3.	CSE 401	Discrete Mathematics & Graph Theory	3	0	0	3	IV
4.	CSE 402	Computer Organization & Architecture	3	0	0	3	IV
5.	CSE 403	Database Management Systems	3	0	0	3	IV
6.	CSE 404	Object Oriented Programming	3	0	0	3	IV
7.	CSE 407	Computer Architecture & Microprocessor Lab	0	0	4	2	IV
8.	CSE 408	Database Management Systems Lab	0	0	4	2	IV
9.	CSE 409	Object Oriented Programming Lab	0	0	4	2	IV
10.	CSE 501	IT Workshop(Python)	0	0	4	2	V
11.	CSE 502	Design & Analysis of Algorithms	3	0	0	3	V
12.	CSE 503	Operating Systems	3	0	0	3	V
13.	CSE 504	Formal Language & Automata Theory	3	0	0	3	V
14.	CSE 507	Design & Analysis of Algorithms Lab	0	0	4	2	V
15.	CSE 508	Operating Systems Lab	0	0	4	2	V
16.	CSE 601	Compiler Design	3	0	0	3	VI
17.	CSE 602	Computer Networks	3	0	0	3	VI
18.	CSE 606	Compiler Design Lab	0	0	4	2	VI
19.	CSE 607	Computer Networks Lab	0	0	4	2	VI
		Total Credit				51	

PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 506	Elective – I	3	0	0	3	V
2.	CSE 603	Elective – II	3	0	0	3	VI
3.	CSE 604	Elective – III	3	0	0	3	VI
4.	CSE 701	Elective – IV	3	0	0	3	VII
5.	CSE 702	Elective – V	3	0	0	3	VII
6.	CSE 801	Elective – VI	3	0	0	3	VIII
		Total Credit				18	

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE 703	Open Elective – I	3	0	0	3	III
2.	CSE 802	Open Elective – II	3	0	0	3	III
3.	CSE 803	Open Elective – III	3	0	0	3	IV
		Total Credit				09	

4 year Curriculum structure
B.Tech. in Computer Science and Engineering
Total credits (4 year course): 162
I. Mandatory Induction Program

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

II. Semester-wise structure of curriculum

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Semester-I (First Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Basic Science Course	ASH 101	Engineering Physics	3	1	0	4
2.	Basic Science Course	ASH 102	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4
3.	Engineering Science Course	ASH 103	Workshop/manufacturing Practices	1	0	4	3
4.	Engineering Science Course	ASH 104	Engineering Graphics	1	0	4	3
5.	Humanities & Social Sciences including Management courses	ASH 105	English	2	0	0	2
6.	Basic Science Course	ASH 106	Engineering Physics Lab	0	0	4	2
				Total Credits			**18**

Semester- II (First Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Basic Science Course	ASH 201	Engineering Chemistry	3	1	0	4
2.	Basic Science Course	ASH 202	Mathematics -II (Probability & Statistics)	3	1	0	4
3.	Engineering Science Course	ASH 203	Programming for problem Solving	3	0	0	3
4.	Engineering Science Course	ASH 204	Basic Electrical Engineering	3	1	0	4

5.	Humanities & Social Sciences including Management courses	ASH 205	English-II	1	0	2	2
6.	Basic Science Course	ASH 206	Engineering Chemistry Lab	0	0	2	2
7.	Engineering Science Course	ASH 207	Programming for problem Solving Lab	0	0	4	2
8.	Engineering Science Course	ASH 208	Basic Electrical Engineering Lab	0	0	2	1
				Total Credits			22

Semester-III (Second Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Engineering Science Course	CSE 301	Analog Electronic Circuits	3	0	0	3
2.	Professional Core Courses	CSE 302	Data Structure	3	0	0	3
3.	Engineering Science Course	CSE 303	Digital Electronics	3	0	0	3
4.	Engineering Science Course	CSE 304	Microprocessor	3	0	0	3
5.	Basic Science Course	ASH 301 A	Mathematics -III (Differential Calculus)	3	0	0	3
6.	Humanities & Social Sciences including Management courses	ASH 302	Humanities-I(Effective Technical Communication)	3	0	0	3
7.	Engineering Science Course	CSE 305	Analog Electronic Circuits Lab	0	0	4	2
8.	Professional Core Courses	CSE 306	Data Structure Lab	0	0	4	2
9.	Engineering Science Course	CSE 307	Digital Electronics	0	0	4	2
				Total Credits			24

Semester-IV (Second Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Core Courses	CSE 401	Discrete Mathematics & Graph Theory	3	0	0	3
2.	Professional Core Courses	CSE 402	Computer Organization & Architecture	3	0	0	3
3.	Professional Core Courses	CSE 403	Database Management Systems	3	0	0	3
4.	Professional Core Courses	CSE 404	Object Oriented Programming	3	0	0	3
5.	Humanities & Social Sciences including Management courses	ASH 401	Management-I (Organizational Behaviour)	3	0	0	3
6.	Mandatory courses	ASH 402	Environmental Science	-	-	-	0
7.	Professional Core Courses	CSE 405	Computer Architecture and Microprocessor Lab	0	0	4	2
8.	Professional Core Courses	CSE 406	Database Management Systems Lab	0	0	4	2
9.	Professional Core Courses	CSE 407	Object Oriented Programming Lab	0	0	4	2
				Total Credits			21

Semester-V (Third Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Core Courses	CSE 501	IT Workshop(Python)	0	0	4	2
2.	Professional Core Courses	CSE 502	Design & Analysis of Algorithms	3	0	0	3
3.	Professional Core Courses	CSE 503	Operating Systems	3	0	0	3

4.	Professional Core Courses	CSE 504	Formal Language & Automata Theory	3	0	0	3
5.	Professional Elective Courses	CSE 505	Elective-I	3	0	0	3
6.	Basic Science Course	ASH 501	Mathematics-IV Numerical Analysis	2	0	0	2
7.	Mandatory courses	ASH 503	Constitution of India	-	-	-	0
8.	Professional Core Courses	CSE 506	Design & Analysis of Algorithms Lab	0	0	4	2
9.	Professional Core Courses	CSE 507	Operating Systems Lab	0	0	4	2
10	Mandatory Course	CSE 508	Summer Training(Min 4 weeks)	-	-	-	0
				Total Credits			20

Semester-VI (Third Year) Curriculum

Sl. No	**Type of Course**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1.	Professional Core Courses	CSE 601	Compiler Design	3	0	0	3
2.	Professional Core Courses	CSE 602	Computer Networks	3	0	0	3
3.	Professional Elective Courses	CSE 603	Elective-II	3	0	0	3
4.	Professional Core Courses	CSE 604	Engineering	3	0	0	3
5.	Humanities & Social Sciences including Management courses	ASH 601	Humanities-II Understanding Culture and Society through Literature	3	0	0	3
6.	Professional Core Courses	CSE 605	Compiler Design Lab	0	0	4	2
7.	Professional Core Courses	CSE 606	Computer Networks Lab	0	0	4	2
8.	Project	CSE 607	Project-I	0	0	6	3
				Total Credits			22

Semester-VII (Fourth Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Elective Courses	CSE 701	Elective-III	3	0	0	3
2.	Professional Elective Courses	CSE 702	Elective-IV	3	0	0	3
3.	Professional Elective Courses	CSE 703	Elective-V	3	0	0	3
4.	Open Elective Courses		Open Elective-I	3	0	0	3
5.	Project	CSE 704	Project-II	0	0	8	4
6.	Project	CSE 705	Internship(min 6 Weeks)	-	-	-	2
				Total Credits			18

Semester-VIII (Fourth Year) Curriculum

Sl. No	Type of Course	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1.	Professional Elective Courses	CSE 801	Elective-VI	3	0	0	3
2.	Open Elective Courses		Open Elective-II	3	0	0	3
3.	Open Elective Courses		Open Elective-III	3	0	0	3
4.	Project	CSE 802	Project-III	0	0	12	6
				Total Credits			15

List of Elective Papers

1. Artificial Intelligence.
2. Neural Network.
3. Deep Learning.
4. Soft Computing (Department / open).
5. Speech and Natural Language Processing.
6. Human Computer Interaction
7. Data Mining
8. Internet of Things
9. Mobile Computing (Department / Open).
10. Social Network Analysis.
11. Data Analytics.
12. Image Processing.
13. Computer Graphics.
14. Computational Complexity.
15. Basic Programming Concept (Open).
16. Software Engineering (Open)
17. Embedded Systems.
18. Advanced Operating Systems.
19. N.O.C.
20. Information Retrieval.
21. Advanced Java.
22. Machine Learning.
23. Web and Internet (Department / Open).
24. Python (Open).
25. Matlab (Open).
26. Cloud Computing.
27. Quantum Computing.

28. Advanced Computer Architecture.
29. Computational Geometry.
30. Distributed Systems.
31. Advanced Algorithms.
32. Formal Methods for System Verifications.
33. Cryptography and Network Security (Department / Open).
34. Theory of Computation.
35. Operations Research.

CHAPTER 2
DETAILED 4-YEAR CURRICULUM CONTENTS
B.Tech. in COMPUTER SCIENCE AND ENGINEERING

Engineering Physics

Course Code	ASH 101
Course Name	Physics
Credits	3L: 1T: 4P
Pre-Requisites	NIL

Syllabus

UNIT I	**Hours=42**
Introduction to Quantum mechanics Wave particle duality, Uncertainty principle, Free-particle wave function and wave-packets, probability current, Expectation values, Schrodinger equation and its application to particle in a box and harmonic oscillator.	10
UNIT II	
Electronic materials Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirectbandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.	6
UNIT III	
Semiconductors Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.	8
UNIT IV	
Light-semiconductor interaction Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.	6

UNIT V	
Measurements Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.	6
UNIT VI	
Engineered semiconductor materials Density of states in 2D, 1d and 0D (qualitatively). Practical examples of low-dimensional systems such as quantum wells, wires, and dots: design, fabrication, and characterization techniques. Heterojunctions and associated band-diagrams.	6

Text Books/ Reference Books

1. *Eisberg and Resnick, Introduction to Quantum Physics.*
2. *D. J. Griffiths, Quantum mechanics.*
3. *J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).*
4. *B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).*
5. *S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).*
6. *A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).*
7. *P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).*
8. *Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.*
9. *Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.*

Mathematics –I (Calculus & Linear Algebra)

Course Code	ASH 102
Course Name	Mathematics-I (Calculus and Linear Algebra)
Credits	3L: 1T: 0P
Pre-Requisites	NIL

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are:

- To introduce the idea of applying differential and integral calculus to notions of Curvature and to improper integrals. Apart from some applications it gives a basic Introduction on Beta and Gamma functions.
- To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To familiarize the student with functions of several variables that is essential in most branches of engineering.
- To develop the essential tool of matrices and linear algebra in a comprehensive manner.

Syllabus

UNIT I	**Hours=40**
Calculus Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	6
UNIT II	
Calculus Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6
UNIT III	
Sequences and Series Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	8
UNIT IV	

Multivariable Calculus (Differentiation) Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	10
UNIT V	
Matrices Inverse and rank of a matrix,rank-nullity theorem; System of linear equations; Symmetric, skewsymmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	10

Text Books/ Reference Books:

1. *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
2. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
3. *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
4. *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.*
5. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.*
6. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.*
7. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.*

Course Outcomes:

At the end of the course the students should be able to:

- Understand the basic knowledge of Calculus and its applications.
- Be familiar with the concept of sequences and series.
- Be thorough with the concept of Linear Algebra and its applications in engineering.

Mathematics –I (Calculus & Linear Algebra)

Course Code	ASH 102
Course Name	Mathematics-I (Calculus and Linear Algebra)
Credits	3L: 1T: 0P
Pre-Requisites	NIL
Comment	For CSE and ECE

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are:

- To introduce the idea of applying differential and integral calculus to notions of Curvature and to improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.
- To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To develop the tool of matrices to solve systems of linear equations arising in many engineering problems by different methods.
- To familiarize the students with the concepts of vector spaces that is essential in most branches of engineering.

Syllabus

UNIT I	**Hours=40**
Calculus Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	6
UNIT II	
Calculus Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6
UNIT III	
Matrices Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.	8
UNIT IV	

Vector Spaces Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, ranknullity theorem, composition of linear maps, Matrix associated with a linear map.	10
UNIT V	
Vector Spaces Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.	10

Text Books/ Reference Books:

1. *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
2. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
3. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.*
4. *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
5. *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.*
6. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
7. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*
8. *V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.*

Course Outcomes:

At the end of the course the students should be able to:

- Understand the basic knowledge of Calculus and its applications.
- Be familiar with the concept of Matrices and solution of system of linear equations.
- Be thorough with the concept of Linear Algebra and its applications in engineering.

Engineering Graphics and Design

Course Code	ASH 103
Course Name	Engineering Graphics & Design (Theory & Lab.)
Credits	1L: 1T: 4P
Pre-Requisites	NIL

Course Objectives:

The student will learn:

- Introduction to engineering design and its place in society.
- Exposure to the visual aspects of engineering design.
- Exposure to engineering graphics standards.
- Exposure to solid modelling.
- Exposure to computer-aided geometric design.
- Exposure to creating working drawings.
- Exposure to engineering communication.

Syllabus

UNIT I	**Hours=40**
Traditional Engineering Graphics Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.	6
UNIT II	
Computer Graphics Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).	6
UNIT III	
Introduction to Engineering Drawing Covering Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.	8
UNIT IV	

Vector Spaces Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, ranknullity theorem, composition of linear maps, Matrix associated with a linear map.	10
UNIT V	
Vector Spaces Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.	10

Text Books/ Reference Books:

9. *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
10. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
11. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.*
12. *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
13. *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.*
14. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
15. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*
16. *V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.*

Course Outcomes:

At the end of the course the students should be able to:

- Understand the basic knowledge of Calculus and its applications.
- Be familiar with the concept of Matrices and solution of system of linear equations.
- Be thorough with the concept of Linear Algebra and its applications in engineering.

Preparatory English

Course Code	ASH 105
Course Name	Preparatory English
Credits	1L: 1T: 2P
Pre-Requisites	Students should be able to understand the English used by the teachers.

Course Objectives:

Syllabus

UNIT I	**Hours=40**
Vocabulary Building The concept of Word Formation. Root words from foreign languages and their use in English. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations. Parts of Speech.	10
UNIT II	
Sentence Structure Interchange of Sentences, Narration, Voice change, Proverbs & Idioms, Framing Questions.	10
UNIT III	
Speaking Skill Classification of speech sounds; Vowels, pure vowels, diphthongs, consonants; Pronunciation; Stress, word-stress and sentence-stress; Intonation, falling & rising tone.	10
UNIT IV	
Writing Skill Vocabulary extension, Word order and structure of words, The fundamentals of grammar, Use of phrases and clauses in sentences, Importance of proper punctuation.	10

Text Books/ Reference Books:

1. *Practical English Usage. Michael Swan. OUP. 1995.*
2. *Remedial English Grammar. F.T. Wood. Macmillan. 2007.*

3. *On Writing Well. William Zinsser. Harper Resource Book. 2001.*

Course Outcomes:

At the end of the course the students should be able to:

Engineering Physics Laboratory

Course Code	CSE 106
Course Name	Engineering Physics Laboratory
Credits	0L: 0T: 4P
Pre-Requisites	NIL

Course Objectives:

Syllabus

Choice of Experiments:

1. **Introduction to Electromagnetic Theory**
   I. Magnetic field from Helmholtz coil.
   II. Measurement of Lorentz force in a vacuum tube.

2. **Introduction to Mechanics**
   I. Coupled oscillators.
   II. Experiments on an air-track.
   III. Experiment on moment of inertia measurement.
   IV. Experiments with gyroscope.
   V. Resonance phenomena in mechanical oscillators.

3. **Quantum Mechanics for Engineers**
   I. Frank-Hertz experiment.
   II. Photoelectric effect experiment.
   III. Recording hydrogen atom Spectrum.

4. **Oscillations, waves and optics**
   I. Diffraction and interference experiments (from ordinary light or laser pointers).
   II. Measurement of speed of light on a table top using modulation.
   III. Minimum deviation from a prism.

Course Outcomes

Engineering Chemistry

Course Code	CSE 106
Course Name	Engineering Chemistry (Chemistry-I, Chemistry Laboratory)
Credits	3L: 1T: 4P
Pre-Requisites	NIL

Course Objectives:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

Syllabus

UNIT I	**Hours=42**
Atomic And Molecular Structure Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	12
UNIT II	
Spectroscopic Techniques And Applications Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.	8
UNIT III	

Intermolecular Forces And Potential Energy Surfaces Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.	4
UNIT IV	
Use Of Free Energy In Chemical Equilibria Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.	6
UNIT V	
Periodic Properties Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	4
UNIT VI	
Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.	4
UNIT VII	
Organic Reactions And Synthesis Of A Drug Molecule Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	4

Text Books/ Reference Books:

1. *University chemistry, by B. H. Mahan.*
2. *Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.*
3. *Fundamentals of Molecular Spectroscopy, by C. N. Banwell.*
4. *Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.*
5. *Physical Chemistry, by P. W. Atkins.*
6. *Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.*

Course Outcomes:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- Synthesize a small drug molecule and analyse a salt sample.

Mathematics-II (Probability and Statistics)

Course Code	ASH 201
Course Name	Mathematics-II (Probability and Statistics)
Credits	3L: 0T: 4P
Pre-Requisites	NIL
Comment	For CSE and ECE

Course Objectives:

- To make the students familiar with the basics of probability theory.
- To explain the use of continuous and bivariate probability distributions in all branches of engineering.
- To develop the tools of basic statistics, applied statistics and small samples in connection with engineering purpose.

Syllabus

UNIT I	**Hours=36**
Basic Probability Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.	12
UNIT II	
Continuous Probability Distributions Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.	4
UNIT III	
Bivariate Distributions Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	4
UNIT IV	
Basic Statistics *Measures of Central tendency:* Moments, skewness and Kurtosis. *Probability distributions:* Binomial, Poisson and Normal, Evaluation of statistical parameters for these three distributions, Correlation and regression, Rank correlation.	8
UNIT V	

Applied Statistics Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	8

Text Books/ Reference Books:

1. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
2. *P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).*
3. *S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.*
4. *W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.*
5. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
6. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*
7. *Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.*

Course Outcomes:

- At the end of the course the students will be able to learn the basics of Probability and Statistics and apply them to solve engineering problems.

Programming for Problem Solving

Course Code	ASH 203
Course Name	Programming for Problem Solving
Credits	3L: 0T: 4P
Pre-Requisites	Basic Engineering Science Course

Course Objectives:

- Introduction to basic problem solving using computer programming languages.
- Introducing basic organization of computers and C programming language.
- Developing programming aptitude.
- Imparting knowledge of basic programming environments.

Syllabus

UNIT I	Hours =40
Fundamentals of Computer Basic concepts of computer organizations. CPU. Memory. I/O units such as hard disk, floppy disk, pen drives, CDROM/Writer, scanner, printers, keyboards etc. Number System Representation. **Introduction to programming languages** Evolution of programming languages, structured programming, the compilation process, object code, source code, executable code, operating systems, interpreters, linkers, loaders, fundamentals of algorithms, flow charts.	6
UNIT II	
C Language Fundamentals Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedenceof operators, Input-output Assignments, Control structures, Decision making and Branching, Decision making & looping.	8
UNIT III	
C Functions User defined and standard functions, Formal and Actual arguments, Functions category, function prototypes, parameter passing, Call-by-value, Call-by-reference, Recursion, Storage Classes.	8
UNIT IV	
Arrays and Strings One-dimensional Array, Multidimensional Array declaration and their applications, String Manipulation. **Pointers** Pointer variable and its importance, Pointer Arithmetic, passing parameters by reference, pointer to pointer, linked list, pointers to functions, dynamic memory allocation.	10

UNIT V	
Structures, Unions Declaration of structures, declaration of unions, pointer to structure & unions. **File Handling** Console input output functions, Disk input output functions, Data files.	8

Text Books:

1. *"Programming in ANSI C", Sixth Edition, E. Balagurusamy,TMH*
2. *Programming in C - Gottfried B.S., TMH 2.*
3. *The 'C' programming language - B.W.Kernighan, D.M.Ritchie, PHI*

Reference Books:

1. *C The Complete Reference - H.Sohildt, TMH 3.*
2. *Let us C - Y.Kanetkar, BPB Publications4.*
3. *A Structured Programming Approach using C – B.A. Forouzan& R.F. Gillberg, THOMSON Indian Edition*
4. *Computer fundamentals and programming in C – PradipDey& Manas Ghosh, OXFORD*

Course Outcomes:

- Knowledge of common Computer organization.
- Knowledge of basic compilers, assemblers and interpreters.
- Students should be able to write different programs for problems at hand.

Basic Electrical Engineering

Course Code	ASH 203
Course Name	Basic Electrical Engineering
Credits	3L: 1T: 2P
Pre-Requisites	Basic Engineering Science Course

Course Objectives:

Syllabus

UNIT I	Hours =40
DC Circuits Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8
UNIT II	
AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.	8
UNIT III	
Transformers Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	8
UNIT IV	
Electrical Machines Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	6
UNIT V	
Power Converters	4

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.	
UNIT VI	
Electrical Installations Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6

Text Books/ Reference Books:

1. *D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.*
2. *D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.*
3. *L.S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.*
4. *E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.*
5. *V.D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.*

Course Outcomes:

Communicative Skills in English

Course Code	ASH 205
Course Name	Communicative Skills in English
Credits	1L: 0T: 2P
Pre-Requisites	Students should be able to understand the English used by the teachers.

Course Objectives:

Syllabus

UNIT I	**Hours=40**
Comprehension & Composition Common Errors, Techniques for writing precisely, Organizing principles of paragraphs in documents, Creating Coherence, Skimming and scanning.	10
UNIT II	
Speaking Skill Basic techniques of conversation: how to begin, interrupt, hesitate and end; Talking about oneself, others; attending an interview; addressing an audience; Introducing yourself, Introducing Others; Describing events; Using language in various contexts/situations.	10
UNIT III	
Writing Skill Writing Short Passages; Writing Reports based on Visuals; Writing Short Argumentative Essays; Writing introduction and conclusion; Watch an Audio-Visual clip & respond; Giving instructions with clarity.	10
UNIT IV	
Oral Communication Initiating and closing conversations; Politeness expressions and their use; Giving opinions; giving feedback; Asking for clarification; Requests; Offers; Complaining & Dealing with complaints; Discussing advantages and disadvantages of a product.	10

Text Books/ Reference Books:

1. *Jones, Daniel. English Pronouncing Dictionary. 17th Edn. CUP.*

2. *Marks, Jonathan. English Pronunciation in Use: Elementary. CUP, 2008.*
3. *K. Mohan and M. Raman, Effective English Communication, Tata McGraw Hill, 2000.*
4. *Wren and Martin, English Grammar and Compositions, S. Chand & Co. Ltd., 2001.*
5. *K. Mishra, Avoid Errors, L Bharathi Prakashan, 1998.*

Course Outcomes:

At the end of the course the students should be able to:

Engineering Chemistry Laboratory

Course Code	CSE 206
Course Name	Engineering Chemistry Laboratory
Credits	0L: 0T: 4P
Pre-Requisites	NIL

Course Objectives:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

Syllabus

Choice of experiments:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Course Outcomes:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.

- Synthesize a small drug molecule and analyse a salt sample.

Programming for Problem Solving

Course Code	CSE 207
Course Name	Programming for Problem Solving
Credits	0L: 0T: 4P
Pre-Requisites	NIL
Comments	The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

Course Objectives:

Syllabus

Experiments:

1. Problem solving using computers:
    a. Familiarization with programming environment
2. Variable types and type conversions:
    a. Simple computational problems using arithmetic expressions
3. Branching and logical expressions:
    a. Problems involving if-then-else structures
4. Loops, while and for loops:
    a. Iterative problems e.g., sum of series
5. 1D Arrays: searching, sorting:
    a. 1D Array manipulation
6. 2D arrays and Strings
    a. Matrix problems, String operations
7. Functions, call by value:
    a. Simple functions
8. Numerical methods (Root finding, numerical differentiation, numerical integration):
    a. Programming for solving Numerical methods problems
9. Recursion, structure of recursive calls
    a. Recursive functions
10. Pointers, structures and dynamic memory allocation
    a. Pointers and structures
11. File handling:
    a. File operations

Course Outcomes:

The student will learn:

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

Programming for Problem Solving

Course Code	CSE 208
Course Name	Engineering Chemistry Laboratory
Credits	0L: 0T: 4P
Pre-Requisites	NIL

Syllabus

Experiments:

1. Basic safety precautions. Introduction and use of measuring instruments–voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers:
    a. Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
    b. Loading of a transformer:
        i. Measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines:
    a. Dc machine (commutator-brush arrangement).
    b. Induction machine (squirrel cage rotor).
    c. Synchronous machine (field winging - slip ring arrangement).
    d. Single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of:
    a. DC-DC converters.
    b. DC-AC converters – PWM waveform.
    c. The use of dc-ac converter for speed control of an induction motor.
    d. Components of LT switchgear.

Course Outcomes:

- To understand and analyze basic electric and magnetic circuits.
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations.

Analog Electronic Circuits

Course Code	CSE 301
Course Name	Analog Electronic Circuits
Credits	3L:0T: 0 P
Pre-Requisites	NIL
Comments	NIL

Course Objectives

- To understand the characteristics of transistors, design and analyze various rectifier and amplifier circuits.

Syllabus

UNIT I	**Hours=42**
Diode circuits P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.	8
UNIT II	
BJT circuits Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; commonemitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits	8
UNIT III	
MOSFET circuits MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.	8
UNIT IV	
Differential, multi-stage and operational amplifiers Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product) .	6
UNIT V	

Linear applications of op-amp Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	6
UNIT VI	
Nonlinear applications of op-amp Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot	6

Text Books/ Reference Books*:*

1. *S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.*
2. *J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.*
3. *J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988. 4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.*
4. *P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.*

Course Outcomes:

At the end of this course, students will demonstrate the ability

- To understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Data Structure

Course Code	CSE 302
Course Name	Data Structure
Credits	3L:0T: 0 P
Pre-Requisites	Any computer language preferably C (Desirable)

Course Objectives

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data Structures.

Syllabus

UNIT I	Hours = 36
Fundamentals: Basic Terminologies: Elementary Data Organizations; Time and Space analysis of Algorithms: Time Complexity, Space complexity, Order Notations. Recursion - Design of recursive algorithms, Searching: Linear Search and Binary Search Techniques and their complexity analysis.	8
UNIT II	
Stacks and Queues ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9
UNIT III	
Linked Lists Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	6
UNIT IV	
Trees Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis**.**	6

UNIT V	
Sorting and Hashing Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing**.** **Graph** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	7

Text Books:

1. *S.K. Srivastava and Deepali Srivastava," Data Structure through C in depth", BPB Publications,2004.*
2. *Ellis Horowitz, SartajSahni ,S A Freed"Fundamentals of Data Structures in C (Second Edition)"Universities Press; Second edition (2008)*

Reference Books:

1. *Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Pearson; 1 edition (30 October 1995)*
2. *"How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education*

Course Outcomes

- For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
- For a given Search problem (Linear Search and Binary Search) student will able to implement it.
- For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
- Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
- Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Digital Electronics

Course Code	CSE 303
Course Name	Digital Electronics
Credits	3L:0T: 0 P
Pre-Requisites	Fundamental knowledge of electronics and electrical circuits.

Course Objectives

- Introduce students to the Digital Systems, learn about number systems, Boolean algebra and logic gates.
- Students learn about the representation, manipulation, and minimization of Boolean functions.
- Students should be able to learn how to design combinational and sequential circuits.
- Students should be able to understand the concept of finite state machines, state minimization, and algorithmic state machines.
- Learn about analysis and synthesis of asynchronous circuits.

Syllabus

UNIT I	Hours = 40
Fundamentals of Digital Systems and Number Systems ***Introduction:*** Need of Digital Systems, Digital Vs Analog Systems, Logic Levels and Pulse Waveforms, Elements & Functions of Digital Logic, and Benefits of Digital Systems. ***Number Systems:*** Systematic way to represent and manipulate number systems, Signed and Unsigned number representation, Binary arithmetic, BCD, Gray-Code, XS-3 code representation, Error Detection and Correction code.	6
UNIT II	
Logic Gates, Logic families to implement gates, Boolean Algebra *Logic Gates:* Binary Logic, Importance of Moore's Law, Introduction of Logic gates. *Logic families:* DTL, TTL, ECL, MOS, CMOS etc. and their operation, design, and specifications. *Boolean Algebra or Switching Algebra:* Basic concept of Boolean algebra, Basic Laws and Properties of Boolean algebra, Definition of Boolean Functions and their properties, Boolean Function representation, manipulation and minimization (by algebraic method, Karnaugh Map method, Quine-McCLUSKY method).	8
UNIT III	
Combinational Logic and Threshold Logic Design ***Combinational Logic Design:*** Introduction of combinational circuits, and design procedure of combinational circuit modules, Binary Adder-Subtractor, Decimal Adder, Comparator, Decoder, Encoder, Multiplexer, De-Multiplexer, Parity generator. ***Threshold Logic Design:*** Basic concept of threshold logic and importance, Threshold element and construction of threshold gate, Boolean function realization using threshold gate, Synthesis of threshold function.	10

UNIT IV	
Sequential Logic Design ***Introduction:*** Basic concept of memory elements like Latches and Flip-Flops, Design of Latches, Notion of Clock, Design of Flip-Flops, Clocking and Timing. ***Synthesis of Synchronous Sequential Circuits:*** Combinational Vs Sequential Circuits, Finite State Machine (FSM), Model of Synchronous Sequential Machine, State transition diagram and State table, Examples of Synchronous Sequential Circuits design methodology. ***Design of Registers and Counters:*** Different variations of Registers and their design, Design of asynchronous and synchronous counters. Design of Asynchronous sequential Circuits.	10
UNIT V	
Analog-to-Digital (A/D), Digital-to Analog Conversion (D/A), Memory devices ***A/D, D/A Conversion:*** Basic concept D/A Conversion, Different types of D/A converters and conversion techniques. *Memory devices:* RAM, ROM, EPROM, EEPROM.	6

Text Books:

1. *Digital Design, 4th Edition, M. Morris Mano and Michael D. Ciletti, published by Pearson Education, Inc., Copyright © 2007.*
2. *Fundamental of Digital Circuits, 4th Edition, A. Anand Kumar, published by PHI Learning Private Limited, Copyright © 2016.*

Reference Books:

1. *Modern Digital Electronics, 4th Edition, R P Jain, published by TMH, Copyright © 2010, 2003, 1997, 1984.*
2. *Switching and Finite Automata Theory, 3rd Edition, ZviKohavi and Niraj K. Jha, published by Cambridge University Press, Copyright © 2010.*

Course Outcomes

- Students Will Be Able To Explain The Concept Of Digital Systems, Number Systems Which Helps Digital Representation Of Information.
- Students Will Be Able To Explain The Basic Logic Operation Of NOT, AND, OR, NAND, NOR, X-OR, X-NOR.
- Students Will Be Capable Of Understanding The Different Type Of Logic Families Like DTL, TTL, ECL, MOS, CMOS, Etc., And Their Operation, Design, And Specification.
- Students Will Be Able To Interpret The Boolean Algebra Expressions, Logic Functions, Circuits, And Truth Tables. Also, Learn The Minimization Techniques Of Boolean Algebra Expressions.
- Students Will Be Able To Design The Combinational Circuits And Analyze The Computer Software Application. Also, Learn The Detail Concept And Synthesis Approaches Of Threshold Logic.
- Students Will Be Able To Understand The Detail Concept Of Memory Elements Like Latches And Edge-Triggered Flip-Flops.

- Students Will Be Able To Design The Synchronous Sequential Circuit, And Also Able To Implement The Computer Software Application.
- Students Will Be Able To Understand The Concept Of Registers, Counters And Their Applications In Digital Circuits. Moreover, Students Will Be Gain Knowledge Of The Detail Designing Procedure Of Asynchronous Sequential Circuits.
- Students will be able to model and analyze the A/D and D/A conversion technique. Also, able to understand the different types of memory devices.

Microprocessor

Course Code	CSE 304
Course Name	Microprocessor
Credits	3L:0T: 0 P
Pre-Requisites	Digital Logic Design

Course Objectives

- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Syllabus

UNIT I	Hours =40
Introduction to microprocessor Basic features of hardware of 8085 microprocessor, Addressing modes of 8985. 8085 microprocessor architecture– as an 8-bit representative.Memory interfacing: Address decoding, Address aliasing, Memory read and write operations, Timing diagrams I/O Interfacing – Memory mapped I/O and I/O mapped I/O	8
UNIT II	
Instruction Set for 8085 Details of 8085 assembly language programming. Examples of Assembly Language Programming Data Transer Techniques: Synchronous and Asynchronous modes of data transfer, Interrupt driven I/O,Interrupts– Polled interrupts and vector interrupts, priority and masking.	8
UNIT III	
Familiarization with peripheral devices 8255 programmable peripheral interface, 8254 programmable counter, 8251 UART programmable communication interface, 8257 DMA Controller. 8259 Interrupt controller, 8279_ Keyboard & display interface . Signal converter and their interfacing techniquesADC0809, DAC 0808.	8
UNIT IV	
Introduction to 16-bit microprocessor and its architecture 8086 as an example,8086Architecture and Internal Resister Set, Brief discussion on Instruction Set, Min-Max mode, Concept of Co-processor and its interfacing, INTEL 80286.	8
UNIT V	

Introduction to micro-controller 8051 as an example. Micro -controller architecture, bi-directional data ports, internal ROM and RAM, counters/timer s, oscillator and clock, serial communication.	8

Text Books:

1. *R. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085".*
2. *B.Ram, "Fundamentals of Microprocessors and Microcontrollers"*

Reference Books:

1. *K. Ayala, "The 8051 Microcontroller ".*
2. *Yu-Cheng Liu and Glenn A. Gibson, "Microcomputer Systems: The 8086/8088 Family".*
3. *J. Uffenberk, "Microcomputers and microprocessors".* 4. *D.V. Hall and SSSP Rad, "Microprocessors and Interfacing".*

Course Outcomes

- Recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
- Identify a detailed s/w & h/w structure of the Microprocessor.
- Illustrate how the different peripherals (8255, 8253 etc.) are interfaced with Microprocessor.
- Distinguish and analyze the properties of Microprocessors & Microcontrollers.

Mathematics -III

Course Code	ASH 301 A
Course Name	Mathematics -III
Credits	3L:0T: 0 P
Pre-Requisites	NIL
Comments	NIL

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and different algebraic structures. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. The students will learn:

- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of different algebraic structures that are used in the modelling of various engineering problems.

Syllabus

UNIT I	Hours = 22
First order ordinary differential equations Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	06
UNIT II	
Ordinary differential equations of higher orders Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	10
UNIT III	
Algebraic Structures Algebraic structures with one binary operation – semigroup, monoid and group. Cosets,Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Error correcting code. Algebraic structures with two binary operations- ring integral domain, and field. Boolean algebra and boolean ring (Definitions and simple examples only).	06

Text Books / Reference Book:

1. *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
2. *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. 3. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.*
3. *S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.*

4. *A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.*
5. *L. Ince, Ordinary Differential Equations, Dover Publications, 1958.*
6. *C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.*
7. *R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures,*
8. *World Scientific, 1999.9. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.*

Course Outcomes:

At the end of the course the students should be able to

- Understand the basics of ordinary differential equations and their applications in engineering
- Be familiar with the concept of algebraic structures and their applications

Effective Technical Communication

Course Code	ASH 302
Course Name	Effective Technical Communication
Credits	3L:0T: 0 P
Pre-Requisites	NIL
Comments	NIL

Course Objectives:

Syllabus

UNIT I	Hours=40
Information Design and Development Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.	8
UNIT II	
Technical Writing, Grammar and Editing Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	8
UNIT III	
Self Development and Assessment Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity.	8
UNIT IV	
Communication and Technical Writing Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	8
UNIT V	

Ethics Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	8

Text Books / Reference Book:

1. *David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004*
2. *Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)*
3. *Shiv Khera, You Can Win, Macmillan Books, New York, 2003.*
4. *Raman Sharma, Technical Communications, Oxford Publication, London, 2004.*
5. *Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)*
6. *Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.*
7. *Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)*

Course Outcomes:

Analog Electronic Circuits Lab

Course Code	CSE 305
Course Name	Analog Electronic Circuits Lab
Credits	0L:0T: 4 P
Pre-Requisites	NIL

Course Objectives:

Syllabus

Experiments:

1. Study the V-I Characteristics of PN-junction diode.
2. Study the V-I Characteristics of Zener diode.
3. Study the input and output characteristics of NPN/PNP transistors.
4. Design and test a single-stage BJT (CE) amplifier and find performance parameters - Av, Ri, Ro, Ai
5. Study of MOSFET drain and transfer characteristics.
6. Study the characteristics of OPAMP.
7. Design a non-inverting amplifier using OPAMP and study the gain characteristics.
8. Design an inverting amplifier using OPAMP and study the gain characteristics.
9. Design Wein bridge oscillator and obtain its characteristics.
10. Design a triangular-wave generator circuit using OPAMP.

Course Outcomes:

Data Structures Lab

Course Code	CSE 306
Course Name	Data Structure Lab
Credits	0L:0T: 4 P
Pre-Requisites	NIL

Course Objectives

- Identify, formulate, review research literature, and analyze complex engineering problems
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs
- Create, select, and apply appropriate data structures for different problems

Syllabus

Experiments:

1. Create a dynamic array.
2. Implement pointer operations.
3. Implement binary search.
4. Create Singly Linked list and doubly linked list and perform: a) Insertion, b) Deletion, c) Display.
5. Implement stack using array and linked list.
6. Implement queue and circular queue using array and linked list.
7. Perform the following operations for stack & queue: a)Insertion, b) Deletion, c) Display.
8. Write a C program that uses Stack operations: a) To convert a given infix expression into its postfix Equivalent, b) Evaluate postfix expression, c) Check for balanced parenthesis.
9. Implement the following: a) Binary Search Tree and its traversal, b) Graph traversal algorithms.
10. Implement the following sorting algorithms: a) Insertion, b) Selection c) Bubble, d) Merge, e) Quick.

Course Outcomes

- Demonstrate knowledge and understanding of the problem and the nature of solution.
- Gain hands-on experience and apply the principles of data structures.
- Apply reasoning informed by the appropriate knowledge to assess different problem.

Digital Electronics Lab

Course Code	CSE 307
Course Name	Digital Electronics Lab
Credits	0L:0T: 4 P
Pre-Requisites	Fundamental knowledge of electronics and basic C programming skill

Course Objectives

- Introduce students to the Digital Systems, learn about number systems, Boolean algebra and logic gates.
- Students learn about the representation, manipulation, and minimization of Boolean functions.
- Students should be able to learn how to design combinational and sequential circuits through Hardware programming design using Verilog/VHDL.
- Students should be able to understand the detail circuit structure and their behaviours with the help of software application.
- Students should be able to learn about the details behaviour of combinational and sequential circuit through Hardware programming Language.

Experiments:

1. Introduction to Verilog/VHDL language.
2. Design of all basic and Universal gates using Verilog / VHDL.
3. Design of XOR and XNOR gate using VHDL.
4. Design of Full -adder and Full -Subtractor using VHDL.
5. Design of 4-bit Parallel Adder-Subtractor using VHDL.
6. Design of 4:1 Multiplexer using VHDL.
7. Design of 1:4 De-multiplexer using VHDL.
8. Design of 8 X 3 Encoder using VHDL.
9. Design of 3X8 Decoder using VHDL.
10. Design of Priority Encoder using VHDL.
11. Design of 4-bit array multiplier using VHDL.
12. Design of S-R Flip-Flop using VHDL.
13. Design of D Flip-Flop using VHDL.
14. Design of J-K/T Flip-Flop using VHDL.
15. Design of Master-Slave Flip-Flop.
16. Design of mod-10 synchronous counter.
17. Design ripple counter/ twisted ring counter.

Text Books:

1. *Digital Design, 4th Edition, M. Morris Mano and Michael D. Ciletti, published by Pearson Education, Inc., Copyright © 2007.*
2. *Fundamental of Digital Circuits, 4th Edition, A. Anand Kumar, published by PHI Learning Private Limited, Copyright © 2016.*
3. *VHDL programming by Example, 4th Edition, Douglas L. Perry, Published by McGraw-Hill, Copyright © 2012.*

Course Outcomes

- Students will be able to design the combinational and sequential circuit, and also able to implement the computer software application.
- Students will be able to explain the details behaviour of the varieties of digital circuits.

Discrete Mathematics and Graph Theory

Course Code	CSE 401
Course Name	Discrete Mathematics and Graph Theory
Credits	3L: 0T: 0 P
Pre-Requisites	Elementary algebra and arithmetic

Course Objectives

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

- Use mathematically correct terminology and notation.
- Apply logical reasoning to solve a variety of problems.
- Understand discrete mathematical structures.
- Formulate and solve graph problems

Syllabus

UNIT I	Hours = 40
Sets and Relation Set Basics, Venn Diagram, counting principles, Inclusion and Exclusion principle, pigeon-hole principle, Induction, Mathematical Induction. **Relations** Groups, Monodies, Types of relation, Diagraphs, Inductive form of relations, Congruence relations on Semi groups. Partially Ordered Set, Lattices, Recursion and Recurrence Relation: Basic idea.	8
UNIT II	
Functions and Algebraic Structures Functions types, mapping in functions, commutative diagrams, Monotone functions, Sequence and discrete function. Generating functions and applications, Rings, Subrings, morphism of rings, ideals and quotient rings. Euclidean domains. Integral domains and fields. **Boolean Algebra** Direct product, Morphisms. Boolean sub-algebra. Boolean Rings. Applications of Boolean algebra in logic circuits and switching functions.	8
UNIT III	
Recursion and Recurrence Relation Basic idea, Sequence and discrete function. Generating functions and applications. **Propositional Logic** Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	8
UNIT IV	

Introduction to Graph Theory and Trees Graphs, Digraphs, Isomorphism, Walks, Paths, Circuits, Shortest Path Problem, Dijkstra's Algorithm, Trees, Properties of Trees, Cotrees and Fundamental Circuits.	8
UNIT V	
Graph Theoretic Algorithms and Applications: Shortest Spanning Trees - Kruskal's Algorithm, Prims Algorithm, DFS, BFS, Cut Sets, Fundamental Cut Sets and Cut Vertices, Planar and Dual Graphs, Graph Coloring, Metric Representation of Graphs, Networks, Flow Augmenting Path, Ford-Fulkerson Algorithm for Maximum Flow.	8

Text Books:

1. *Kolman, Busby and Ross, "Discrete mathematical structures" (6th Ed.) PHI, 2009.*
2. *Kenneth H. Rosen: Discrete Mathematics and its Applications, 7th Edition, McGraw Hill, 2011.*
3. *Deo N., "Graph Theory with Applications to Engineering and Computer Science", PHI, 2004.*
4. *C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill*

Reference books:

1. *R. Balakrishnan and K. Ranganathan," A Text book of Graph Theory" (2nd Ed.), MH,2013.*
2. *Tremblay and Manohar, Discrete mathematical structures with applications to computer science, McGraw Hill, 2001.*
3. *Tremblay and Manohar, Discrete mathematical structures with applications to computer science, McGraw Hill, 2001.*

Course Outcomes:

- For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.
- For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.
- For a given a mathematical problem, classify its algebraic structure.
- Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
- Develop the given problem as graph networks and solve with techniques of graph.

Computer Organization & Architecture

Course Code	CSE 402
Course Name	Computer Organization & Architecture
Credits	3L:0T: 0 P
Pre-Requisites	Digital logic Design

Course Objectives:

The student should be made to:

- Gives a view of computer system from user's perspective.
- Types of instructions.

Syllabus

UNIT I	Hours=40
Introduction to Computer System Representation of basic information, Computer types, Different functional units of computer, operational concept. Computer Organization and Computer Architecture and its difference. Performance of a Computer. Memory locations and addressing-Byte addressability-Big endian and little endian assignment-word alignment. Addressing modes and MIPS addressing. MIPS registers and instruction types. Operations of the Computer Hardware, Operands of the Computer Hardware. Representing Instructions in the Computer, Logical Operations, Instructions for Making Decisions, Supporting Procedures in Computer Hardware.	10
UNIT II	
ALU Design High speed adder and subtractions design: ripple carry Adder/subsctractor, Carry look ahead adder/ substractor design, Multiplexer design, AND, OR, SLT, OVERFLOW design. Design of 8-bit ALU for Adder/Sub/AND/OR/RLL/RLR. Multiplier Design: multiplication of positive numbers-Signed operand multiplication and Booth algorithm-Fast multiplier design-Carry Save addition of Summands. Integer Division. Floating point numbers and operation.	9
UNIT III	
Memory System Basic concept of memory, Semiconductor RAM memories-Read only memories. Speed size cost, cache memories, performance consideration virtual memory, memory management requirement, and secondary storage.	8
UNIT IV	
Data Path Design And Control Design Hardwired controlled and micro programmed control. MIPS Data path design for Rtype,I-type and J-Type of Instructions and its hardwired control design.	7
UNIT V	

Pipeline An Overview of Pipelining, Pipelined Data path and Control ,Data Hazards: Forwarding versus Stalling, Control Hazards	6

Text Books:

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.

Reference books:

1. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 2000. 2. Sima D, Fountain T and Kacsuk P,"Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

Course Outcomes

At the end of the course, the student should be able to:

- Evaluate performance of different architectures with respect to various parameters.
- Study about different hazards and its resolution.
- Analyze performance of different ILP techniques.
- Identify cache and memory related issues in multi-processors.

Database Management Systems

Course Code	CSE 403
Course Name	Database Management Systems
Credits	3L:0T: 0 P
Pre-Requisites	Basic Professional Course

Course Objectives:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Syllabus

UNIT I	Hours=40
Database system architecture Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	8
UNIT II	
Relational query languages Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	8
UNIT III	
Storage strategies Indices, B-trees, hashing. **Transaction processing** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	8
UNIT IV	

Database Security Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	8
UNIT V	
Advanced topics Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	8

Text Books:

1. *"Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.*

Reference Books:

1. *"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.*
2. *"Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education*
3. *"Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley*

Course Outcomes:

- For a given query write relational algebra expressions for that query and optimize the developed expressions.
- For a given specification of the requirement design the databases using E_R method and normalization.
- For a given specification construct the SQL queries for Open source and Commercial DBMS MYSQL, ORACLE, and DB2.
- For a given query optimize its execution using Query optimization algorithms
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
- Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Object Oriented Programming

Course Code	CSE 404
Course Name	Object Oriented Programming
Credits	3L: 0T: 0 P
Pre-Requisites	Data Structures and Algorithms (Desirable)

Course Objectives

- Introduce students to the Object Oriented Programming paradigm.
- To familiarize students to use standard tools and techniques for software development, using object oriented approach.
- Students should be able to understand fundamental concepts of OOP to solve different problems of varied nature.
- To introduce event driven GUI applications using Java/C++.

Syllabus

UNIT I	Hours = 36
Introduction to C++/Java and Object oriented Concepts Introduction: Need of OOP, History & Evolution, Concepts, and Benefits of OOP. **Programming in C++/Java** Implementing operations and arrays. Introduction, Structure Definitions, Accessing Members of Structures, Header Files and Namespaces.	9
UNIT II	
Data Abstraction & Encapsulation Class Scope and Accessing Class. Abstract data types and their specification. How to implement an ADT? Members, Separating Interface from Implementation, Controlling Access Function And Static Members, Initializing Class Objects: Constructors, Using Default Arguments With Constructors, Using Destructors	10
UNIT III	
Polymorphism & Inheritance Polymorphism: Overloading, Overriding Methods, Abstract Classes, Class's Behaviors Fundamentals of Operator Overloading, Restrictions On Operators Overloading, Introduction to Inheritance, Reusability, Base Classes And Derived Classes, Protected Members, Public, Protected and Private Inheritance. Introduction to virtual functions/interface, Abstract Base Classes And Concrete Classes.	10
UNIT IV	

Generic Types and Collection **Exception Handling:** Try Throw, Catch, Throwing an Exception, Catching an Exception, Re-throwing an Exception, Exception specifications, Processing Unexpected Exceptions, Stack Unwinding, Constructors, Destructors and Exception Handling, Exceptions and Inheritance. Function Templates, Overloading Template Functions, Class Template Collection Framework for Java (Sets, Hash Map, List etc.).	3
UNIT V	
Files and I/O Streams Files and Streams, Creating a Sequential Access File, Reading Data From A Sequential Access. **File, GUI** Swings/JavaFx/C#.The software development process.	4

Text Books:

1. *Object Oriented Programming With C++, 7th Edition, E Balagurusamy, 2018, TMH.*
2. *Mastering C++, 2nd Edition, Venugopal and Buyya, 2013, McGraw Hill Education*

Reference books:

1. *Computing Concepts with C++ Essentials by Horstmann, 2003, John Wiley,*
2. *The Complete Reference in Java By Herbert Schildt, 2002, TMH.*

Course Outcomes:

- Specify simple abstract data types and design implementations, using abstraction functions to document them.
- Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
- Name and apply some common object-oriented design patterns and give examples of their use.
- Design applications with an event-driven graphical user interface

Organizational Behaviour

Course Code	ASH 401
Course Name	Organizational Behaviour
Credits	3L:0T: 0 P
Pre-Requisites	NIL

Course Objectives:

- The objective of the course is to orient the engineering students with the concepts and practical implications of Behavior, personality and attitude of individuals and groups in organization.

Syllabus

UNIT I	Hours =40
Organisational Behaviour Concept and Emergence of OB Concept; Historical Background-Hawthorne Studies, Psychological foundations; Models of Organisational Behaviour, Challenges and Opportunities for Organisational Behavior; Ethics and Organisational Behaviour.	8
UNIT II	
Individual Behaviour Personality, Learning, Values and Attitudes, Perception, Learning Behaviourist, cognitive and social learning; Stress at work. Management's assumptions about people- McGregor's Theory X and Theory Y;	8
UNIT III	
Motivation Maslow's Need Hierarchy, Herzberg's Two Factors Theory, Vroom's Expectancy Theory; Theory of Intrinsic Motivation by Ken Thomas; Work –Designing for creating motivating Jobs.	8
UNIT IV	
Inter-personal Behaviour Interpersonal communication and Feedback, Feedback utilisation; Transactional Analysis (TA); Johari Window. Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Group Decision Making; Organisational Politics.	8
UNIT V	
Leadership Concept and Styles; Fielder's Contingency Model; Leadership Effectiveness; Sources, patterns, levels, and types of conflict; Traditional and modern approaches to conflict; Functional and dysfunctional conflicts; Resolution of conflict. Organisational change- resistance and management.	8

Text Books:

1. *Robbins, Stephen P. and Timothy A. Judge: Organisational Behaviour. Prentice -Hall, New Delhi.*
2. *Aswathappa, K: Organisation Behaviour. Himalaya Publishing House, New Delhi.*

Reference Books:

1. *Singh, K: Organizational Behaviour: Text and Cases. Pearson.*
2. *Pareek, U. and Khanna, S: Understanding Organizational Behaviour. Oxford University Press.*
3. *Sharma, R. A: Organisational Theory and Behaviour. Tata McGraw -Hill Publishing Co. Ltd.*
4. *Sekaran, Uma: Organisational Behaviour: Text and Cases. Tata McGraw-Hill Publishing Co. Ltd.*
5. *Singh, B. P. and T. N. Chhabra: Organisation Theory and Behaviour. DhanpatRai and Co. P. Ltd., New Delhi; 2000.*

Course Outcomes:

- The students will acquire the skills of understanding individual and group behavior, culture, attitude and personality.
- The students will gain the knowledge of organizational behavior.

Environmental Science

Course Code	ASH 402
Course Name	Environmental Science
Credits	2L: 0T: 0 P
Pre-Requisites	NIL
Comments	NIL

Course Objectives:

Syllabus

UNIT I	Hours =40
Multidisciplinary nature of environmental studies Definition, scope and importance Need for public awareness.	6
UNIT II	
Natural Resources, Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources : Use and overexploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.	6
UNIT III	
Motivation Maslow's Need Hierarchy, Herzberg's Two Factors Theory, Vroom's Expectancy Theory; Theory of Intrinsic Motivation by Ken Thomas; Work –Designing for creating motivating Jobs.	6
UNIT IV	
Ecosystems Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, Structure and function of the following ecosystem :- a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	8

UNIT V	
Environmental Pollution Definition, Cause, effects and control measures of : a) Air pollution, b) Water pollution c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution, g) Nuclear hazards, Solid waste **Management** Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, **Disaster management** Floods, earthquake, cyclone and landslides.	8
UNIT VI	
Social Issues and the Environment From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies. **Environmental ethics** Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.	6

Text Books:

Reference Books:

Course Outcomes:

Computer Architecture and Microprocessor Lab

Course Code	CSE 405
Course Name	Computer Architecture and Microprocessor Lab
Credits	0L: 0T: 4 P
Pre-Requisites	Microprocessor & Microcontrollers Theory, Digital Electronics Theory And Lab, Computer Architecture And Organization Theory

Course Objectives:

- To practice assembly language programming on 8085.
- To practice fundamentals of interfacing/programming various peripheral devices with microprocessor/microcontroller.
- Study of different component of PC and its working.
- Design and simulation of simple processor.

Syllabus

Experiments:

1. Recognize various components of PC and its dismantling and assembling detail study of motherboard and microprocessor.

2. Study of SMPS and printer.

3. Familiarization with 8085 register level architecture and trainer kit components, including the memory map.

4. Familiarization with the process of storing and viewing the contents of memory as well as registers; Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical); Assignments based on above.

5. Familiarization with 8085 simulator on PC; Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator; Assignments based on above.

6. Design and simulation of ALU (32-bit).

7. Design and simulation of 32-bit simple single cycle processor.

8. Design and simulation of 32-bit simple pipelined processor.

9. Programming using kit/simulator for: table look up, Copying a block of memory, Shifting a block of memory, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, String Matching, Multiplication using Booth's Algorithm.

10. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit eg, subroutine for delay, reading switch state & glowing LEDs accordingly, finding out the frequency of a pulse train etc.

Text Books:

1. *R. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085".*

2. *B.Ram, "Fundamentals of Microprocessors and Microcontrollers"*
3. *David A. Patterson and John L. Hennessey, "Computer organization and design", Morgan Kauffman / Elsevier, Fifth edition, 2014.*

Reference books:

1. *K. Ayala, "The 8051 Microcontroller".*
2. *Yu-Cheng Liu and Glenn A. Gibson, "Microcomputer Systems: The 8086/8088 Family".*
3. *J. Uffenberk, "Microcomputers and microprocessors".*
4. *D.V. Hall and SSSP Rad, "Microprocessors and Interfacing".*
5. *V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", VI th edition, Mc Graw-Hill Inc, 2012.*
6. *John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata Mc Graw Hill, 1998.*

Course Outcomes

The students will able to:

- Develop assembly language programs for problem solving using software interrupts and various assembler directives.
- Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.
- Study of different component of PC and its working.
- Design and simulation of simple processor

Database Management Systems Lab

Course Code	CSE 406
Course Name	Database Management Systems Lab
Credits	0L:0T: 4 P
Pre-Requisites	Basic Professional Course

Course Objectives:

- To provide a sound introduction to the creation of problem statements from real life situations.
- To give a good formal foundation on the relational model of data and usage of Relational Algebra.
- To introduce the concepts of basic SQL as a universal Database language.
- To enhance knowledge to advanced SQL topics like embedded SQL, procedures connectivity through JDBC.
- To enable the design of an efficient database using normalization concepts.
- To enable students to be create indexes for databases for efficient retrieval.
- To enable the student to experiment different transaction concept practically.
- To provide a introduction to Use of host language interface with embedded SQL.

Syllabus

Problems:

1. Creating table, inserting data, updating table data, data record deletion, viewing data, modifying table structure, renaming and destroying table.

2. Arithmetic, logical operator, range searching, pattern matching, numeric function- scalar & group functions, string functions, Date function, table conversion functions.

3. Grouping data, join, sub-queries, union, intersection, minus clause, indexing, view, granting and revoking permissions.

4. Null value concept, primary key, and foreign key, unique, creating constraints, creating Indexes.

5. Introduction to PL/SQL – data type, branching, looping, simple problem solving using PL/SQL, Transaction concepts –commit, rollback, save point, introduction to cursor, parameterized cursor, locking.

6. Stored procedure and functions, package, trigger.

7. Use of host language interface with embedded SQL.

8. Use of user interfaces and report generation utilities typically available with RDBMS products.

Text Books:

1. *"Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.*
2. *"Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education*

Reference Books:

1. *"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.*
2. *"Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley*

Course Outcomes

- Construct problem definition statements for real life applications and implement a database for the same.
- Design conceptual models of a database using ER modeling for real life applications and also construct queries in Relational Algebra.
- Create and populate a RDBMS, using SQL.
- Write queries in SQL to retrieve any type of information from a data base.
- Analyze and apply concepts of normalization to design an optimal database.
- Analyze and apply concepts of transactions.
- Practically learn the concept of user interfaces and report generation utilities of RDBMS products.

Object Oriented Programming Lab

Course Code	CSE 407
Course Name	Object Oriented Programming Lab
Credits	3L:0T: 0 P
Pre-Requisites	NIL

Course Objectives

Upon successful completion of this Lab the student will be able to:

- To familiarize students to use standard tools and techniques for software development, using object oriented approach
- Students should be able to understand fundamental concepts of OOP to solve different problems of varied nature based on Encapsulation , Inheritance and polymorphism

Syllabus

Experiments:

1. Simple C++ Programs to Implement Various Control Structures: a) If statement, b) Switch case statement and do while loop, c) For loop, d) While loop.
2. Programs to Understand Structure & Unions: a) Structure, b) Union.
3. Programs to Understand Pointer Arithmetic: a) Functions & Recursion, b) Inline Functions.
4. Programs to Understand Different Function Call Mechanism.
5. Programs to Understand friend functions and static functions Constructors & Destructors. Use of "this" Pointer.
6. Programs to Implement Inheritance and Function Overriding.
7. Programs to Implement Overload Unary & Binary Operators as Member Function & Non Member Function.
8. Programs on : a) Class Templates, b) Virtual Functions, c) Abstract class, d) Exception Handling

Course Outcomes

- Demonstrate knowledge and understanding of the problem and the nature of solution
- Gain hands-on experience and apply the principles of OOP
- Apply reasoning informed by the appropriate knowledge to assess different problem using OOP principles

IT Workshop (Python)

Course Code	CSE 501
Course Name	IT Workshop (Python)
Credits	0L: 0T: 4P
Pre-Requisites	Basic Programming Knowledge

Course Objectives:

- Understand the programming basics (operations, control structures, data types, etc.)
- Readily use the Python programming language
- Apply various data types and control structure
- Understand class inheritance and polymorphism
- Understand the object-oriented program design and development
- Understand and begin to implement code

Syllabus

UNIT I	Hours =40
Introduction Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation.	8
UNIT II	
Data Types And Control Structures Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements, Strings and string operations, Control Structures: loops and decision.	8
UNIT III	
Modularization And Classes Standard modules, Packages, Defining Classes, Defining functions, Functions and arguments (signature).	8
UNIT IV	
Exceptions And Data Structures Data Structures (array, List, Dictionary), Error processing, Exception Raising and Handling.	8
UNIT V	
Object Oriented Design Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism	8

Text Books:

1. *Starting Out with Python plus MyProgrammingLab with Pearson eText --Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256*

Reference Books:

1. *Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material*
2. *Python Programming using problem solving Approach by ReemaThareja, OxfordUniversity, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173*

Course Outcomes

After completion of course, students would be able to:

- Students can use Python interactively
- Students can demonstrate understanding of the role of testing in scientific computing, and write unit tests in Python.
- Students can write code in Python to perform mathematical calculations and scientific simulations.

Design and Analysis of Algorithms

Course Code	CSE 502
Course Name	Design and Analysis of Algorithms
Credits	3L:0T: 0 P
Pre-Requisites	Basic knowledge of introductory courses on mathematics, Programming, and Data Structures.

Course Objectives:

- Introduce students to the basic concept of algorithms in computing, analyzing algorithms, and designing algorithms.
- Students learn about the asymptotic notation of algorithms.
- Students should be able to write correctness of proofs for algorithms. Also, able to analyze the efficiency of algorithms based on asymptotic complexity.
- Students should be able to demonstrate different modeling of problem-solving like a graph, data structures, decomposing the problem.
- Learn about the different techniques of algorithms like divide-and-conquer, greedy, dynamic programming.
- Students will be able to synthesize efficient algorithms in a given engineering problem.

Syllabus

UNIT I	Hours = 40
Introduction of Algorithms Introduction, Motivation, the role of algorithms in computing. **Analyzing of algorithms** Model of Computation like RAM, TM, etc., space and time complexity, asymptotic notation, functions, and running time are applied in well-known algorithms like heap sort, search algorithms, etc. **Designing algorithms** Definition of recursion, use, and limitation, Examples of Towers Hanoi, Tail recursion, etc., an overview of designing techniques.	10
UNIT II	
Divide and Conquer Basic concept, element of dynamic programming, use, Examples- Quick sort, Merge sort, Binary search, the maximum-subarray problem, Strassen's algorithm for matrix multiplication, etc., Methods for solving recurrences. **Dynamic Programming** Basic concept, use, Examples- matrix-chain multiplication, All pair shortest paths, Single-source shortest path, Longest common subsequence Traveling Salesman problem etc. **Branch and Bound** Basic concept, Least cost search, use, Example- The 15-puzzle problem, 0/1 knapsack problem, Traveling salesman problem etc.	8
UNIT III	

Backtracking method Basic concept, use, Examples- 8-Queens problem, Graph coloring problem, Hamiltonian, knapsack problem, etc. **Greedy Method** Basic concept, use, Examples- Knapsack problem, Job sequencing with deadlines, Huffman Coding, Matroids, task-scheduling problems, minimum spanning tree (Prim's and Kruskal's algorithms). **Lower Bound Theory** Comparison trees based on searching, sorting, and selection, Lower Bound techniques through reduction.	8
UNIT IV	
Disjoint Set manipulation Set manipulation algorithm like UNION-FIND, union by rank, Path. **Graph Algorithms** Properties of graphs and graph traversal algorithms: BFS and DFS, Minimum Spanning Trees, Graph traversal Shortest Path problems, Maximum Flow problems etc.	7
UNIT V	
NP-Completeness Notion of NP-completeness: P class, NP-hard class, NP-complete class, Circuit Satisfiability problem, Clique Decision Problem, etc. **Approximation Algorithms** Necessity of approximation scheme, performance guarantee, Polynomial time approximation schemes: 0/1 knapsack problem, Traveling-salesman problem, Vertexcover Problem.	7

Text Books:

1. *Introduction to Algorithms,3rd Edition, T H. Cormen, C E. Leiserson, R L. Rivest, and Clifford Stein, published by PHI Learning Private Limited (Original edition published by the MIT Press, Cambridge, MA, USA), Copyright © 2011.*
2. *Fundamental of Compter Algorithms, 2nd Edition, E. Horowitz, S. Sahni, and S. Rajasekaran, published by Universities Press (India) Private Limited, Copyright © 2008, 2010.*

Reference Books:

1. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014.*
2. *Algorithms, 1st Edition, S. Dasgupta, C. Papadimitriou, and U. Vazirani, published by McGraw-Hill Education, Copyright © 2008.*

Course Outcomes:

- Students will be able to apply the concept and design strategies to algorithm design.
- Students will be able to analyze the efficiency of algorithms based on space and time complexity theory.
- Students will be capable of understanding the different type algorithm design techniques, and also learned the concept of which design technique is more suited for finding the solution of a given problem.
- Students will be able to synthesize the efficient algorithm in a given engineering problem.

Operating System

Course Code	CSE 503
Course Name	Operating System
Credits	3L:0T: 0 P
Pre-Requisites	Microprocessor and Microcontrollers

Course Objectives:

- To learn the mechanisms of OS to handle processes and threads and their communication.
- To learn the mechanisms involved in memory management in contemporary OS.
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
- To know the components and management aspects of concurrency management.
- To learn to implement simple OS mechanisms.

Syllabus

UNIT I	Hours=40
Introduction Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	8
UNIT II	
Processes Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling** Foundation and Scheduling objectives, Types of Schedulers, **Scheduling criteria:** CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; **Multiprocessor scheduling:** Real Time scheduling: RM and EDF.	8
UNIT III	
Inter-process Communication Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.	8
UNIT IV	
Deadlocks Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and **Deadlock Avoidance:** Banker's algorithm, Deadlock detection and Recovery.	8

UNIT V	
I/O Hardware I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms **File Management** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	8

Text Books:

1. *Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.*
2. *Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India*

Reference books:

1. *Create processes and threads.*
2. *Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.*
3. *For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.*
4. *Design and implement file management system.*
5. *For a given I/O devices and OS (specify) develop the I/O management functions in OS*
6. *As part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.*

Course Outcomes:

- The skill that a student will acquire.
- The knowledge (Theoretical/applied/both) the student will gain.

Formal Languages and Automata Theory

Course Code	CSE 504
Course Name	Formal Language and Automata Theory
Credits	3L: 0T: 0 P
Pre-Requisites	Graph Theory, Discrete Mathematics.

Course Objectives

- To understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.
- To understand Decidability and Undesirability of various problems
- To construct pushdown automata and the equivalent context free grammars.
- To prove the equivalence of languages described by pushdown automata and context free grammars.
- To construct Turing machines and Post machines and prove the equivalence of languages described by Turing machines and Post machines.

Syllabus

UNIT I	Hours =40
Finite Automata Basics of Strings and Alphabets, DFA, transition graphs, regular languages, non-deterministic FA, equivalence of DFA and NDFA, Mealy and Moore Machine, minimization of Finite Automata.	8
UNIT II	
Regular grammar Regular grammars, regular expressions, equivalence between regular languages, properties of regular languages, pumping lemma. Relationship between DFA and Regular expression.	8
UNIT III	
Context Free Languages Leftmost and rightmost derivation, parsing and ambiguity, ambiguity in grammar and languages, simplification of CFG, Normal forms	8
UNIT IV	
Pushdown Automata NDPDA, DPDA, context free languages and PDA, comparison of deterministic and non-deterministic versions, closure properties, pumping lemma for CFL.	8
UNIT V	
Turing Machines	8

Variations, halting problem, PCP, Chomsky Hierarchy, Recursive and Recursive enumerable language, Undecidable problem.	

Text Books:

1. *An Introduction to Formal Languages and Automata, by Peter Linz, Fifth Edition, Jones & Bartlett Learning.*

Reference books:

1. *Express Learning-Automata Theory and Formal Languages ,Kandar*
2. *Introduction to Automata Theory, Languages, and Computation, 3e ,Hopcroft*
3. *Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2008.*

Course Outcomes

- Construct finite state machines and the equivalent regular expressions.
- Prove the equivalence of languages described by finite state machines and regular expressions.
- Construct pushdown automata and the equivalent context free grammars.
- Prove the equivalence of languages described by pushdown automata and context free grammars.
- Construct Turing machines and Post machines and prove the equivalence of languages described by Turing machines and Post machines.

Mathematics -IV

Course Code	ASH 501
Course Name	Mathematics -IV
Credits	3L: 0T: 0 P
Pre-Requisites	NIL

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in Numerical Methods. The students will learn:

- The effective mathematical tools for the solutions of nonlinear equations and the methods of interpolation.
- The tools of numerical differentiation and integration.

Syllabus

UNIT I	Hours = 24
Solution of algebraic and transcendental equations Solution of polynomial and transcendental equations – Bisection method, NewtonRaphson method and Regula-Falsi method.	6
UNIT II	
Finite differences and interpolation Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.	6
UNIT III	
Numerical Differentiation Numerical Differentiation, Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.	6
UNIT IV	
Numerical Integration Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Milne's and Adam's predicator-corrector methods.	6

Text Books/ Reference Books:

1. *P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.*
2. *S. S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.*
3. *E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons 2006.*

Course Outcomes:

At the end of the course the students should be able to

- Solve nonlinear equations and ordinary differential equations by numerical methods. learn interpolation and solve several problems through numerical integration.

Constitution of India

Course Code	ASH 503
Course Name	Constitution Of India
Credits	2L:0T: 0 P
Pre-Requisites	NIL

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement.
- To civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik.
- Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Text Books/Reference Books:

1. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.

2. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

Design and Analysis of Algorithms Lab

Course Code	CSE 506
Course Name	Design and Analysis of Algorithms Lab
Credits	0L: 0T: 4P
Pre-Requisites	Basic Mathematical Concept and Programming Language Skill

Course Objectives:

- Students should be able to understand to determine the time complexity through programming language (C/C++/Java/Python) and also able compute the CPU time of a given problem.
- Students should be able to learn various algorithm designing techniques using the primary data structure.
- Principles for good algorithm design and verified by the implementation.

Experiments:

1. Based on the Euclid Algorithm, implement the GCD in the given two numbers. After, implementing the programing, find out the time complexity for executing each steps. Also, based on the different input size, compute the CPU time.
2. Implement the Binary search/Quicksort/Merge sort/Heap sort/Insertion sort/Selection sort algorithms. Analysis the time complexity. Observed based on your implementation, which designing technique concept is used for above-mentioned problems and why?
3. Given a sorted array of non-repeated/distinct integers A [1…...n]. Write an algorithm such that there is an index I for which a[i]=i in O(logn) time. Implement your algorithm to justify your runtime.
4. Implement the Tower of Hanoi problem for n number of discs, and analysis the time complexity.
5. Implement the closest-Pair of points (Assume that all points are one dimensional) and analysis the time complexity.
6. Implement the maximum value of contiguous subsequences and analysis the time complexity.
7. Implement the Topological sort and analysis the time complexity.
8. Implement the Huffman coding compression algorithms.
9. Implement the Prim's and Krushkal's algorithms.
10. Implement shortest path in weighted Graph (Dijkstra's algorithm).
11. Implement Bellman Ford and Floyd-Warshall Algorithm and analysis the time complexity by your implementation.
12. Implement the coin change problem.
13. Implement the fractional knapsack problem
14. Implement the job scheduling algorithm.
15. Implement the matrix chain Multiplication.
16. Implement the Traveling Salesman problem.

Test Books/ Reference books:

1. *Data Structures and Algorithms in java, 3rd edition, A.Drozdek, Cengage Learning.*
2. *Data Structures with Java, J.R.Hubbard, 2ndedition, Schaum's Outlines, TMH.*
3. *Design and Analysis of Algorithms, P.H.Dave and H.B.Dave, Pearson education.*

4. *Data Structures and java collections frame work, W.J.Collins, Mc Graw Hill.*
5. *Problem Solving with Algorithms and Data Structures using Python, by Brad Miller and David Ranum, Luther College.*
6. *Data Structures and Algorithms in Python by Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley.*

Course Outcomes:

- Students will be able to detail the analysis of all the algorithm design techniques through implementation.
- Students will be able to understand the proper data structure is used based on the given problem.

Operating system Lab

Course Code	CSE 507
Course Name	Operating system Lab
Credits	0L:0T: 4 P
Pre-Requisites	NIL

Course Objectives

- This lab complements the operating systems course. Students will gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.

Syllabus

Experiments:

1. Overview of Shell scripting and shell programming.
2. Write a C program to simulate the following non-preemptive CPU Scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority Scheduling.
3. Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
4. Write a C program to simulate Peterson's software solution for Race condition.
5. Write a C program to simulate the following contiguous memory allocation techniques: a) Worst-fit, b) Best-fit and c) First-fit.
6. Write a C program to simulate page replacement algorithms a) FIFO, b) LRU and c) LFU.
7. Write a C program to simulate the following file organization techniques: a) Single level directory, b) Two level directory and c) Hierarchical.

Course Outcomes:

Upon the completion of Operating Systems practical course, the student will be able to:

- Understand and implement basic services and functionalities of the operating system using system Calls.
- Use modern operating system calls and synchronization libraries in software/ hardware interfaces.
- Understand the benefits of thread over process and implement synchronized programs using Multithreading concepts.
- Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
- Implement memory management schemes and page replacement schemes.
- Simulate file allocation and organization techniques.
- Understand the concepts of deadlock in operating systems and implement them in multiprogramming System.

Complier Design

Course Code	CSE 601
Course Name	Complier Design
Credits	3L:0T: 0 P
Pre-Requisites	PCC-CS302(IT Workshop),PCC-CS502 (Formal Language & Automata Theory)

Course Objectives:

- To understand and list the different stages in the process of compilation.
- Identify different methods of lexical analysis.
- Design top-down and bottom-up parsers.
- Identify synthesized and inherited attributes.
- Develop syntax directed translation schemes.
- Develop algorithms to generate code for a target machine.

Syllabus

UNIT I	Hours = 40
Introduction to Compliers Overview of the Translation Process, A Simple Compiler, Difference between interpreter, assembler and compiler. Overview and use of linker and loader, types of Compiler, Analysis of the Source Program, The Phases of a Compiler, Cousins of the Compiler, The Grouping of Phases ,The Structure of a Compiler. Applications of Compiler Technology. **Lexical Analysis** The Role of the Lexical Analyzer, Specification and recognition of Tokens, The Lexical-Analyzer Generator Lex.	8
UNIT II	
Syntax Analysis Context-free language and grammar, push-down automata, LL(1) grammar and topdown parsing, operator grammar, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).	8
UNIT III	
Syntax-Directed Translation Attribute grammar, syntax directed definition, evaluation and flow of attribute in a syntax tree. **Symbol Table** Structure, Symbol attributes and management.	8
UNIT IV	
Run-time environment Procedure activation, parameter passing, value return, memory allocation, and scope. **Intermediate Code Generation**	8

Translation of different language features, different types of intermediate forms.	
UNIT V	
Code Improvement (optimization) Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Register allocation and target code generation.	8

Text Books:

1. *Alfred V. Aho, Ravi Sethi, Monica S. Lam and J.D. Ullman, "Compilers: Principles, Techniques and Tools",(2nd Ed.),Pearson Education Ltd.,2007.*
2. *Alfred V. Aho and J.D. Ullman, "Principles of Compiler Design", Narosa Publication,2002*

Reference Books:

1. *Andrew W. Appel, "Modern Compiler Implementation in C/Java", Cambridge University Press,2003.*
2. *K. D. Cooper and L. Torczon "Engineering a Compiler"(2nd Ed.),Morga Kaufmann,2011..*

Course Outcomes:

- For a given grammar specification develop the lexical analyser.
- For a given parser specification design top-down and bottom-up parsers.
- Develop syntax directed translation schemes.
- Develop algorithms to generate code for a target machine.

Computer Networks

Course Code	CSE 602
Course Name	Computer Networks
Credits	3L: 0T: 0 P
Pre-Requisites	Data Structures and Algorithms (Desirable)

Course Objectives

- To develop an understanding of modern network architectures from a design and Performance perspective.
- To introduce the students to the major concepts involved in Wide-Area Networks (WANs), Local Area Networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming.
- To provide a WLAN measurement ideas.

Syllabus

UNIT I	Hours = 40
Data communication Components Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, **LAN** Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN. **Techniques for Bandwidth utilization** Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	9
UNIT II	
Data Link Layer and Medium Access Sub Layer Error Detection and Error Correction -Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA.	9
UNIT III	10
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	
UNIT IV	
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	6

UNIT V	
Application Layer Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	6

Text Books:

1. *Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.*
2. *Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.*

Reference Books:

1. *Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition. 2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.*
2. *TCP/IP Illustrated, Volume 1, W. Richard Stevens, and Addison-Wesley, United States of America.*

Course Outcomes:

- Explain the functions of the different layer of the OSI Protocol.
- Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component For a given problem related TCP/IP protocol develop the network programming.
- Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools. Note: The syllabus is taken from AICTE syllabus.

Software Engineering

Course Code	CSE 604
Course Name	Software Engineering
Credits	3L: 0T: 0 P
Pre-Requisites	NIL

Course Objectives:

- To discuss the process for developing large software.
- To analyse and model a particular system.
- To develop alternative solutions for the system.
- To implement, test and validate a systems design.

Syllabus

UNIT I	Hours =40
System Analysis & Design Overview, Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model, Function Point Analysis (FPA).	8
UNIT II	
System Requirement Specification and System analysis DFD, Data Dictionary, ER diagram, Process Organization & Interactions. System Design- Problem Partitioning, Top-Down & Bottom-Up design; **Decision tree** Decision table and structured English; Functional vs. Object- Oriented approach.	8
UNIT III	
Coding & Documentation Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.	8
UNIT IV	
Testing Levels of Testing, White & Black box testing, Integration Testing, structural testing Test case Specification, Reliability Assessment, Validation & Verification Metrics, and Monitoring & Control.	8
UNIT V	
Software Project Management Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. CASE TOOLS: Concepts, use and application. Software reliability and quality management.	8

Text Books:

1. RajibMall, Fundamentals of Software Engineering. 3ed, PHI.

Reference Books:

1. *R. G. Pressman, Software Engineering, TMH.*
2. *Behforooz, Software Engineering Fundamentals, OUP*

Course Outcomes:

- Discuss the process for developing large software.
- Analyse and model a particular system.
- Develop alternative solutions for the system.
- Implement, test and validate a systems design.

Compiler Design Lab

Course Code	CSE 605
Course Name	Compiler Design Lab
Credits	0L: 0T: 4 P
Pre-Requisites	NIL

Course Objectives:

- To understand and implement the principles, techniques, and also available tools used in compiler construction process. This will enable the students to work in the development phase of new computer languages in industry.

Syllabus

Experiments

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines.
2. Write a C program to identify whether a given line is a comment or not
3. Write a C program to test whether a given identifier is valid or not.
4. Write a C program to simulate lexical analyzer for validating operators
5. To Study about Lexical Analyzer Generator(LEX) and Flex(Fast Lexical Analyzer)
6. Create a Lexer to take input from text file and count no of characters, no. of lines & number of words.
7. Design Predictive Parser for the given language.
8. Design a LALR bottom up parser for the given language.
9. Convert the BNF rules into Yacc form and write code to generate abstract syntax tree.
10. A program to generate machine code from the abstract syntax tree generated by the parser.

Text Books/ Reference Books:

Course Outcomes:

Computer Networks Lab

Course Code	CSE 606
Course Name	Computer Networks Lab
Credits	0L: 0T: 4P
Pre-Requisites	C/C++ Programming

Course Objectives:

- To introduce Network related commands and configuration files in Linux Operating System..
- To introduce tools for Network Simulation
- To introduce Socket programming for client server application

Syllabus

Experiments

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of data link layer flow control techniques.
3. Study of Socket Programming and Client – Server model.
4. Write a socket Program for Echo/Ping/Talk commands.
5. Simulate different routing protocols like RIP, OSPF, and EIGRP.
6. Simulate other protocols like NAT, VLAN, and ACL etc.
7. Implement Encryption and decryption.

Text Books/ Reference Books:

1. *TCP/IP Illustrated, Volume 1, W. Richard Stevens, and Addison-Wesley, United States of America.*

Course Outcomes:

- Use network related commands and configuration files in Linux Operating System**.**
- For a given problem related TCP/IP protocol develop the network programming.
- Configure different protocols using open source available software and tools.
- Analyze network traffic using network monitoring tools.

Humanities-II (Effective Technical Communication)

Course Code	CSE-702
Course Name	Humanities-II (Effective Technical Communication)
Credits	3L: 0T: 0P
Pre-Requisites	NIL

Syllabus

UNIT I	Hours = 42
Information Design and Development Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.	8
UNIT II	
Technical Writing, Grammar and Editing Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	10
UNIT III	
Self-Development and Assessment Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity.	8
UNIT IV	
Communication and Technical Writing Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	8
UNIT V	
Ethics Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer,	8

Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	

Text Books/ Reference Books:

1. *David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.*
2. *Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843).*
3. *Shiv Khera, You Can Win, Macmillan Books, New York, 2003.*
4. *Raman Sharma, Technical Communications, Oxford Publication, London, 2004.*
5. *Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4).*
6. *Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.*
7. *Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213).*

List of Electives

Artificial Intelligence

Course Code	
Course Name	Artificial Intelligence
Credits	3L: 0T: 0P
Pre-Requisites	NIL

Course Objectives

- To study the basic concepts of artificial intelligence and its architecture.
- To study the basic concept of artificial intelligence, knowledge, and knowledge base.
- To understand the concept and architecture of expert system.
- To study expert system tools and build the expert system using software shell.

Syllabus

UNIT I	Hours=40
Introduction To Artificial Intelligence Overview of AI, definition and importance of knowledge, knowledge based systems, representation of knowledge, knowledge organization, knowledge manipulation, acquisition of knowledge.	8
UNIT II	
Introduction To Expert Systems Features of expert systems, knowledge engineering, basic expert system terminology, human experts and artificial experts, algorithmic and heuristic methods, difference between conventional programs and expert systems, Architecture of expert systems.	8
UNIT III	
Knowledge Representation Rule based methods, rule execution, forward chaining and backward chaining, knowledge representation using semantic nets, structure of semantic nets, Frame-based methods.	8
UNIT IV	

Expert System Tools Types of tools for expert system building, system building aids, support facilities, debugging aids, I/O facilities, explanation facilities, knowledge base editors, stages in the development of expert system tools, procedure oriented methods, object-oriented methods, logic-based methods, access oriented methods.	8
UNIT V	
Expert Systems Building an Expert System – Development phases in expert system building, development constraints, reliability, maintainability, examples of expert systems, and difficulties in development of expert systems.	8

Text Books:

1. *Donald A. Waterman, "A Guide to Expert Systems", Pearson*
2. *Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2007.*

Reference Books:

1. *Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill 2008.*
2. *Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.*
3. *Stuart Russel, Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of expert system for industrial problems.
- Students will know the design pre-requisites and design procedure of expert system.
- Students will understand the concept of fuzzy logic and will try to implement in project work

Neural Networks

Course Code	
Course Name	Neural Network & Deep Learning
Credits	3L: 0T:-0P
Pre-Requisites	NIL

Course Objectives:

- To study Artificial Neural Networks and its applications in the field of computation.
- To study basics of Biological Neural Network and Artificial Neural Network.
- To study different methods of representing ANN.
- To study various architectures of ANN and applications of ANN.
- To understand pattern classification and pattern recognition techniques.

Syllabus

UNIT I	Hours =40
Introduction Features, structure and working of Biological Neural Network. Computing Comparison of BNN and ANN, History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model.	8
UNIT II	
Neural Net For Pattern Classification Hebbs net, Perceptron, Adaline model, Basic learning laws, Topology of Neural network architecture, Backpropagation neural net – Architecture, Delta Learning Rule algorithm – applications.	8
UNIT III	
Neural Nets Based On Competition Kohonen Neural Network –Applications, Learning Vector QuantizationApplications, Counter Propagation Network- Applications.	8
UNIT IV	
Pattern Association Hetero-associative memory neural network applications, Auto-associative net, Iterative Auto-associative net- Bidirectional Associative Memory Applications.	8
UNIT V	
Adaptive Resonance Theory & Neocognitron	8

Motivation, Architecture, Operation- Algorithm, applications- Neocognitron: Architecture, Algorithm, Applications.	

Text Books:

1. *LaureneV. Fausett, "Fundamentals of Neural Networks-Architectures, Algorithms and Applications", Pearson Education, 2011*
2. *B. Yegnanarayana, "Artificial neural Networks", PHI, 2007.*

Reference Books:

1. *James. A. Freeman and David.M.Skapura, "Neural Networks Algorithms, Applications and Programming Techniques ", Pearson Education, Sixth Reprint, 2011.*
2. *Simon Haykin, "Neural Networks and Learning Methods", PHI Learning Pvt. Ltd., 2011.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of neural net based intelligent system for industrial problems.
- Students will know the design pre-requisites and design procedure of intelligent system.
- Students will understand the concept of pattern classification and pattern association and will try to implement in project work.

Deep Learning

Course Code	
Course Name	Deep Learning
Credits	3L: 0T: 0P
Pre-Requisites	Soft computing/Neural Networks

Course Objectives:

- To study deep learning and its applications in the field of computation.
- To study the basics of neural network and deep learning.
- To study the concepts of gradient descent, Singular Value Decomposition.
- To study various architectures of CNN.
- To understand RNN and its architectures.

Syllabus

UNIT I:	Hours=40
History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Perceptrons, Multilayer Perceptrons (MLPs), FeedForward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors. Principal Component Analysis (PCA) and its interpretations, Singular Value Decomposition.	8
UNIT II:	
Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.	8
UNIT III:	
Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization. Learning Vectorial Representations Of Words.	8
UNIT IV:	
Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.	8

UNIT V:	
Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs Encoder Decoder Models, Attention Mechanism, Attention over images	8

Text Books:

1. *Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, http://www.deeplearningbook.org*
2. *"Deep Learning Tutorial", LISA lab, University of Montreal, 2015 http://deeplearning.net/tutorial/deeplearning.pdf*

Reference Books:

1. *Li Deng and Dong Yu, " Deep Learning: Methods and Applications ", https://www.microsoft.com/enus/research/wp-content/uploads/2016/02/DeepLearning-NowPublishing-Vol7-SIG-039.pdf.*
2. *Francois Chollet, "Deep Learning with Python", Manning Publishing Co, 2018, https://tanthiamhuat.files.wordpress.com/2018/03/deeplearningwithpython.pdf.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of neural net based intelligent system for industrial problems.
- Students will know the design pre-requisites and design procedure of intelligent system.
- Students will understand the concept of pattern classification and pattern association and will try to implement in project work.

Soft Computing

Course Code	
Course Name	Soft Computing
Credits	3L: 0T: 0P
Pre-Requisites	NIL

Course Objectives:

- To introduce concept of soft computing techniques and applications.
- To introduce basics of genetic algorithms and their applications in optimization problem.
- To introduce the concepts of fuzzy sets, fuzzy logic and its application.
- To familiarize with tools and techniques of Soft Computing.
- To develop skills for solving problems in different application domain using Soft Computing Techniques.

UNIT – I	**Hours=40**
Introduction To Soft Computing And Neural Networks Evolution of Computing: Soft Computing Constituents, Hard Computing, From Conventional AI to Computational Intelligence: Machine Learning Basics, Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.	8
UNIT – II	
Fuzzy Logic Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	8
UNIT – III	
Genetic Algorithms And Optimizations Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition. Single and multi-/many objective optimizations.	8
UNIT – IV	
MATLAB/Python Lib Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.	8
UNIT – V	
Recent Trends Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.	8

Text Books:

1. *Neuro-Fuzzy and Soft computing: A Computational Approach to Learning and Machine IntelligenceJang, Sun, Mizutani, Pearson Education (2004)*
2. *Principles of Soft Computing – S.N. Sivanandam and S. N. Deepa, Wiley India Pvt Limited (2011).*

Reference Books:

1. *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications – S. Rajasekaran and G.A Vijayalakshmipai, Prentice-Hall of India Pvt Limited (2006)*
2. *Fuzzy Set Theory: Foundations and Applications- George J. Klir, Ute St. Clair, Bo Yuan, Prentice Hall(1997).*
3. *Neural Networks: Algorithms, Applications and Programming Techniques- Freeman J.A. & D.M.*

Course Outcomes:

- Understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- Apply Genetic Algorithm to solve single objective and multiobjective optimization problems.
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Apply neural networks to pattern classification and regression problems.
- Effectively use existing software tools to solve real problems using a soft computing approach.
- Develop some familiarity with current research problems and research methods in Soft Computing Techniques.

Speech and Natural Language Processing

Course Code	
Course Name	Speech and Natural Language processing
Credits	3L: 0T: 0P
Pre-Requisites	Basic Programming Skills General Understanding Of Statistics

Course Objectives:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP). It provides the understanding of the computational properties of natural languages and the algorithms for processing linguistic information. The course will introduce both linguistic (knowledge-based) and statistical approaches to NLP, illustrate the use of NLP techniques and tools in a variety of application areas, and provide insight into many open research problems.

Syllabus

UNIT I	Hours=40
Introduction Introduction to NLP, challenges of NLP , Phases in natural language processing, applications Language Modeling: Grammar-based LM, Statistical LM Regular Expression, Finite State Automata, Morphology and Finite State Transducers, N-grams, Smoothing, HMM and Speech Recognition: Speech Recognition Architecture, Overview of HMM. Evaluation of language models.	4
UNIT II	
Word Classes and Part-of-Speech Tagging English word classes, Targets for English, Part of speech Tagging, Rule Based part of speech Tagging, Stochastic part of speech Tagging, HMM,Transformation Based Tagging. Handling of unknown words, named entities, multi word expressions. **Context Free Grammars for English** Constituency, Context Free rules and Trees, Sentence level construction, The Noun Phrase, Coordination, Agreement, The verb phrase and sub-categorization. Parsing with context free grammars: Basic Top down Parser, and Bottom-up parsing, the early Algorithm, Finite state parsing method. **Features and Unifications** Feature structures, Unification of Features Structures, Features Structures in the grammar, Implementing Unification. **Lexicalized and probabilistic parsing** Probabilistic context free grammars, problems with probabilistic context free grammars, probabilistic lexicalized GFG.	8
UNIT III	

Semantics Representing Meaning Meaning structure of language, First order predicate calculus, linguistically relevant concept, Related Re-presentational approaches, Alternative approaches to meaning. **Semantic Analysis** Syntax driven semantic analysis, Attachment of Fragment of English,. Robust Semantic Analysis.	8
Lexical Semantics Relation among lexemes and their senses, Internal Structure of words. WordNet, Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches.	
UNIT IV	
Pragmatics Discourse Reference resolution, Text Coherence, Discourse Structure, constraints on co-reference algorithm for pronoun resolution Psycholinguistics Studies of reference and coherence. Natural Language generation: Introduction to language generation, Architecture for generation, , Discourse planning.	8
UNIT V	
Applications of NLP Introduction to corpus elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. stemmers and lemmatiser, Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, Machine Translation– Overview.	8

Text and Reference Books:

1. *Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.*
2. *Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.*
3. *Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.*
4. *Richard M Reese, ―Natural Language Processing with Java, OReilly Media, 2015.*
5. *Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.*

Course Outcomes:

- Understand core algorithms and data structures used in NLP.
- Apply these mathematical models and algorithms in applications in software design and implementation for NLP.
- Develop NLP components, such as n-gram language models stemmer, part-of-speech taggers.
- Evaluate the merits of use of different statistical approaches for different types NLP tasks.
- Implement a simple NLP systems.

Data Mining and Data Warehousing

Course Code	
Course Name	Data Mining and data Warehousing
Credits	3L: 0T: 0P
Pre-Requisites	Databases and Probability

Course Objectives:

- To introduce data warehousing and mining techniques.
- Be acquainted with the tools and techniques used for Knowledge Discovery in Databases.

Syllabus

UNIT I	Hours = 40
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Integration of a Data Mining System with a Data Warehouse; Data Preprocessing.	7
UNIT II	
Mining Frequent Patterns, Associations and Correlations; Mining Methods; Mining various Kinds of Association Rules; Correlation Analysis, Constraint Based Association Mining, Classification and Prediction, Basic Concepts, Decision Tree Induction; Bayesian Classification; Rule Based Classification; Classification by Back propagation, Support Vector Machines, Associative Classification; Lazy Learners; Other Classification Methods; Prediction; Cluster Analysis – Types of Data in Cluster Analysis.	8
UNIT III	8
Cluster Analysis; Types of Data; Categorization of Major Clustering Methods, Kmeans, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model-Based Clustering Methods; Clustering High Dimensional Data, Constraint, Based Cluster Analysis, Outlier Analysis, Data Mining Applications.	
UNIT IV	
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, and Similarity search in Time-series analysis.	8
UNIT V	
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;	9

Text Books:

1. *JiaweiHan , M Kamber and J Pei " Data Mining Concepts and Techniques", Third Edition, Elsevier Publication, 2011.*
2. *Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007*

Reference Books:

1. *Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.*
2. *G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi – 2006.*
3. *A. Berson& S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi,2004*

Course Outcomes:

After completion of course, students would be:

- Apply data mining techniques and methods to large data sets.
- Use data mining tools.
- Compare and contrast the various classifiers.

Internet of Things

Course Code	
Course Name	Internet of Things
Credits	3L: 0T: 0P
Pre-Requisites	Computer Networks

Course Objectives:

- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and characteristics.

Syllabus

UNIT I	Hours = 40
Introduction and Applications Smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security.	8
UNIT II	
IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints** Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote control.	8
UNIT III	
Industrial Automation Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial **Building Automation** Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.	8
UNIT IV	
Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases	8

UNIT V	
IOT Physical Devices & Endpoints What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.	8

Text/ Reference Books:

1. *Mandler, B., Barja, J., Mitre Campista, M.E., Cagáňová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing, 2015*
2. *Arshdeep Bahga, Vijay Madisetti "Internet of Things - A Hands-on Approach", Universities Press, First Edition, 2015*
3. *David Hanes, Gonzalo Salgueiro, and Patrick Grossetete,IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things,CISCO Press,2017.*

Course Outcomes:

- Identify requirements from emerging WSN applications on WSN platforms, Communication systems, protocols and middleware.
- Understand, compare and evaluate communication and network protocols used in WSNs.
- To develop prototypes for domain specific IoTs.
- To customize real time data for IoT applications.

Social Network Analysis

Course Code	
Course Name	Social Network Analysis
Credits	3L: 0T: 0P
Pre-Requisites	Wireless Networks (Desirable)

Course Objectives:

- Students will be able to understand and formulate research questions relevant to social network analysis.
- Students will understand the sources, advantages, and disadvantages of alternative types of social network data.
- Students will be able to describe a social network and compare attributes across different social networks.
- Students will understand theoretical and empirical issues in current research on social network analysis.

Syllabus

UNIT I	Hours =40
Introduction Introduction to social network mining. Illustration of various social network mining tasks with real-world examples. Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.	8
UNIT II	
Modelling, Aggregating And Knowledge Representation Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.	9
UNIT III	
Extraction And Mining Communities In Web Social Networks Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.	9

UNIT IV	
Predicting Human Behaviour And Privacy Issues Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and countermeasures.	8
UNIT V	
Visualization And Applications Of Social Networks Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, Visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	6

Text Books:

1. *Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.*
2. *Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.*

Reference Books:

1. *Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.*
2. *Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.*

Courses outcomes:

- Understand the basic concepts of social networks.
- Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks.
- Implement mining algorithms for social networks.
- Perform mining on large social networks and illustrate the results.

Mobile Computing

Course Code	
Course Name	Mobile Computing
Credits	3L: 0T: 0P
Pre-Requisites	Computer Networks

Course Objectives:

- To study the specifications and functionalities of various protocols/standards of mobile networks.
- To learn about the concepts and principles of mobile computing.
- To explore both theoretical and practical issues of mobile computing.
- To develop skills of finding solutions and building software for mobile computing applications.

Syllabus

UNIT I	Hours = 36
Introduction Challenges in mobile computing**,** Description of cellular system, Frequency Reuse, Co-channel and Adjacent channel interference, Propagation Models for Wireless Networks, Multipath Effects in Mobile Communication, channel allocation, Handoff, types of handoffs; location management.	9
UNIT II	
Evolution of Modern Mobile Wireless Communication System First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, GSM: Architecture and Protocols ,2.5G Wireless Networks, The General Packet Radio Services: (GPRS), Overview of CDMA systems: IS-95 Networks.	10
UNIT III	
3G Mobile Networks, Cellular WLAN Integration, Introduction to 4G, WiMAX, LTE, Mobile IP, Mobile TCP.	10
UNIT IV	
Support for mobility File systems, World Wide web, Wireless application protocol, Mobile operating systems, Mobile agents, Satellite Systems, Global Positioning System.	3
UNIT V	
Mobile Ad- hoc Network (MANET) Layered architecture of MANET, Ad hoc network routing protocols, MAC and Transport layer issues of	4

MANET, Introduction to Wireless Sensor Network ,Wireless Mesh Network , VANET	

Text Books/ Reference Books:

1. *P.K. Pattnaik, Rajib Mall, "Fundamentals Of Mobile Computing", PHI, 2015.*
2. *D.P. Agrawal and Q.A. Zeng, "Introduction to Wireless and Mobile Systems",3rd edition, Thomson Learning, 2010.*
3. *J. Schiller, "Mobile Communications", 2nd edition, Pearson Education, 2012.*

Course Outcomes:

- Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support.
- Identify the important issues of developing mobile computing systems and applications.
- Develop mobile computing applications by analyzing their characteristics and requirements, selecting the appropriate computing models and software architectures, and applying standard programming languages and tools.
- Organize and manage software built for deployment and demonstration.

Data Analytics

Course Code	
Course Name	Data Analytics
Credits	3L:0T: 0 P
Pre-Requisites	Data Structure, Statistics Data Mining

Course Objectives:

The Student should be made to:

- Be exposed to big data.
- Learn the different ways of Data Analysis.
- Be familiar with data streams.
- Learn the mining and clustering.
- Be familiar with the visualization.

Syllabus

UNIT I	Hours=34
Introduction to Big data Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs. reporting - Modern data analytic tools, **Statistical concepts** Sampling distributions, resampling, statistical inference, and prediction error.	6
UNIT II	
Data analysis Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, and Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks. **Fuzzy logic** Extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.	9
UNIT III	
Mining data streams: 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.	6

UNIT IV	
Frequent item sets and clustering Mining Frequent item sets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism.	7
UNIT V	
Frameworks and visualization MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.	6

Text Books:

1. *Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*
2. *Montgomery, Douglas C. and Runger, George C. (2014) Applied Statistics and Probability for Engineers, 6th edition, John Wiley & Sons, Inc (ISBN- 978-1118539712)* Reference books:

1. *Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.*
2. *Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.*
3. *P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of*
4. *Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.*
5. *Eric Sammer, "Hadoop Operations", O'Reilley, 2012.*

Course Outcomes:

After completion of course, students would be:

- Demonstrate understanding of hypotheses testing for samples to solve engineering problems.
- Perform linear and multiple linear regression analyses.
- Demonstrate ability to design and analysis of single-factor experiments.
- Demonstrate ability to do design of experiments with several factors.
- Describe big data and use cases from selected business domains.
- Explain NoSQL big data management.
- Install, configure, and run Hadoop and HDFS.
- Perform map-reduce analytics using Hadoop.
- Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Image Processing

Course Code	
Course Name	Image Processing
Credits	3L:0T:0P
Pre-Requisites	NIL

Course Objectives:

- To become familiar with digital image fundamentals.
- Be exposed to simple image processing techniques.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- Learn to represent image in form of features.

Syllabus

UNIT I	Hours = 40
Digital Image Fundamentals Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, neighborhood, adjacency, connectivity, distance measures, Color image fundamentals, RGB, HSI models.	8
UNIT II	
Image Enhancements **Spatial Domain:** Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering. **Frequency Domain:** Introduction to Fourier Transform, Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	8
UNIT III	
Image Restoration Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering.	8
UNIT IV	

Image Segmentation and Color Image Processing Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Morphological processing, erosion and dilation, Segmentation by morphological watersheds, basic concepts, Dam construction, Watershed segmentation algorithm. Color models, RGB, YUV, HSI; Color transformations, formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.	8
UNIT V	
Wavelets and Morphological Image Processing Uncertainty principles of Fourier Transform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub band filter banks, wavelet packets. Erosion and Dilation, Opening and Closing, The Hit-or-Miss Operation, Some Basic Morphological Algorithms, Boundary Extraction, Extraction of Connected Components, Convex Hull, Thinning and Thickening.	8

Text Books:

1. *Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010.*
2. *Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002.*

Reference Books:

1. *Kenneth R. Castleman,Digital Image Processing Pearson, 2006.*
2. *Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.*
3. *D,E. Dudgeon and RM. Mersereau,Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.*
4. *William K. Pratt,Digital Image Processing John Wiley, New York, 2002.*
5. *Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.*

Course Outcomes:

At the end of the course, the students should be able to:

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

Computer Graphics

Course Code	
Course Name	Computer Graphics
Credits	3L:0T: 0 P
Pre-Requisites	Analytic Geometry, Linear Algebra, Basic Programming

Course Objectives:

- Gain knowledge about graphics hardware devices and software used.
- Understand the two-dimensional graphics and their transformations.
- Understand the three-dimensional graphics and their transformations.
- Appreciate illumination and color models.
- Be familiar with understand clipping techniques. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
- To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
- To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Syllabus

UNIT I	Hours=40
Introduction to Computer Graphics & Graphics Systems Overview of computer graphics & its uses, Classification, characteristics & components & applications of computer graphics, Representing pictures, Basic Terminologies: Pixel, Resolution & its different types, Dots, Dot Pitch, Aspect ratio; Raster scan display: Refresh rate & Interlacing, Retrace, CRT, Shadow mask, Aperture grill, Bit planes, Color depth, Color palette, Frame buffer, Video controller, General architecture of Raster Scan display, Active & Passive graphics devices, Computer graphics software.	8
UNIT II	
Scan Conversion Points & lines, Line drawing algorithms: DDA algorithm, Advantages & Disadvantages; Bresenham's line algorithm; Circle generation algorithm: Basic concepts, DDA circle drawing algorithm, Midpoint circle drawing algorithm, Brsenham's circle drawing algorithm; Ellipse generation algorithm: Basic concepts, Midpoint ellipse generation algorithm; Aliasing, Antialiasing, Methods of antialiasing.	8
UNIT III	

Polygon Filling algorithms and Transformation Inside & Outside test of polygon: Even-Odd method, Winding number method; Polygon filling algorithms: Scan line polygon, Scan line seed fill algorithm, Boundary fill algorithm, Flood fill algorithm. **Basic transformations** Translation, rotation, scaling, reflection, shear; Transformation between coordinate systems; Homogeneous coordinates & Combined transformations; Inverse transformation: Rotation about an arbitrary point, General fixed-point scaling, Reflection through an arbitrary line.	8
UNIT IV	
Viewing and Clipping Viewing transformation, Viewing pipeline, Window to viewport co-ordinate transformation; Clipping: Point clipping, Line clipping -- Cohen-Sutherland algorithm, Liang-Barsky algorithm, Polygon clipping – Sutherland-Hodgeman algorithm, WeilerAtherton algorithm; Text clipping. 3D transformation and Projection: **3D transformations** Translation, rotation, scaling, reflection & shearing. Rotation about an axis parallel to a coordinate axis, Rotation about an arbitrary axis in space, reflection through an arbitrary plane; 3D Projection: Parallel projection – Orthographic, Axonometric, Oblique; Perspective projection – transformation matrix, vanishing points, Single-point, Two-point, Three-point perspective transformation.	8
UNIT V	
Curves, Hidden Surfaces, Color and Shading Models Curve generation algorithm- DDA method, approximation method, Spline representation, Continuity, Piecewise Cubic Spline, Bezier curves – Cubic Bezier, Mid-point Bezier, Bspline curves; Depth comparison, Z-buffer algorithm, Back faces detection, BSP tree method, Painter's algorithm, Scan-line algorithm; Hidden line elimination method, wire frame methods; Introduction, Modeling Light Intensities and Sources, Diffuse Reflection, Lambert's Cosine Law, Specular Reflection, Half-toning, Color Models - RGB Color, CMY Color.	8

Text Books:

1. *Computer Graphics Multimedia and Animation, Malay K. Pakhira, 2nd Ed., PHI Learning Pvt. Ltd.*
2. *D. P. Mukherjee, Fundamentals of Computer Graphics & Multimedia, Prentice Hall.*
3. *D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, McGraw Hill.*

Reference Books:

1. *D. Hearn and M. P. Baker, Computer Graphics (C version), Prentice Hall.*
2. *J. F. K Buford., Multimedia Systems, Pearson Education.*
3. *P. K. Andleigh and K. Thakrar, Multimedia Systems Design, Pearson Education India*
4. *S. Harrington, Computer Graphics: A programming Approach, McGraw Hill.*
5. *V. Dam; F. H. John; J. D. Foley; S. K. Feiner, Computer Graphics principles and practice, Pearson Education.*

6. *W. M. Newman and R. F. Sproull, Principles of Interactive computer Graphics, McGraw Hill.*
7. *M. E. Cook, Principles of Interactive Multimedia, McGraw Hill.*
8. *Mukhopadhyay and A. Chattopadhyay, Introduction to Computer Graphics and Multimedia, Vikas Publishing House.*

Course Outcomes:

- Design two-dimensional graphics.
- Apply two dimensional transformations.
- Design three-dimensional graphics.
- Apply three dimensional transformations.
- Apply Illumination and color models.
- Apply clipping techniques to graphics.
- Design animation sequences.

Computational Complexity

Course Code	
Course Name	Computational Complexity
Credits	3L:0T: 0 P
Pre-Requisites	Data Structure, Algorithm, Theory of Computation

Course Objectives:

The Student should be made to:

- Learn the main computational complexity classes, their underlying models of computation, and relationships.
- Understand the concept of reductions and its role in classifying problems by their computational complexity.
- Be able to show using reductions that a problem is NP-complete.
- Be familiar with the concepts of randomized, approximation, and parallel algorithms and aware of the related complexity classes.

Syllabus

UNIT I	Hours=40
Introduction Easy and hard problems. Algorithms and complexity. Turing machines: Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems.	4
UNIT II	
The Halting Problem and Undecidable Languages Counting and diagonalization. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem. Deterministic Complexity Classes: DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability.	6
UNIT III	
NP and NP-completeness Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NPcompleteness. Cook-Levin Theorem. Polynomial transformations: 3- satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.	6
UNIT IV	
Space complexity and hierarchy theorems DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NL- completeness. NL=coNL. Hierarchy theorems.	10
UNIT V	

Randomized Complexity The classes BPP, RP, ZPP. Interactive proof systems: IP = PSPACE.	6
UNIT VI	
Optimization and approximation Combinatorial optimization problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, traveling salesman problem, minimum partition.	8

Text Books:

1. *Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press,2009.*
2. *Sanjeev Arora, et al, Complexity Theory: A Modern Approach, Cambridge University Press, 1st edition, 2009.*

Reference Books:

1. *Allen Downey, Think Complexity: Science and Modeling, O'Reilly Media, 2nd Edition, 2018*
2. *OdedGoldreich, P, NP, and NP-Completeness: The Basics of Computational Complexity, Cambridge University Press, 1st edition, 2010*
3. *Neil Deaton Jones, Computability and Complexity: From a Programming Perspective, The MIT Press, 2007*
4. *Goldreich, Computational Complexity: A Conceptual Perspective, Cambridge University Press, 1st edition, 2008)*

Course Outcomes:

- Students will be able to formulate computational models with resource constraints, and be able to describe relationships between these models.
- Students will be able to analyze computational problems from a complexity perspective, and so locate them within the complexity landscape.
- Students will be able to apply mathematical skills and knowledge from earlier years (e.g., from logic and discrete mathematics) to concrete problems in computational complexity.
- Students will gain an appreciation of the broader importance of fundamental problems in computer science, such as the P vs. NP problem.

Basic Programming Concept

Course Code	
Course Name	Basic Programming Concept
Credits	3L:0T:0P
Pre-Requisites	Mathematics

Course Objectives:

- The objective of this course is to provide fundamentals of Computer Systems and problem-solving techniques using C language programming.

Syllabus

UNIT I	Hours=40
Introduction to Computer Computer system concepts, characteristics of computer, generations and types of computer, components of computer system, Booting process, classification of digital computer system, organization of computers. Input and Output devices, Storage devices.	8
UNIT II	
Introduction to Computer Languages System software, application software, firmware, Programming languages classification: machine language, assembly language & high-level language. Evolution of programming languages: first generation, second generation, third generation & fourth generation languages, Language translator: Compiler, Interpreter, and Assembler. Operating System - Definition, Job, Objective and evolution of operating system, Types of operating systems.	8
UNIT III	
Programming Fundamentals Software development life cycle and structured programming, Flowchart and Algorithms, Introduction to C programming, basic programming using input and output operators and expressions, programming using if and if-else, Programming using looping-for, while, do-while; use of switch and break.	8
UNIT IV	
Storage Class, Preprocessors, Arrays based Programming and Modular Programming Defining and processing 1-d and 2-d arrays for problem solving. Defining and calling a function, modular programming using functions, passing arguments and arrays to functions, functions of void and returning values.	8
UNIT V	
Programming using Strings & Structures and Files Defining and processing string as array of character, use of null char, defining and processing structures, passing strings and structures to functions. Input and Output Files.	8

Text Books:

1. *Yashavant P. Kanetkar, Let Us C, Fifth Edition.*
2. *E Balaguruswamy, Programming with C, Tata McGraw Hill, 2015.*

Reference Books:

1. *Byron S. Gottfried, Programming with C Language, Schaum Series, Tata McGraw Hill, 2015.*
2. *Kernighan & Richie, C Programming, Prentice Hall of India, 2002.*

Course Outcomes

- Learn fundamental knowledge of computer hardware and number systems.
- Learn basic terminology used in computer programming.
- Develop ability to write, compile and debug programs in C language.
- Design programs involving decision structures, loops and functions.
- Understand the dynamics of memory by the use of pointers.
- Learn the basic concepts of object-oriented programming paradigm.

Software Engineering

Course Code	
Course Name	Software Engineering
Credits	3L: 0T: 0 P
Pre-Requisites	NIL

Course Objectives:

- **To discuss the process for developing large software.**
- **To analyse and model a particular system.**
- **To develop alternative solutions for the system.**
- **To implement, test and validate a systems design.**

Syllabus

UNIT I	Hours =40
Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model, Function Point Analysis(FPA).	8
UNIT II	
System Requirement Specification, System analysis- DFD, Data Dictionary, ER diagram, Process Organization & Interactions. System Design- Problem Partitioning, Top-Down & Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	8
UNIT III	
Coding & Documentation- Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.	8
UNIT IV	
Testing- Levels of Testing, White & Black box testing, Integration Testing, structural testing Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	8
UNIT V	
Software Project Management- Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. CASE TOOLS: Concepts, use and application. Software reliability and quality management.	8

Text Books:

1. RajibMall, Fundamentals of Software Engineering. 3ed, PHI.

Reference Books:

1. *R. G. Pressman, Software Engineering, TMH*.
2. *Behforooz, Software Engineering Fundamentals, OUP*.

Course Outcomes:

- Discuss the process for developing large software.
- Analyse and model a particular system.
- Develop alternative solutions for the system.
- Implement, test and validate a systems design.

Embedded Computing Systems

Course Code	
Course Name	Embedded Computing Systems
Credits	3L:0T: 0 P
Pre-Requisites	NIL

Course Objectives:

- To understand and design embedded systems and real-time systems.
- To identify the unique characteristics of real-time systems.
- To explain the general structure of a real-time system.
- To define the unique design problems and challenges of real-time systems.
- To apply real-time systems design techniques to various software programs.

Syllabus

UNIT I	Hours =38
Hardware Concepts Application and characteristics of embedded systems, Overview of Processors and hardware units in an embedded system, General purpose processors, Microcontrollers:8051, Application- Specific Circuits (ASICs), ASIP, FPGA, ARMbased System on a Chip (SoC), Network on Chip (NoC), Levels of hardware modelling, Verilog, Sensors, A/D-D/A converters, Actuators.	8
UNIT II	
Interfacing using RS-232, UART, USB, I2C, CAN bus, Flexray, SRAM and DRAM, Flash memory.	6
UNIT III	
Real-Time Operating Systems Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA).	8
UNIT IV	
Commercial Real-time operating systems Time services, Features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real- time operating systems, Microkernel based systems, Benchmarking real-time systems.	8
UNIT V	

Embedded Application Development UML 2.0, State charts, General language characteristics, MISRA C, Hardware/Software Co- design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.	8

Text Books:

1. Embedded Systems Design – A Unified Hardware /Software Introduction, by Frank Vahid and Tony Givargis,John Wiley (2001).

2. An Embedded Software Primer, by David E.Simon, Pearson Education Asia (1999).

Reference Books:

1. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers (2000).

Course Outcomes:

- Understand and design embedded systems and real-time systems.
- Identify the unique characteristics of real-time systems.
- Explain the general structure of a real-time system.
- Define the unique design problems and challenges of real-time systems.
- Apply real-time systems design techniques to various software programs.

Advanced Operating System

Course Code	
Course Name	Advanced Operating System
Credits	3L:0T: 0 P
Pre-Requisites	Operating System

Course Objectives:

- To Understand the working of a distributed Operating system.
- To understand the issues in designing a distributed Operating System.
- To understand the synchronization primitives of interaction of distributed Operating System.
- To understand the construct and functioning of Distributed shared – memory and Deadlock management in distributed environment.
- To understand the various failure modes of the system and failure recovery in a distributed environment.

Syllabus

UNIT I	Hours =40
Distributed Systems Architectures of Distributed Systems, System Architecture types, Issues in distributed operating systems, Communication networks, Communication primitives. Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Programs.	8
UNIT II	
Theoretical Foundations Inherent limitations of a distributed system, Lamport's logical clocks, Vector clocks, Casual ordering of messages, Global state, Cuts of a distributed computation, Termination detection. Distributed Mutual Exclusion, Introduction, The classification of mutual exclusion and associated algorithms, A comparative performance analysis.	8
UNIT III	
Distributed Deadlock Detection Introduction, Deadlock handling strategies in distributed systems, Issues in deadlock detection and resolution, Control organizations for distributed deadlock detection, Centralized and distributed deadlock detection algorithms, Hierarchical deadlock detection algorithms. Agreement protocols, Introduction-the system model, a classification of agreement problems, Solutions to the Byzantine agreement problem, Applications of agreement algorithms. **Distributed resource management** Introduction, Architecture, Mechanism for building distributed file systems, Design issues, Log structured file systems.	8
UNIT IV	

Distributed shared memory Architecture, Algorithms for implementing DSM, Memory coherence and protocols, Design issues. Distributed Scheduling, Introduction, Issues in load distributing, Components of a load distributing algorithm, Stability, Load distributing algorithm, Performance comparison, Selecting a suitable load sharing algorithm, Requirements for load distributing, Task migration and associated issues.	6
UNIT V	
Failure Recovery and Fault tolerance Introduction, Basic concepts, Classification of failures, Backward and Forward error recovery, Backward error recovery, Recovery in concurrent systems, Consistent set of check.	6
Check Points Synchronous and asynchronous check pointing and recovery, Check pointing for distributed database systems, Recovery in replicated distributed databases.	4

Text Books:

1. *Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001*

Reference Books:

1.Andrew S.Tanenbaum, "Modern operating system", PHI, 2003

2. *Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003*

Course Outcomes:

- The course will help the students to understand the basic aim and scope of Distributed Operating System.
- The Course will help students in analyzing the various issues in designing a Distributed Operating system and also give insight into various solutions to overcome the issues at hand.
- Deep understanding of deadlock handling and synchronization primitives of various algorithms in distributed environment.
- Understanding of process scheduling and implementation of memory coherence, load balancing, processor to processor interaction.
- Deep understanding of Failure recovery and fault tolerance.

Network on Chip

Course Code	
Course Name	Network On Chip
Credits	3L: 0T: 0 P
Pre-Requisites	Computer Networks and Data Communication

Course Objectives:

- To introduce basic interconnection networks and its various uses.
- To introduce popular topologies in Noc.
- To introduce Routing and routing mechanics in Noc.
- To introduce flow control and QoSpremitives in NoC.

Syllabus

UNIT I	Hours=40
Introduction to Interconnection Networks Uses of Interconnection Networks, **Network Basics:** Topology, Routing Flow Control, Router Architecture, Performance of Interconnection Networks.	8
UNIT II	
Topology Basics Channels and Nodes, Direct and Indirect Networks, Cuts and Bisections, Paths, Traffic Patterns, Performance**,** Throughput and Maximum Channel Load, Latency, Path Diversity, Packaging Cost. **Basics of Popular Topologies:** Butterfly Networks, Structure, Performance, Packaging cost, Path diversity, Number of Stages; Torus Networks, Structure, Performance, Packaging cost, Path diversity. Meshes and Express cubes.	8
UNIT III	
Routing Basics Taxonomy of Routing Algorithms, The Routing Relation, Deterministic Routing, Oblivious Routing, Minimal Oblivious Routing, Load Balanced Oblivious Routing, Adaptive Routing, Routing Mechanics.	8
UNIT IV	
Flow Control Basics Resources and Allocation Units, Buffer less Flow Control, Circuit Switching, Buffered Flow Control, Packet-Buffer Flow Control, Flit-Buffer, Flow Control, Buffer Management and Backpressure, Flit-Reservation Flow Control.	8
UNIT V	

Deadlock and Livelock Deadlock, Deadlock Avoidance, Adaptive Routing, Deadlock Recovery, Livelock; Quality of Service, Burstiness and Network, Implementation of Guaranteed Services, Delays, Implementation of Best-Effort Services, Separation of Resources.	8

Text Books:

1. "Principle and Practices of Interconnection Networks", William J. Dally and brain Towles.Morgankaufmann.

Reference Books:

1. "Network – On – Chip: From Implementation to programming Paradigm", Sheng Ma Libo Huang Mingche Lai Wei Shi, Margan Kaufman.

Course Outcomes:

- In depth analysis of Commercial NoCs.
- Understanding of basic requirements of NoC topologies and various performance factors.
- Understanding how to avoid deadlocks and lovelocks in various choices of routing algorithms present.
- Understanding the QoS requirements.

Information Retrieval

Course Code	
Course Name	Information Retrieval
Credits	3L: 0T: 0 P
Pre-Requisites	Any Programming Language (Preferably java) Probability and Linear algebra

Course Objectives:

- To learn and study algorithms which will enable to design, and implement modern information retrieval systems.
- To investigate search evaluation, retrieval feedback, search log mining, and applications in web information management.

Syllabus

UNIT I	Hours = 36
Introduction Introduction, History Of IR, Components Of IR, Issues, Open Source Search Engine Frameworks, The Impact Of The Web On IR, IR Versus Web Search, The Basic Building Blocks Of A Modern Search Engine System, Including Web Crawler, Basic Text Analysis Techniques.	9
UNIT II	
Models of Information Retrieval Inverted Index, Query Processing, Search Result Interface. Boolean And Vector-Space Retrieval Models, Term Weighting, TF-IDF Weighting, Cosine Similarity, Preprocessing, Efficient Processing With Sparse Vectors, Language Model Based IR, Probabilistic IR, Latent Semantic Indexing, Relevance Feedback And Query Expansion.	10
UNIT III	10
Text Mining Information Filtering; Organization And Relevance Feedback, Text Mining, Text Classification And Clustering. **Categorization Algorithms** Naive Bayes; Decision Trees; And Nearest Neighbor. **Clustering Algorithms** Agglomerative Clustering; KMeans; Expectation Maximization (EM).	
UNIT IV	3
Link Analysis Link Analysis, Hubs And Authorities, Page Rank And HITS Algorithms, Searching And Ranking, Relevance Scoring And Ranking For Web.	

UNIT V	4
Similarity and evaluation measures Evaluation Measures, Similarity And Distance Measures, Snippet Generation, Summarization, Question Answering, Cross-Lingual Retrieval, Hadoop & Map Reduce And Modern Search Applications.	

Text Books:

1. *C. Manning, P. Raghavan, and H. Schutze, Introduction to Information Retrieval, Cambridge University Press, 2008.*
2. *Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1stEditionAddisonWesley, 2009.*
3. *Mark Levene, An Introduction to Search Engines and Web Navigation, 2nd Edition Wiley.*

Reference Books:

1. *Ophir Frieder "Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series", 2nd Edition, Springer, 2004.*
2. *Manu Konchady, "Building Search Applications: Lucene, Ling Pipe", and First Edition, Gate Mustru Publishing, 2008.*

Course Outcomes:

- Recognize underlying technologies of modern information retrieval system.
- Obtain hands-on experience by using existing information retrieval toolkits to set up your own search engines and improving their search accuracy.
- Helps in gaining in-depth understanding of the methods like document text-mining techniques, page-rank etc. and develop your own idea for new solutions for different verticals.

Advanced Java Programming

Course Code	
Course Name	Advanced Java Programming
Credits	3L:0T: 0P
Pre-Requisites	Core Java

Course Objectives:

- To impart the basic concepts of Enterprise architecture.
- To understand concepts about CGI and request response model
- To understand basic concepts about Session management.
- To enable them to understand issues related to the application of J2EE in real world.

Syllabus

UNIT I	Hours = 36
Fundamentals Introduction, Client & server side programming. Enterprise architecture styles: Single tier, 2-tier, 3-tier, n-tier; Relative comparison of the different layers of architectures. MVC Architecture: Explanation, Need, Drawbacks, J2EE Web Services, Different components & Containers.	8
UNIT II	
Servlet Introduction, Advantages over CGI, How it works?, Servlet life cycle, Servlet API (Different interfaces & classes of generic servlet & HTTP servlet), Accessing user information by means of Request & Response, Servlet session management techniques and relative comparison.	9
UNIT III	
Java Server Pages JSP: Introduction, Comparison between JSP & servlet, Architecture/Life cycle, Different types of JSP architectures and relative comparison. JSP tags, Directives, Scripting elements, Actions; JSP Implicit objects, Accessing user information using implicit objects. Beans- useBeans, setProperty, getProperty, Session Tracking, User Passing Control and Data Between Pages, Sharing Session and application data.	6
UNIT IV	
Database Connectivity JDBC- Introduction, Database driver ,Different approaches to connect an application to a database server, Establishing a database connection and executing SQL statements, JDBC prepared statements, JDBC data sources.	6
UNIT V	

Reinforcement learning and control Introduction- J2EE, JavaBeans- Bean Builder, advantages, Design Patterns, Properties- Simple, Bound, Constrained, BeanInfo interface, Persistence, Customizer, JavaBean API, EJB- Architecture, Usage, Benefits, Beans- Sessions, Stateless, Statefull, Entity and Message driven, Introduction to Struts-Basic Idea.	7

Text Books:

1. *Uttam K. Roy,"Advanced Java Programming", Oxford University Press. Inc., 2015.*
2. *Ivor Horton,"Beginning J2EE 1.4", SPD Publication, 2008.*

Reference Books:

1. Austin and Pawlan,"Advanced Programming for JAVA 2 Platform", Pearson, 2000.

Course Outcomes:

Student will able to implement:

- Servlet.
- JSP.
- JAVA Beans.
- EJB.
- Stateful Sessions.
- Following key learning indicators will reflect out of this course for the students.
- Different layers of architecture.
- CGI vs. Java Alternatives.
- Lifecycle of servlet and JSP.
- JDBC Connections.
- Implementations of hibernate and struts frameworks.

Machine Learning

Course Code	
Course Name	Machine Learning
Credits	3L:0T: 0P
Pre-Requisites	Probability and Linear Algebra; Basic programming skills preferably in python

Course Objectives:

- To impart the basic concepts of machine learning and algorithms.
- To understand concepts about supervised and unsupervised learning.
- To understand basic concepts about deep learning and learning theory.
- To enable them to understand issues related to the application of machine learning Algorithms.

Syllabus

UNIT I	Hours = 36
Fundamentals Introduction, Different Types of Learning, Hypothesis Space and Inductive Bias, Evaluation and Cross-Validation, Linear Regression Introduction to Decision Trees Learning Decision Tree, Overfitting.	8
UNIT II	
Supervised learning Supervised learning setup, LMS, Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines.	9
UNIT III	
Learning Theory Model selection and feature selection, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms;. Bias/variance tradeoff, Union and Chernoff/ Hoeffding bounds, VC dimension, Worst case (online) learning. .	6
UNIT IV	
Unsupervised learning Clustering K-means, EM. Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), ICA (Independent components analysis).	6
UNIT V	
Reinforcement learning and control MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), LQG, Q-learning. Value function, approximation, Policy search. Reinforce. POMDPs.	7

Text Books:

1. *EthemAlpaydin, Introduction to Machine Learning, 3rd Edition, PHI, 2015.*
2. *Tom M. Mitchell, Machine Learning, McGraw Hill Education; First edition (1 July 2017).*

Reference Books:

1. *T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition 2009.*
2. *Christopher Bishop.Pattern Recognition and Machine Learning Springer; 2011 edition (15 February 2010).*

Course Outcomes:

For a given problem student will able to analyze and implement the solution using:

- Linear regression.
- Logistic regression, decision trees, k-nearest neighbor.
- Bayesian learning and the naïve Bayes algorithm.
- Support vector machines and kernels.
- Neural networks to determine and justify the correctness.
- For a given problem student will able to analyse.
- Hypothesis space, overfitting, bias and variance.
- Tradeoffs between representational power and learnability.
- Evaluation strategies and cross-validation and feature reduction methods.

Web and Internet

Course Code	
Course Name	Web and Internet
Credits	3L: 0T: 0P
Pre-Requisites	A First Module In Programming.
Comments	Elective for Department of CSE and Open

Course Objectives:

- This course has a practical emphasis on the design and techniques for developing internet-based applications, mainly focusing on web programming.
- Topics include HTML, client-side scripting language (JavaScript), server-side programming (Servlets, JSP, and J2EE), and XML/web services.
- This course will also cover some important topics needed for internet-based application developments, such as Internet architectures and web security.

Syllabus

UNIT I	Hours =40
Internet and World Wide Web Introduction, Internet Addressing, ISP, types of Internet Connections, Introduction to WWW, WEB Browsers, WEB Servers, URLs, HTTP, WEB Applications, Tools for web site creation.	8
UNIT II	
HTML5 Introduction to HTML5, Lists, adding graphics to HTML5 page, creating tables, linking documents, forms, frames, Cascading Style sheets.	7
UNIT III	
Java Script Introduction, programming constructs: variables, operators and expressions, conditional checking, functions and dialog boxes, JavaScript DOM, creating forms, introduction to Cookies, Jquery.	8
UNIT IV	
AJAX Introduction, HTTP Request, XMLHttpRequest, AJAX Server Script. **PHP** Introduction, syntax, statements, operators, PHP and MySQL, PHP and AJAX.	10
UNIT V	
Introduction to ASP.net, J2EE, POJO, Java servlets and JSP.	7

Text Books:

1. *Ivan Bayross, Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl CGI, BPB.*
2. *Steven M. Schafer, HTML, CSS, JavaScript, Perl, Python and PHP, Wiley India Textbooks.*
3. *Stephen Walhter, Kevin Hoffman, Nate Dudek, ASP.NET Unleashed, Pearson Education.*
4. *Paul S. Wang, G. Keller, S. Katila, An Introduction to Web Design + Programming, Cengage Learning.*

Reference Books:

1. *Jeffery C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education*

Course Outcomes:

After completion of course, students would be able to:

- Write syntactically correct HTTP messages and describe the semantics of common HTTP methods and header fields
- Write a valid standards-conformant HTML document involving a variety of element types, including hyperlinks, images, lists, tables, and forms
- Use CSS to implement a variety of presentation effects in HTML and XML documents, including explicit positioning of elements
- Demonstrate techniques for improving the accessibility of an HTML document, Javascript, ASP.net.

Matlab

Course Code	
Course Name	Matlab
Credits	3L: 0T: 0P
Pre-Requisites	Basic Programming Knowledge
Comments	Open

Course Objectives:

- Understand the Matlab Desktop, Command window and the Graph Window.
- Be able to do simple and complex calculation using Matlab.
- Be able to carry out numerical computations and analyses.
- Understand the mathematical concepts upon which numerical methods rely.
- Ensure you can competently use the Matlab programming environment.
- Understand the tools that are essential in solving engineering problems.

Syllabus

UNIT I	Hours=40
Introduction to Matlab Matlab Interactive Sessions, Computing with Matlab, Variables, Arrays, Functions and Files.	6
UNIT II	
Programming Techniques Program Design and Development, Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, Loops, The Switch Structure, Debugging Mat Lab Programs.	8
UNIT III	
Plotting XY- plotting functions, Subplots and Overlay plots, Special Plot types, Interactive plotting, Function Discovery, Regression, 3-D plots.	8
UNIT IV	
Probability and Statistics Interpolation, Statistics, Histogram and probability, The Normal Distribution, Random number Generation.	10
UNIT V	
Symbolic Processing With Matlab Symbolic Expressions and Algebra, Algebraic and Transcendental Equations, Calculus, Symbolic Linear Algebra.	8

Text Books:

1. Introduction to Matlab 7 for Engineers, by William J. Palm III, McGraw Hill 2005.

Reference Books:

1. *S. J. Chapman. MATLAB Programming for Engineers. Thomson, 2004*
2. *J. Cooper. A MATLAB Companion for Multivariable Calculus. Academic Press, 2001.*

Course Outcomes:

After completion of course, students would be able to:

- Able to use Matlab for interactive computations.
- Familiar with memory and file management in Matlab.
- Able to generate plots and export this for use in reports and presentations.
- Able to use basic flow controls.

Cloud Computing

Course Code	
Course Name	Cloud Computing
Credits	3L: 0T: 0P
Pre-Requisites	Operating Systems, Virtualization Technologies, Networking.

Course Objectives:

- The student will also learn how to apply trust-based security model to real-world security problems**.**
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Syllabus

UNIT I	Hours=40
Introduction to Cloud Computing, The Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication-as-a-Service, Infrastructure-as-a-Service, Monitoring-as-a-Service, Platform-as-a-Service, Software-as-a-Service, Building Cloud Network.	8
UNIT II	
Federation in the Cloud, Presence in the Cloud, Privacy and its Relation to Cloud-Based Information Systems, Security in the Cloud, Common Standards in the Cloud, End User Access to the Cloud Computing.	7
UNIT III	
Introduction, Advancing towards a Utility Model, Evolving IT infrastructure, Evolving Software Applications, Continuum of Utilities, Standards and Working Groups, Standards Bodies and Working Groups, Service Oriented Architecture, Business Process Execution Language, Interoperability Standards for Data Center Management, Utility Computing Technology, Virtualization, Hyper Threading, Blade Servers, Automated Provisioning, Policy Based Automation, Application Management, Evaluating Utility Management Technology, Virtual Test and development Environment, Data Center Challenges and Solutions, Automating the Data Center.	10
UNIT IV	
Software Utility Application Architecture, Characteristics of an SaaS, Software Utility Applications, Cost Versus Value, Software Application Services Framework, Common Enablers, Conceptual view to Reality, Business Profits, Implementing Database Systems for Multitenant Architecture.	7
UNIT V	

Other Design Considerations, Design of a Web Services Metering Interface, Application Monitoring Implementation, A Design for an Update and Notification Policy, Transforming to Software as a Service, Application Transformation Program, Business Model Scenarios, Virtual Services for Organizations, The Future.	8

Text Books:

1. *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009.*
2. *Bunker and Darren Thomson, "Delivering Utility Computing", 2006, John Wiley & Sons Ltd.*

Reference Books:

1. *John W. Rittinghouse and james F. Ransome, "Cloud Computing Implementation, Management and Security", 2010, CRC Press, Taylor & Francis Group, Boca Raton London New York. [Unit -11 and Unit II].*
2. *Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007. [Unit -11I to Unit V]* 3. *George Reese, "Cloud Application Architectures", O'reilly Publications, 2009.*

Course Outcomes:

After completion of course, students would be able to:

- Identify security aspects of each cloud model.
- Develop a risk-management strategy for moving to the Cloud.
- Implement a public cloud instance using a public cloud service provider.
- Apply trust-based security model to different layer.

Quantum Computing

Course Code	
Course Name	Quantum Computing
Credits	3L:0T: 0P
Pre-Requisites	Linear Algebra Basics

Course Objectives:

- The course will provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing.

Syllabus

UNIT I	Hours =40
Qubit & Quantum States The Qubit, Vector Spaces. Linear Combination of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.	8
UNIT II	
Matrices & Operators Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators.	8
UNIT III	
Commutator Algebra Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics. Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices.	8
UNIT IV	
Density Operator Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector. Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures	8

UNIT V	
Recent trends in Quantum Computing Research Quantum Computing Applications of soft computing. Quantum Cryptography, Quantum Automata Theory etc.	8

Text Books:

1. *M. A. Nielsen and I. L. Chuang. Quantum Computation and Quantum Information. Cambridge University Press, 2000.*
2. *Quantum Computing Explained By DAVID Mc MAHON*

Reference Books:

1. *Quantum Computing without Magic by Zdzislaw Meglicki*
2. *Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann*
3. *. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.*

Course Outcomes:

- Knowledge of Vector spaces, Matrices, Quantum state, Density operator and Quantum Measurement theory.
- Application of quantum computing to soft computing and Cryptography.

Advance Computer Architecture

Course Code	
Course Name	Advance Computer Architecture
Credits	3L:0T: 0P
Pre-Requisites	Computer Organization and Architecture

Course Objectives:

The student should be made to:

- Understand the micro-architectural design of processors.
- Learn about the various techniques used to obtain performance improvement and power savings in current processors.

Syllabus

UNIT I	Hours =40
Pipelining Basic And Intermediate Concept Review of Fundamentals of CPU, Memory and IO, Trends in technology, power, energy and cost, Dependability, Performance Evaluation, Review of Pipelining, Examples of some pipeline in modern processors, pipeline hazards, data hazards, and control hazards. Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance.	12
UNIT II	
Instruction Level Parallelism ILP concepts, Pipelining overview, Compiler Techniques for Exposing ILP, Dynamic Branch Prediction, Dynamic Scheduling, Multiple instruction Issue, Hardware Based Speculation, Static scheduling, Multi-threading, Limitations of ILP, Case Studies of Intel core i7 and ARM Cortex A8.	8
UNIT III	
Data-Level Parallelism Vector architecture, SIMD extensions, Graphics Processing Units, Loop level parallelism.	6
UNIT IV	
Thread Level Parallelism Symmetric and Distributed Shared Memory Architectures, Performance Issues, Synchronization, Models of Memory Consistency. **Case studies** Intel i7 Processor, SMT & CMP Processors.	6
UNIT V	

Cache Performance Reducing Cache Miss Penalty and Miss Rate, Reducing Hit Time, Main Memory and Performance, Memory Technology.	8

Text Books:

1. *John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.*

Reference Books:

1. *Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition,2000.*
2. *Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.*

Course Outcomes:

At the end of the course, the student should be able to:

- Evaluate performance of different architectures with respect to various parameters.
- Study about different hazards and its resolution.
- Analyze performance of different ILP techniques.
- Identify cache and memory related issues in multi-processors.

Computational Geometry

Course Code	
Course Name	Computational Geometry
Credits	3L: 0T: 0P
Pre-Requisites	UG level course in Operating Systems

Course Objectives:

- The aim and the purpose of the course to be taught.

Syllabus

UNIT I	Hours =40
Polygon Triangulation Polygons-Jordan Curve Theorem-The Art Gallery Theorem-Fisk's Proof of Sufficiency, Triangulation: theory-Existence of a Diagonal-Properties of Triangulations-Triangulation Dual-3-Coloring Proof. Area of polygon and its theorem. **Polygon Partitioning** Monotone partitioning, Trapezoidalization, Monotone Mountains. Convex partitioning.	12
UNIT II	
Convex Hulls in Two Dimensions Definitions of convexity and convex hulls, Extreme points and Naive algorithms for extreme points-Extreme Edges Quick Hull, Graham's Algorithm, Lower Bound, Incremental Algorithm, Divide and Conquer Polyhedra, Regular Polytopes-Euler's Formula. Hull Algorithms-incremental algorithm and complexity, Polyhedral Boundary Representations.	7
UNIT III	
Voronoi Diagrams Applications: Preview, Definitions and Basic Properties, Half planes**,** Size of Diagram, Delaunay Triangulations, Properties of Delaunay Triangulations**,** Properties of Voronoi Diagrams, Algorithms, Applications in Detail-Nearest Neighbors, Largest Empty Circle Minimum Spanning Tree-Traveling Salesperson Problem.	6
UNIT IV	
Arrangements Voronoi Diagrams & Medial Axis, Connection to Convex Hulls, Connection to Arrangements, Combinatorics of Arrangements, Combinatorics of Arrangements, Incremental Algorithm.	7
UNIT V	

Duality, Higher-Order Voronoi Diagrams, Applications, Segment-Segment Intersection, Segment-Triangle Intersection.	8

Text Books:

1. *Computational Geometry in C 2nd edition by Joseph O'Rourke(Cambridge university press).*

Reference Books:

1. *Computational Geometry Algorithms and Applications Third Edition, Springer by Mark de Berg · Otfried Cheong Marc van Kreveld · Mark Overmars.*

Course Outcomes:

- The skill that a student will acquire.
- The knowledge (Theoretical/applied/both) the student will gain.

Distributed Systems

Course Code	
Course Name	Distributed Systems
Credits	3L:0T: 0P
Pre-Requisites	UG level course in Operating Systems

Course Objectives:

- Introduce students to the general properties, characteristics, and issues of distributed systems. Also, students should be able to understand how modern systems works.
- Students should be able to learn on distributed algorithms and how these algorithms are applied when designing and implementing real systems.
- Students learned about some topics on clock synchronization, coordination algorithms, transactions, and replications.
- Students should be able to understand design and implementation issues on distributed shared memory.
- Students should be able to learn experimental experience in designing and implementing real systems through computer-based assignments.

Syllabus

UNIT I	Hours = 40
Introduction *Background:* Brief definitions of distributed systems, *M*otivation, Examples of distributed Systems, Relation to parallel systems, Message passing systems Vs. Shared memory systems, Execution process for synchronous Vs. asynchronous, Case Study, World Wide Web.	8
UNIT II	
Communications in Distributed Computing Models *System Models:* Architectural models, Interaction model, Failure model, security model. *Inter process communication:* API for the internet protocols, External data representation and Marshaling, Client-Server communication, and Group communication, Message queues, Case study: Interprocess communication in Unix. *Distributed objects and Remote invocation:* Distributed objects, Communication between distributed objects, Request Reply protocols, Remote procedure call, Remote method invocation, Case study: Java RMI.	8
UNIT III	
Peer-to-Peer services and File systems *Peer-to-Peer systems:* Introduction, Napster and its legacy, Peer-to-peer middleware, Routing overlays, Case study: Pastry, Tapestry. *Distributed File systems: Introduction, File service architecture, Andrew file system. Name services:* Introduction, Name services and the Domain Name System, directory services, Case study: The Global Name Service.	8
UNIT IV	

Synchronization and Replication *Time and Global States:* Introduction, Clocks, events, and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states. *Coordination and Agreement:* Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication. *Transaction and Concurrency control:* Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering. *Distributed Transactions:* Introduction, Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery, Replication.	8
UNIT V	
Process and Resource Management *Process Management:* Process migration, Features, Mechanism, and Threads: Models, Issues, Implementation. *Resource Management: Introduction, Scheduling Algorithms, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach.*	8

Text Books:

1. *Distributed Systems Concept and Design, 5th Edition, George Coulouris, Jean Dollimore, Tim Kindberg, published by Pearson Education, Copyright © 2012.*

Reference Books:

1. *Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, published by Prentice Hall of India, 2007.*
2. *Distributed computing: principles, algorithms, and systems, Kshemkalyani, Ajay D., and MukeshSinghal, published by Cambridge University Press, 2011.*
3. *Distributed Systems: Principles and Paradigms, 3rd Edition, Tanenbaum A.S., Van Steen M., published by Pearson Education, 2017.*

Course Outcomes:

- Students will be able to apply the concept of distributed systems, techniques, and trends.
- Students will be capable of applying the concept of network virtualization, remote method invocation, and distributed objects.
- Students will be able to understand the peer-to-peer services, distributed file systems, domain name system.
- Students will gain the knowledge of logical clocks, distributed mutual exclusion, distributed deadlocks, concurrency control in distributed transactions, replications.
- Students will be able to capture the knowledge of process and resource management.

Formal Methods for System Verifications

Course Code	
Course Name	Formal Methods for System Verifications
Credits	3L:0T: 0P
Pre-Requisites	General knowledge in discrete mathematics, and C/C++ programming skill.

Course Objectives:

- Introduce students to the mathematically proving formally specified properties of computer systems.
- Students will be able to learn on theoretical aspects of specification formalisms and algorithm verifications.
- Students should be able to understand mathematically-based techniques for the specification, development, and verification of software and hardware systems.
- Students will acquire skill in using language for model description and specification of model behaviors in modeling and verification of event-driven systems.

Syllabus

UNIT I	Hours = 40
Introduction to the formal methods and modeling systems *Introduction:* The need for formal methods, Motivation for formal verification, Hardware and software verification, simple verification examples. Modeling systems: Modeling concurrent systems, concurrent systems, Kripke structures, State/configuration of a program or hardware module, Operational semantics and state transition diagrams (finite and infinite-state), Specifying a state transition relation: explicit enumeration and implicit specifications, Constructing a state transition relation from a description of a program or hardware system.	10
UNIT II	
Logical formalism *Propositional logic:* Declarative sentences, Natural deduction, Propositional logic as a formal language, Semantics of propositional logic, Normal forms, SAT solver. *Predicate logic:* The need of predicate logic, predicate logic as a formal language, Proof theory of predicate logic, Semantics of predicate logic, Undecidability of predicate logic. *Temporal logic:* motivation for their use in specifying properties of reactive systems, The computational Tree logic CTL*, Linear-time Temporal Logic (LTL): syntax, semantics and usage in specifying properties of computer systems, Computation-tree Temporal Logic (CTL): syntax, semantics, difference with respect to LTL and usage in specifying properties, Examples of some commonly specified properties in CTL and LTL.	8
UNIT III	
Model checking for verification: *CTL model checking:* CTL model checking using finite Kripke structures: explicit-state algorithms, CTL model checking with fairness, The fixed-point characterization of CTL. *LTL model checking:* LTL model checking using finite Kripke structures: an automate theoretic technique, Discussion on automate-theoretic LTL model checking, The LTL model-checking algorithm, Reduction of LTL model checking to fair CTL model checking.	8

CTL model checking:* The properties of CTL*, LTL and CTL as subset ofCTL*, The expressive power of CTL*. *Study of Verification Tools:* SMV, NuSMV.	
UNIT IV	
Binary Decision Diagrams, and Symbolic model checking: *Binary Decision Diagrams:* Introduction to Binary Decision Diagram (BDD), and modelling hardware with BDDs, Algorithms for BDD operations, Concept of OBDDs and ROBDDs and operation on ROBDDs. *Symbolic model checking:* Fix point Representations, Symbolic model checking for CTL, Fairness of Symbolic model checking, Symbolic LTL model checking.	7
UNIT V	
Model checking and Automata Theory *Introduction: Automata on finite and infinite words, Model checking using automata, Checking emptiness, Translating LTL into automata, On-the-Fly model checking.*	7

Text Books:

1. *Logic in Computer Science: Modelling and Reasoning about Systems, 2nd Edition , M. Huth and M. Ryan, published by Cambridge University Press, Copyright © 2011 (Reprinted 2007, 2010, 2011).*
2. *Model Checking, E. M. Clarke, O. Grumberg and D. Peled, MIT Press, 1999.*

Reference books:

1. *Higher Order Logic and Hardware Verification, T. F. Melham, published by Cambridge University Press, Print publication year: 1993, online publication date: January, 2010.*
2. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014. T. F. Melham, Higher Order Logic and Hardware Verification, Cambridge University Press, 1993.*
3. *The Temporal Logic of Reactive and Concurrent System Specification, Z. Manna and A. Pnueli, Springer Verlag, 1992.*

Course Outcomes:

- Students will be able to understand formal methods which are applying for Hardware and Software verifications.
- Students will be able to write the formal proofs based on the propositional logic, predicate logic, and temporal logic to verify the hardware circuits and program verifications.
- Students will be capable of writing the formal properties and specifications in computation tree logic (CTL), linear-time temporal logic (LTL).
- Students will be able to verify the systems using CTL and LTL model checking.
- Students will be able to construct and use Binary Decision Diagrams (BDDs) in symbolic model checking.
- Students will be able to understand the model checking using automata and also able to translating LTL into automata.
- Students will be able to learn the verification tools: SMV, PVS.

Cryptography& Network Security

Course Name	Cryptography & Network Security
Credits	3L:0T: 0 P
Pre-Requisites	Computer Networks, Discrete Mathematics
Comments	Elective for Deptt and Open

Course Objectives:

Students will try to learn:

- The concepts of classical encryption techniques and concepts of finite fields and number theory.
- And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
- And explore the design issues and working principles of various authentication Protocols.
- And explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
- The ability to use existing cryptographic utilities to build programs for secure communication.
- The concepts of cryptographic utilities and authentication mechanisms to design secure applications.

Syllabus

UNIT I	Hours = 40
Introduction and Mathematical Foundations Overview on Modern Cryptography, Ciphers and Secret Messages, Security Attacks and Services. Number Theory, Probability and Information Theory, Mathematical Tools for Cryptography: Substitutions and Permutations, Modular Arithmetic, Euclid's Algorithm, Finite Fields, Polynomial Arithmetic, Discrete Logarithms. Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems.	8
UNIT II	
Conventional and Modern Symmetric Encryption Algorithms Theory of Block Cipher Design, Feistel Cipher Network Structures, DES and Triple DES, Modes of Operation (ECB, CBC, OFB, CFB), Strength (or Not) of DES. Modern Symmetric Encryption Algorithms: IDEA, CAST, Blowfish, Twofish, RC2, RC5, Rijndael (AES), Key Distribution. Stream Ciphers and Pseudo Random Numbers: Pseudo random sequences, Linear Congruential Generators, Cryptographic Generators, Design of Stream Cipher, One Time Pad, and Cryptanalysis of Symmetric Key Ciphers.	8
UNIT III	
Public Key Cryptography, Hashes and Message Digests Prime Numbers and Testing for Primality, Factoring Large Numbers, RSA, DiffieHellman, ElGamal, Key Exchange Algorithms, Public-Key Cryptography Standards. Hashes and Message Digests: Message Authentication, MD5, SHA, RIPEMD, HMAC, Cryptanalysis of Asymmetric Key Ciphers, Modern Trends in Asymmetric Key Cryptography.	8
UNIT IV	
Digital Signatures, Certificates, User Authentication Digital Signature Standard (DSS and DSA), Security Handshake Pitfalls, Elliptic Curve Cryptosystems. Authentication of Systems: Kerberos V4 and V5, X.509 Authentication Service. Digital Watermarking and Steganography.	8

UNIT V	
Network Security Secret Sharing Schemes, Network Protocols, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure/Multipurpose Internet Mail Extensions (S/MIME), Intruders and Viruses, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots. Firewalls, IPSEC, Private networks access security (L2F, PPTP, and L2TP), Web Security, privilege management infrastructure (PMI) and Access Control, security in e-commerce, smart cards.	8

Text Books:

1. *William Stallings, Cryptography and Network Security, Principles and Practice, 7th Edition, Pearson Education, 2017.*
2. *Schneier, Bruce, John Wiley & Sons, "Applied cryptography: protocols, algorithms, and source code in C" (20th Anniversary Ed.), 2015.*

Reference Books:

1. *Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill.*
2. *Mollin, Richard A. "An introduction to cryptography."(2nd Ed.) CRC Press, 2006.*

Course Outcomes:

- Identify information security goals, classical encryption techniques and acquirefundamental knowledge on the concepts of finite fields and number theory.
- Understand, compare and apply different encryption and decryption techniques to solveproblems related to confidentiality and authentication
- Apply the knowledge of cryptographic checksums and evaluate the performance ofdifferent message digest algorithms for verifying the integrity of varying message sizes**.**
- Apply different digital signature algorithms to achieve authentication and create secureapplications.
- Apply network security basics, analyze different attacks on networks and evaluate theperformance of firewalls and security protocols like SSL, IPSec, and PGP.
- Apply the knowledge of cryptographic utilities and authentication mechanisms todesign secure application

Theory of Computation

Course Code	
Course Name	Theory of Computation
Credits	3L:0T: 0 P
Pre-Requisites	Calculus, Data Structures and Algorithms

Course Objectives:

- To understand problem classification and problem solving by machines.
- To study computing machines by describing, classifying and comparing different types of computational models.
- Understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.
- Be aware of Decidability and Un-decidability of various problems.
- Learn types of grammars.

Syllabus

UNIT I	Hours = 40
Introduction to Finite Automata Introduction: Alphabet, languages and grammars. Production rules and derivation of languages. Chomsky hierarchy of languages. Regular expressions, regular languages, applications, Regular grammars, Finite Automata- DFA and NFA, conversion of NFA to DFA, NFA with null move, conversion of NFA with Null move to DFA without Null move, Equivalence of DFA and NFA, Finite Automat with output- Mealy Machine and Moore Machine, Conversion to one machine to another.	8
UNIT II	
Regular expressions and languages Basic of Regular expressions, Basic Operation on RE- Kleene's theorem, Identities of RE, The Arden's theorem, Construction of Finite Automata from RE, NFA to DFA conversion using ε-Closure method, Construction of Regular Grammar from RE, Construction of FA from Regular Grammar, Closure and decision properties of regular sets. Pumping lemma of regular sets. Minimization of finite automata.	8
UNIT III	
Context-Free Grammars and languages Definitions of Context free Grammar-Backus Naur Form (BNF), Derivation and Parse Tree, Applications of context free grammars, Ambiguity in CFG. Simplification of CFG-Removal of Useless Symbols, Unit Production and Null Production. Left and right linear grammars, Equivalence of Left and right linear grammars. Normal FormChomsky and Greibach normal forms, Closure properties of context free languages. Pumping lemma, Ogden's lemma.	8
UNIT IV	

Push Down Automata and Turning Machines: Introduction to Push Down Automata, Acceptance by a PDA, Deterministic Push Down Automata and Non-deterministic Automata. Two-stack PDA, Construction of PDA from CFG and Construction of CFG equivalent to PDA. Turing machines-Transitional representation, Conversion of RE to TM, Twostack and TM, Turing machines and Variation of Turing machine model, Turing computability, Type 0 languages. Church Turing hypothesis. TM languages, Unrestricted grammar.	8
UNIT V	
Unsolvable Problems and computational complexity Recursive and recursively enumerable sets and its properties, Universal languages, Reducibility and Undecidable problems, Rice Theorem, Post Correspondence problem and modified PCP. Types of computational complexity- Time and space complexity, The Classes P, NP. P=NP? – The million Dollar question, NPcomplete, NP-Hard.	8

Text Books:

1. *John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education Publ.,2008.*
2. *John C Martin, "Introduction to Languages and the Theory of Computation", Fouth Edition, Tata McGraw Hill Publishing Company, 2011.*

Reference books:

1. *PoonamSinha,Sunita, A Saxena,"Theory of Computation", Laxmi Publication,2014.*
2. *H. R. Lewis and C. H. Papadimitriou,"Elements of the Theory of Computation",(2nd Ed.), Prentice Hall, Englewood Cliffs,2005.*

Course Outcomes:

At the end of the course, the student should be able to:

- Design Finite State Machine, Pushdown Automata, and Turing Machine.
- To write mathematical expressions for the formal languages.
- Explain the Decidability or Undecidability of various problems.
- Students will apply this basic knowledge of Theory of Computation in the computer field to solve computational problems and in the field of compiler also.

Operations Research

Course Code	
Course Name	Operations Research
Credits	3L: 0T: 0P
Pre-Requisites	Engineering Domain Basics Knowledge

Course Objectives:

- The objective of the course is to orient the engineering students with the concepts and practical implications of Operations Research and Optimization Techniques.

Syllabus

UNIT I	Hours =40
Decision Theory, Introduction to Operation Research, Introduction to Linear Programming, Transportation problems, Assignment Problem.	8
UNIT II	
Construction of a Network Diagram, Game Theory, Markov Chains, Waiting Line, Replacement.	8
UNIT III	
Integer Programming, Goal Programming, Dynamic Programming, Applied Queuing Models, Simulation Modeling.	8
UNIT IV	
Forecasting Models, Specific Inventory Models under uncertainty, Linear Programming-Sensitivity Analysis, Large scale linear programming, discrete optimization models.	8
UNIT V	
Network models and Optimization, Non-Linear Programming, Analytical Hierarchy Process, Yield Management and Revenue Optimization.	8

Text Books:

1. *Taha H. A: Operations Research an Introduction. Pearson Education, New Delhi; 2014.*
2. *Sharma J.K:Operations Research .PHI, New Delhi; 2014.*

Reference books:

1. *Bertsimas, D., & Freund, R. M: Data models and decisions: The fundamentals of management science. Dynamic Ideas USA; 2004.*
2. *Srinivasan G: Quantitative Models in Operations and Supply Chain Management. PHI, New Delhi; 2013.*
3. *Rajagopal: Operations Research. Prentice Hall of India Pvt. Ltd., New Delhi; 2013.*
4. *Pai: Operations Research. OXFORD UNIVERSITY PRESS, New Delhi; 2014.*
5. *Bertsimas, D., & Tsitsiklis, J. N: Linear Optimization. Athena Scientific; 2010.*
6. *Powel, S. G., & Baker, K. R: Management Science: The art of modeling with spreadsheets. Wiley US;2009.*

Course Outcomes:

- The students will acquire the skills of Optimization techniques.
- The students will gain the knowledge of applying the concepts of operations research in engineering problems.

Advanced Algorithms

Course Name	Advanced Algorithms
Credits	3L:0T: 0P
Pre-Requisites	UG level course in Algorithm Design and Analysis

Course Objectives:

- Introduce students to the advanced methods of designing and analysis of algorithms in computing.
- Students should be able to select appropriate algorithm techniques for a specific problem.
- Students learn about the different modeling of problem-solving like data structures, graph, decomposing the problem, which is used to solve the advanced algorithmic issues.
- Students should be able to classify the different classes of problems based on their computational difficulties.

Syllabus

UNIT I	Hours= 40
Overview of Design Paradigms *Background:* Motivation, the role of algorithms in computing, Analyzing of algorithms, algorithms like heap sort, search algorithms, etc. *Designing techniques: over*view of Divide and Conquer, Greedy method, Dynamic Programming, Branch and Bound, Backtracking, Graph traversal algorithms.	7
UNIT II	
Matroids, String and Graph Matching *Matroids:* Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. *String Matching:* Introduction to string-matching problem, Naïve algorithm, Rabin Karp, String matching with finite automata, Knuth-Morris-Pratt algorithms and complexity analysis. *Graph Matching:* Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	8
UNIT III	
Max-Flow Problem and Matrix Computation *Flow-Networks:* Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. *Matrix Computations:* Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	8
UNIT IV	

Shortest Path Problems, Modulo Representation of integers/polynomials, Discrete Fourier Transform (DFT): *Shortest Path Problems in Graphs:* Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. *Modulo Representation of integers/polynomials:* Chinese Remainder Theorem, Conversion between base-representation and modulorepresentation. *Discrete Fourier Transform:* DFT and FFT algorithms.	8
UNIT V	
Theory of NP-Hard and NP-Completeness Problems, and Approximation Algorithms: *Theory of NP-Hard and NP-Completeness Problems:* P, NP, and NP- Complete complexity classes, Polynomial-time verification, NP- completeness and reducibility, NP-completeness proofs. *Approximation Algorithms:* Notion of NP-completeness: P class, NP-hard class, NP- complete class, Circuit Satisfiability problem, Clique Decision Problem, etc. *Approximation Algorithms: Approximation algorithms for vertex- cover problem, set cover, TSP, knapsack, subset-sum problem etc.*	9

Text Books:

1. *Introduction to Algorithms, 3rd Edition, T H. Cormen, C E. Leiserson, R L. Rivest, and Clifford Stein, published by PHI Learning Private Limited (Original edition published by the MIT Press, Cambridge, MA, USA), Copyright © 2011.*
2. *The Design and Analysis of Computer Algorithms by Aho, Hopcroft, Ullma.*

Reference Books:

1. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014.*
2. *Algorithms, 1st Edition, S. Dasgupta, C. Papadimitriou, and U. Vazirani, published by McGraw-Hill Education, Copyright © 2008.*

Course Outcomes:

- Students will be able to apply the concept and design strategies to algorithm design.
- Also, capable of writing the correctness of algorithms systematically.
- Students will be able to choose a suitable data structure for solving the problems, and also design the appropriate algorithms.
- Students will be capable of classifying the different class of problems based on their completeness theorem.
- Students will be able to understand more details in the field of advanced data structures for synthesizing more complicated problems in the field of engineering.