

Curriculum Under Autonomy

*With effective from Academic
Year 2023-2024
(R23)*

R23**Curriculum & Syllabus for B. Tech under Autonomy
Incorporation of NEP2020***First Year Curriculum Structure (Effective from 2023-24 admission batches)
Department of Computer Science and Engineering***Group A**

1stYear 1stSemester									
Sl.No	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	SCI	Multidisciplinary	CH(CSE)101	Engineering Chemistry	2	0	0	2	2
2	SCI	Multidisciplinary	M101	Engineering Mathematics –I	3	0	0	3	3
3	ENGG	Major	CS101	Programming for Problem Solving	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU(CSE)101	Professional Communication	2	0	0	2	2
5	HUM	Value added course	HU(CSE)102	Values and Ethics	2	0	0	2	2
6	HUM	Value added course	HU(CSE)103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
7	SCI	Skill enhancement	CH(CSE)191	Engineering Chemistry Lab	0	0	2	2	1
8	ENGG	Skill enhancement course	ME(CSE)191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
9	ENGG	Major	CS191	Programming for Problem Solving Lab	0	0	3	3	1.5
10	HUM	Ability Enhancement Course	HU(CSE)191	Professional Communication Lab	0	0	2	2	1
Total of Theory, Practical, and Mandatory Activities/Courses								23	18

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project;*

1 st Year 2 nd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS201	Data Structures	3	0	0	3	3
2	SCI	Multidisciplinary	PH(CSE)201	Engineering Physics	3	0	0	3	3
3	SCI	Multidisciplinary	M(CSE)201	Engineering Mathematics –II	3	0	0	3	3
4	ENGG	Minor	EE(EC)201	Basic Electrical and Electronics Engineering	3	0	0	3	3
5	HUM	Value added course	HU(CSE)201	Environmental Science	2	0	0	2	2
6	HUM	Value added course	HU(CSE)202	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
7	ENGG	Major	CS291	Data Structures Lab	0	0	3	3	1.5
8	SCI	Skill enhancement course	PH(CSE)291	Engineering Physics Lab	0	0	3	3	1.5
9	ENGG	Minor	EE(EC)291	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
10	ENGG	Skill enhancement course	ME(CSE)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
11	HUM	Ability Enhancement Course	HU(CSE)291	Design thinking Lab	0	0	2	2	1
Total of Theory, Practical, and Mandatory Activities/Courses								29	22

2 nd Year 3 rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	CS302	Design and Analysis of Algorithms	3	1	0	4	4
3	SCI	Minor	M(CSE)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CSE)301	Digital Logic and Electronics	3	0	0	3	3
B.PRACTICAL									
5	ENGG	Major	CS391	Computer Organization and Architecture Lab	0	0	3	3	1.5
6	ENGG	Major	CS392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
7	ENGG	Skill Enhancement Course	CS393	IT Workshop Lab (SciLab/MATLAB/C++)	0	1	3	4	2.5
8	ENGG	Minor	EC(CSE)391	Digital Electronics Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 401	Operating Systems	3	0	0	3	3
2	ENGG	Major	CS 402	Formal Language and Automata Theory	3	0	0	3	3
3	ENGG	Major	CS 403	Computer Networks	3	0	0	3	3
4	SCI	Minor	M(CSE)401	Probability and Statistics	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(CSE)401	Principles of Management	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 491	Operating Systems Lab	0	0	3	3	1.5
7	ENGG	Major	CS 493	Computer Networks Lab	0	0	3	3	1.5
8	ENGG	Major	CS 494	Programming using Python	0	0	3	3	1.5
9	ENGG	Minor	CS 492	Numerical Methods Lab	0	0	3	3	1.5
10	HUM	Ability Enhancement Course	HU(CSE)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory, Practical and Mandatory Activities/Courses								28	21

3 rd Year5 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 501	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CS 502	Database Management Systems	3	0	0	3	3
3	ENGG	Major	CS 503	Object Oriented Programming using Java	3	0	0	3	3
4	ENGG	Major	CS 504 A CS 504 B CS 504 C	Compiler Design Cryptography and Network Security Computer Graphics	3	0	0	3	3
5	HUM	Minor	HU(CSE)501	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 591	Artificial Intelligence Lab	0	0	3	3	1.5
7	ENGG	Major	CS 592	Database Management Systems Lab	0	0	3	3	1.5
8	ENGG	Major	CS 593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	PRJ	Internship	CS581	Internship	0	0	2	2	2
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 601	Web and Internet Technology	3	0	0	3	3
2	ENGG	Major	CS 602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CS 603	Software Engineering	3	0	0	3	3
4	ENGG	Major	CS 604 A CS 604 B CS 604 C	Mobile Computing Natural Language Processing Cloud Computing	3	0	0	3	3
5	ENGG	Minor	CS 605	Cyber Law and Ethics	3	0	0	3	3
B.PRACTICAL									
6	ENGG	Major	CS 691	Web and Internet Technology Lab	0	0	3	3	1.5
7	ENGG	Major	CS 692	Machine Learning Lab	0	0	3	3	1.5
8	ENGG	Major	CS 693	Software Engineering Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

4 th Year 7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 701	Neural Networks and Deep Learning	3	0	0	3	3
2	ENGG	Major	CS 702 A CS 702 B CS 702 C	Advanced Algorithms Advanced Computer Architecture Advanced Operating Systems	3	0	0	3	3
3	ENGG	Minor	CS 703 A CS 703 B CS 703 C	Information Theory and Coding Ad-Hoc and Sensor Networks Data Mining and Data Warehouse	3	0	0	3	3
4	HUM	Minor	HU(CSE)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
5	ENGG	Major	CS 791	Neural Networks and Deep Learning Lab	0	0	3	3	1.5
6	ENGG	Major	CS 792 A CS 792 B CS 792 C	Advanced Algorithms Lab Advanced Computer Architecture Lab Advanced Operating Systems Lab	0	0	3	3	1.5
7	PRJ	Project	CS 793	Major Project-I	0	0	12	12	6
Total of Theory, Practical and Mandatory Activities/Courses								29	20

4th Year 8th Semester

Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 801 A CS 801 B CS 801 C	Real Time Systems Data Analytics Soft Computing	3	1	0	4	4
2	ENGG	Major	CS 802 A CS 802 B CS 802 C	VLSI Design & Application Bio-informatics Robotics	3	1	0	4	4
3	ENGG	Minor	CS 803 A CS 803 B CS 803 C	Introduction to IoT Image Processing Optimization Techniques	3	0	0	3	3
B.PRACTICAL									
4	ENGG	Minor	CS 893 A CS 893 B CS 893 C	Internet of Things Lab Image Processing Lab Optimization Techniques Lab	0	0	3	3	1.5
5	PRJ	Project	CS 881	Major Project-II	0	0	12	12	6
6	PRJ	Internship	CS882	Grand Viva	0	0	0	0	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

1 st Year 1 st Semester									
Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS101	Programming for Problem Solving	3	0	0	3	3
2	SCI	Multidisciplinary	CH(CS)101	Engineering Chemistry	2	0	0	2	2
3	SCI	Multidisciplinary	M(CS)101	Engineering Mathematics –I	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU101	Professional Communication	2	0	0	2	2
5	HUM	Value added course	HU102	Values and Ethics	2	0	0	2	2
6	HUM	Value added course	HU103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS191	Programming for Problem Solving Lab	0	0	3	3	1.5
2	HUM	Ability Enhancement Course	HU191	Professional Communication Lab	0	0	2	2	1
3	SCI	Skill enhancement course	CH(CS)191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill enhancement course	ME(CS)191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
Total of Theory & Practical								23	18

*HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project;

Credit Distribution

R23 B.TECH. CSE

Category	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	Total Credit to obtain UG Degree (Category Wise)	Credit Allocation as per NEP to obtain UG Degree	7th Semester	8th Semester	Total Credit (Category Wise)	Credit Allocation as per NEP
Major (Core)	4.5	4.5	10	13.5	16.5	17.5	66.5	60	9	8	83.5	80
Minor Stream	-	4.5	7.5	4.5	2	3	21.5	24	5	4.5	31	32
Multidisciplinary	5	6	-	-	-	-	11	9	-	-	11	9
Ability Enhancement Courses (AEC)	3	1	-	3	-	-	7	8	-	-	7	8
Skill Enhancement Courses (SEC)	2.5	3	2.5	-	-	-	8	9	-	-	8	9
Value Added Courses common for all UG	3	3	-	-	-	-	6	6 to 8	-	-	6	6 to 8
Internship	-	-	-	-	2	-	2	2 to 4	-	1.5	3.5	2 to 4
Research Project	-	-	-	-	-	-	-	-	6	6	12	12
Total Credit (Semester Wise)	18	22	20	21	20.5	20.5	122	120	20	20	162	160

Distribution of Subjects under Different Categories Major Courses

R23 B.TECH. CSE

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Programming for Problem Solving	CS101	1 st	3:0:0	3
2.	Programming for Problem Solving Lab	CS191	1 st	0:0:3	1.5
3.	Data Structures	CS201	2 nd	3:0:0	3
4.	Data Structures Lab	CS291	2 nd	0:0:3	1.5
5.	Computer Organization and Architecture	CS301	3 rd	3:0:0	3
6.	Design and Analysis of Algorithms	CS302	3 rd	3:1:0	4
7.	Computer Organization and Architecture Lab	CS391	3 rd	0:0:3	1.5
8.	Design and Analysis of Algorithms Lab	CS392	3 rd	0:0:3	1.5
9.	Operating Systems	CS401	4 th	3:0:0	3
10.	Formal Language and Automata Theory	CS402	4 th	3:0:0	3
11.	Computer Networks	CS403	4 th	3:0:0	3
12.	Operating Systems Lab	CS491	4 th	0:0:3	3
13.	Computer Networks Lab	CS493	4 th	0:0:3	3
14.	Programming using Python	CS494	4 th	3:0:0	3
15.	Artificial Intelligence	CS501	5 th	3:0:0	3
16.	Database Management Systems	CS502	5 th	3:0:0	3
17.	Compiler Design	CS504A	5 th	3:0:0	3
	Cryptography and Network Security	CS504B			
	Computer Graphics	CS504C			
18.	Object Oriented Programming using Java	CS503	5 th	3:0:0	3
19.	Artificial Intelligence Lab	CS591	5 th	0:0:3	1.5
20.	Database Management Systems Lab	CS592	5 th	0:0:3	1.5
21.	Object Oriented Programming using Java Lab	CS593	5 th	0:0:3	1.5
22.	Web and Internet Technology	CS601	6 th	3:0:0	3
23.	Machine Learning	CS602	6 th	3:1:0	4
24.	Mobile Computing	CS604A	6 th	3:0:0	3
	Natural Language Processing	CS604B			
	Cloud Computing	CS604C			
25.	Software Engineering	CS603	6 th	3:0:0	3
26.	Web and Internet Technology Lab	CS691	6 th	0:0:3	1.5
27.	Machine Learning Lab	CS692	6 th	0:0:3	1.5
28.	Software Engineering Lab	CS693	6 th	0:0:3	1.5
Total for Major Courses up to 3rd Year					60
29.	Neural Networks and Deep Learning	CS701	7 th	3:0:0	3
30.	Advanced Algorithms	CS702A	7 th	3:0:0	3
	Advanced Computer Architecture	CS702C			
	Advanced Operating Systems	CS702C			
31.	Advanced Algorithms Lab	CS792A	7 th	0:0:3	1.5
	Advanced Computer Architecture Lab	CS792B			
	Advanced Operating Systems Lab	CS792C			
32.	Neural Networks and Deep Learning Lab	CS791	7 th	0:0:3	1.5

Major Courses (Contd.)

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
33.	Real Time Systems	CS801A	8 th	3:1:0	4
	Data Analytics	CS801B			
	Soft Computing	CS801C			
34.	VLSI Design & Application	CS802A	8 th	3:1:0	4
	Bio-informatics	CS802B			
	Robotics	CS802C			
Total for Major Courses up to 4th Year					80

Minor Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Basic Electrical and Electronics Engineering	EE(EC)201	2 nd	3:0:0	3
2.	Basic Electrical and Electronics Engineering Lab	EE(EC)291	2 nd	0:0:3	1.5
3.	Discrete Mathematics	M(CSE)301	3 rd	3:0:0	3
4.	Digital Logic and Electronics	EC(CSE)301	3 rd	3:0:0	3
5.	Digital Electronics Lab	EC(CSE)391	3 rd	0:0:3	1.5
6.	Probability and Statistics	M(CSE)401	4 th	3:0:0	3
7.	Numerical Methods Lab	CS492	4 th	0:0:2	1
8.	Database Management System Laboratory	CS(EE)591A	5 th	0:0:3	1.5
	Computer Network Laboratory	CS(EE)591B			
	Sensors and IoT Laboratory	CS(EE)591C			
9.	Economics for Engineers	HU(CSE)501	5 th	2:0:0	2
10.	Cyber Law and Ethics	CS605	6 th	3:0:0	3
11.	Artificial Intelligence and Machine Learning	CS(EE)601	6 th	2:0:0	2
	Bio-Medical Instrumentation	ECS(EE)601			
	Analog and Digital Communication	EC(EE)601			
12.	Information Theory and Coding	CS703A	7 th	3:0:0	3
	Ad-Hoc and Sensor Networks	CS703B			
	Data Mining and Data Warehouse	CS703C			
13.	Human Resource Development and Organizational Behavior	HU(CSE)701	7 th	0:0:2	1
Total for Minor Courses up to 3rd Year					24

Minor Courses (Contd.)

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
14.	Introduction to IoT	CS803A	8 th	3:0:0	3
	Image Processing	CS802B			
	Optimization Techniques	CS803C			
15.	Internet of Things Lab	CS893A	8 th	3:0:0	3
	Image Processing lab	CS893B			
	Optimization Techniques Lab	CS893C			
Total for Minor Courses up to 4th Year					32

Multidisciplinary Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Engineering Mathematics – I	M(CSE)101	1 st	3:0:0	3
2.	Engineering Chemistry	CH(CSE)201	1 st	2:0:0	2
3.	Engineering Physics	PH(CSE)201	2 nd	3:0:0	3
4.	Engineering Mathematics – II	M(CSE)201	2 nd	3:0:0	3
4.					
Total for Multidisciplinary Courses up to 3rd Year/4th Year					11

Ability Enhancement Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Professional Communication	HU101	1 st	2:0:0	2
2.	Professional Communication Laboratory	HU191	1 st	0:0:2	1
3.	Design Thinking Lab	HU(CSE)291	2 nd	0:0:2	1
4.	Principles of Management	HU(CSE)401	4 th	2:0:0	2
5.	Soft Skill and Aptitude	HU(CSE)491	6 th	0:0:2	1
Total for Ability Enhancement Courses up to 3rd Year/4th Year					7

Skill Enhancement Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Engineering Chemistry Laboratory	CH(CSE)191	1 st	0:0:2	1
2.	Workshop and Manufacturing Practices Laboratory	ME(CSE)191	1 st	0:0:3	1.5
3.	Engineering Physics Laboratory	PH(CSE)291	2 nd	0:0:3	1.5
4.	Engineering Graphics and Design Laboratory	ME(CSE)291	2 nd	0:0:3	1.5
5.	IT Workshop Lab (SciLab/MATLAB/C++)	CS393	3 rd	0:1:3	2.5
Total for Ability Enhancement Courses up to 3rd Year/4th Year					8

Value Added Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Values and Ethics	HU(CSE)102	1 st	2:0:0	2
2.	Constitution of India	HU(CSE)103	1 st	1:0:0	1
3.	Environmental Science	HU(CSE)201	2 nd	2:0:0	2
4.	Indian Knowledge System	HU(CSE)202	2 nd	1:0:0	1
Total for Value Added Courses up to 2nd Year					6

Internship

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Internship	CSE581	5 th	0:0:0	2
Total for Internship up to 3rd Year					2

Research Project

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1.	Major Project – I	CS793	7 th	0:0:12	6
2.	Major Project – II	CS882	8 th	0:0:12	6
Total for Research Project for 4th Year					12

***Recommended MOOCs
courses for attaining the
Honours for AICTE UG
programmes
as per MAKAUT***

Dated: 05.08.2021

**Massive Open Online Courses (MOOCs) scheme at MAKAUT, WB
(Applicable from the session 2020-21)**

(Updated on 05.08.21)

All India Council for Technical Education (AICTE) has introduced Model Curriculum for Bachelor of Technology programme with 160 credits in the entire programme of 4 years, and additional 20 credits will be required to be achieved through Massive Open Online Courses (MOOCs) from different platform for the degree of Bachelor of Technology with Honours. These additional 20 credits will have to be acquired with online courses (MOOCs) as per AICTE. Students of B Tech program will have to complete additional 20 credits through MOOCs within 4 years of time. 16 credit points is applicable for 3 year UG programs. This creates an excellent opportunity for students to acquire the necessary additional skill set for employability through massive open online courses where the rare expertise of world famous experts from academics and industry are available. Maulana Abul Kalam Azad University of Technology, West Bengal (MAKAUT, WB) has thus decided to introduce AICTE model curriculum for its B.Tech Programmes and allow students to choose courses from any established online platform as per following revised guidelines from academic year 2020-21.

GUIDELINES FOR MOOCs

MOOCs (Massive Open Online Courses) have been inducted in University curriculum and academic activities in the following ways:

1. MOOCs for Honours Degree at Undergraduate Level
2. MOOCs for mandatory Coursework of Research Scholars for Ph.D. degree
3. MOOCs are also used for credit transfer as equivalent to theory courses of Curriculum under recommendation of BoS.
4. MOOCs for Mandatory Additional Requirements (MAR)

1 (A) MOOCs for B.Tech Honours Degree

For B.Tech Honours Degree, a B.Tech student will have to earn 20 credits from MOOCs from any established MOOCs platform addition to 160 credits for B.Tech degree.

The total of 20 credits that is required to attain eligibility for B.Tech Honours degree is distributed over four years in the following way:

1st year: 4-8 credits

2nd year: 4-8 credits

3rd year: 4-8 credits

4th year: 4 credits

A student of first year has to cover courses from at least three skills:

1. Computer Programming with Python /R
2. Soft skills
3. values and Ethics

Students of all streams are to be equipped with Programming skill in the language that is in high demand worldwide in the first year itself so that they can apply this skill in the subsequent semesters in their different areas including their core area of study.

Soft skill is very essential for grooming of the student and student must be exposed to it in the very beginning of the 4 year long program.

Ethics is something that one should practice. Students are to be made aware of the ethics right in the beginning of the 4 year long program so that they can practice at least some of the ethical norms as applicable to Institutional environment and society, and be prepared to practice ethics in their working life.

All of the MOOCs courses are to be taken any MOOCs platform as per following scheme of credit points. There would not be any concept of fixed basket anymore. However, during choosing courses in the online platform students would essentially avoid the courses taught/offered through the curriculum in the offline/class room mode.

For NPTEL/Swayam platform: Credit points as specified in the platform

For other MOOCs platforms like Coursera, edX, Udemy, Simplilearn etc

Courses of 4 weeks to 7 weeks: 1 credit point

Courses of 8 weeks to 11 weeks: 2 credit point

Courses of 12 weeks to 15 weeks: 3 credit point

Courses of 16 weeks or more: 4 credit point

Where duration of MOOCs courses are available in hours

For every 8 hours of course: 1 credit point

However, for the courses with duration less than 8 hours, multiple courses could be taken together (preferably in the same area) to consider 1 credit point. But where duration is available in week, count of hours will not be applicable. The above structure is indicative only. And BoS/DC concerned may propose credit points of the courses offered through MOOCs platform based on the content and level (beginner/intermediate/ advanced) of the courses.

1 (B) MOOCs for B. Pharm Program

For B. Pharm Honours degree, 8 credits will have to be obtained by students in addition to the credits specified for B.Pharm degree curriculum during entire period of 4 years. These credits have to be obtained through the MOOCs platforms.

1 (C) MOOCs for UG Architecture Degree

For B. Arch Honours degree, 8 credits will have to be obtained by the students in addition to B. Arch Curriculum during entire period of 5 years from MOOCs platform.

1 (D) MOOCs for UG Architecture Degree

For Non-AICTE programs, a student will have to earn 16 credits from MOOCs in addition to 120 credits for UG degree.

The total of 16 credits that is required to attain eligibility for Honours degree is distributed over four years in the following way:

1st year: 4-8 credits

2nd year: 4-8 credits

3rd year: 4 credits

As mentioned earlier, Student has to cover courses in the first year:

MOOCs on R or Python Programming Language, MOOCs on Soft skill and MOOCs on Values & Ethics for the reason already mentioned.

The scheme of credit calculation would be same as mentioned above for different MOOCs platforms.

2. MOOCs for Research Scholars for Ph.D. degree

Research scholars have to take MOOCs as mandatory as a part of coursework for Ph.D. degree as per advice of the Research Supervisor. The credits for the course will be as per the assignment of credit for the course in the University website according to the length (in weeks) of the course, even if there is different credit assignment in the MOOCs platforms.

3. MOOCs for Credit Transfer

University had already introduced provision of credit transfer through MOOCs courses. Therefore, different courses of curriculum could be taken from MOOCs platform and credits could be transferred, if offered through online and credits are earned. However, to offer courses of curriculum through MOOCs platform like NETEL/SWAYAM/ Coursera/edX/Simplilearn etc, offering institute must get the course mapping (Mapping between the University course and that offered from the online platform) approved from the University for appropriate Credit Transfer Scheme.

If a student of the university is unable to attend a theory course due to attending internship or any other justified reason, the student may be allowed with special permission of the University to pursue equivalent MOOCs for against the theory course. However, content mapping to be completed preferably by BoS or appropriate authority is essential before opting the courses in MOOCs platform. More than one MOOCs courses may be necessary to be mapped to cover the syllabus of the theory course and the student has to complete all the MOOCs to cover the course. Credits earned in total in all the courses will be considered for equivalence and credit transfer.

Evaluation of the MOOCs course

Evaluation of the MOOCs courses would be done by the organization by whom it is being offered. In extraordinary circumstances, the modality of evaluation through certified personnel, online or offline, will be decided by the appropriate authority.

Uploading of MOOCs Data

Every Affiliated Institution has to upload the details of MOOCs data in respect of each student time to time in University's examinations portal and/or hard/soft copy as per instruction of the Controller of Examinations of the University. This is applicable for University's In-House Programs also.

4, MOOCs for Mandatory Additional Requirements (MAR)

MOOCs in MAR is provided for encouraging every student to enter in Digital Content form of Education from well-known Universities or organizations.

Students can choose any MOOCs course as per their interest area. There is no credit system for MOOCs in MAR as points could be earned as specified in the scheme and the MOOCs courses which are taken for earning credits for Honors degree will not be considered in MAR purpose.

The validity of uploaded certificates in the University portal is subject to acceptance of appropriate committee/expert review.

Colleges interested to deliver any course(s) online through MOOCs platform, should get vetted from the University regarding mapping of course for credit transfer/assessment process.

This notification supersedes all earlier instructions regarding MOOCs courses.

**MOOC for First Year AICTE Programmes
(Affiliated Colleges)**

A. Category: Ethics

SL	Course	Provider	Duration	Credits	Name of University / Institute	Status
1	Ethics in Engineering Practice	NPTEL	8weeks	3	IIT Kharagpur	Active
2	A Life of Happiness and Fulfilment	Coursera	6 weeks	2	Indian School of Business	Active
3	Introduction to Philosophy	Coursera	5 weeks	1	University of Edinburgh	Active
4	Ethical Leadership Through Giving Voice	Coursera	4 weeks	2	University of Virginia	Active

B. Category: Soft Skills

SL	Course	Provider	Duration	Credits	Name of University / Institute	Status
1	Technical English for engineers	NPTEL	8 Weeks	3	IIT Madras	Active
2	Body Language: Key to Professional Success	NPTEL	4 Weeks	1	IIT Ropar	Active
3	Psychology at Work	Coursera	6 weeks	2	University of Western Australia	Active
4	Communication in the 21st Century Workplace	Coursera	4 weeks	1	University of California	Active
5	Successful Career Development	Coursera	7 weeks	2	University System of Georgia	Active
6	Working in Teams: A Practical Guide	edX	4 weeks	1	University of Queensland	Active
7	Communication theory: bridging academia and practice	Coursera	9 weeks	3	Higher School of Economics	Active
8	Write Professional Emails in English	Coursera	5 weeks	2	Georgia Institute of Technology	Active
9	Technical Writing	Coursera	5 weeks	1	Moscow Institute of Physics and Technology	Active
10	Interpersonal Communication for Engineering Leaders	Coursera	4 weeks	1	Rice University	Active

C. Category: Programming Skills

SL	Course	Provider	Duration	Credits	Name of University / Institute	Status
1	Introduction to Programming with MATLAB	Coursera	9 weeks	3	Vanderbilt University	Active
2	Programming In C++	NPTEL	8 weeks	3	IIT Kharagpur	Active
3	Learn to Program: The Fundamentals	Coursera	7 weeks	2	University of Toronto	Active
4	Introduction to computer Science	Edx	4-5 weeks	2	Microsoft	Active
5	Introduction to Computer Science and Programming Using Python	Edx	Self Paced	4	MIT, USA	Active
6	Statistics and R	edX	Self Paced	4	Harvard University	Active
7	Introduction to Programming in C	Coursera	4 weeks	4	Duke University	Active
8	Java Programming: Solving Problems with Software	Coursera	4 weeks	4	Duke University	Active
9	Responsive Website Basics: Code with HTML, CSS, and JavaScript	Coursera	4 weeks	1	University of London Microsoft	Active
10	Introduction to HTML5	Coursera	3 weeks	1	University of Michigan	Active
11	HTML5 Coding Essentials and Best Practices	edX	6 weeks	2	W3C	Active
12	Problem solving through Programming In C	NPTEL	12 Weeks	4	IIT Kharagpur	Active
13	Joy of computing using Python	NPTEL	12 Weeks	4	IIT Ropar	Active
14	Programming, Data Structures and Algorithm Using Python	NPTEL	8 Weeks	3	CMI	Active
15	Foundation of Data Structures	edX	6 weeks	2	IIT Bombay	Active
16	Learn to Program: The Fundamentals	Coursera	7 weeks	3	University of Toronto	Active
17	Web Design for Everybody (Basics of Web Development and Coding) Specialization	Coursera	15 weeks	4	University of Michigan	Active
18	Programming Basics	edX	9 weeks	3	IIT Bombay	Active

D. Category: Statistics

SL	Course	Provider	Duration	Credits	Name of University / Institute	Status
1	Inferential Statistics	Coursera	7 weeks	2	University of Amsterdam	Active
2	Linear Regression and Modelling	Coursera	4 weeks	1	Duke University	Active

E. Category: Environmental Studies

SL	Course	Provider	Duration	Credits	Name of University / Institute	Status
1	The Science of Well Being	Coursera	6 weeks	2	Yale University	Active
2	Ecology: Ecosystem Dynamics and Conservation	Coursera	5 weeks	1	American Museum of Natural History, Howard Hughes Medical Institute	Active
3	Effective Problem Solving and Decision Making	Coursera	4 weeks	1	University of California	Active
4	Moralities of Everyday Life	Coursera	6 weeks	2	Yale University	Active
5	Introduction to Logic	Coursera	10 weeks	3	Stanford University	Active
6	The Science of Everyday Thinking	edX	12 weeks	4	University of Queensland	Active
7	Digital Security and Human Rights	edx	3 weeks	1	Amnesty International X	Active
8	Ethics in Engineering Practices	NPTEL	8 weeks	4		Active
9	Introduction to Philosophy: God, Knowledge, and Consciousness	edX	12 weeks	4	MIT	Active
10	Development of Sociology in India	NPTEL	4 Weeks	1	IIT Kanpur	Archived
11	Introduction to Logic	NPTEL	12 weeks	4	IIT Kanpur	Archived
12	Introduction to Problem-solving and Programming	NPTEL	12 weeks	4	IIT Kanpur	Archived
13	Speak English Professionally: In Person, Online & On the Phone	Course era	4 weeks	1	Georgia Tech	Active
14	Java Fundamentals for Android Development	edX	6 weeks	2	GalileoX	Active
15	Environmental Studies: A Global Perspective	edX	Self Paced	4	Curtin University	Active
16	Science, Technology and Society	NPTEL	12 weeks	4		Active
17	Critical Thinking & Problem Solving	edX	3 weeks	3	Rochester Institute of Technology	Active

**List of MOOCs for UG Honors degree
(AICTE Programs)
Effective for Odd Semester of 2020-21
Department of Computer Science & Engineering
(2nd to 4th Year)**

S L	Basket of Courses	Provider	Duration	Credits	Name of University/ Institute	Status
1.	AP Computer Science A: Java Programming Polymorphism and Advanced Data Structures	edX	6 weeks	2	Purdue University	Active
2.	Build your very first iOS app	edX	8 weeks	3	Curtin University	Active
3.	A Complete Guide to Game Design	edX	5 weeks	2	HP	Active
4.	Introduction to Computer Science & Programming Specialization	Coursera	8 weeks	3	University of London	Active
5.	Introduction to scripting in Python	Coursera	8 weeks	3	Rice University	Active
6.	Foundation of Data Structures	edX	6 weeks	2	IIT Bombay	Active
7.	Synthesis of Digital Systems	MIT online course	12 weeks	3	MIT	Active
8.	Bayesian Statistics: Techniques and Models	Coursera	5 weeks	2	UC Santa Cruz	Active
9.	Financial Modelling and Analysis	edX	9 weeks	3	University of Cape Town	Active
10.	Animation and CGI Motion	edX	12 weeks	3	Columbia University	Active
11.	Web Application Development	Coursera	6 weeks	2	IBM	Active
12.	Web Design for Everybody Specialization	Coursera	12 weeks	3	University of Michigan	Active
13.	The Bits and Bytes of Computer Networking	Coursera	4 weeks	1	Google	Active
14.	Introduction to Network Automation	Coursera	4 weeks	1	CISCO	Active
15.	IBM: Introduction to Statistics for Data Science using Python	edX	6 weeks	2	IBM	Active
16.	Introduction to data science in python	Coursera	6 weeks	2	University of Michigan	Active
17.	What is Data Science?	Coursera	3 weeks	1	IBM	Active
18.	Introduction to Big Data	Cousera	3 weeks	1	University of California San Diego	Active
19.	The Data Science Tool Box	Cousera	2 weeks	1	John Hopkin's University	Active
20.	Data Driven Decision Making	Cousera	2 weeks	1	PWC	Active
21.	A Crash Course in Data Science	Cousera	1 weeks	1	John Hopkin's University	Active
22.	Introduction to Cybersecurity Fundamentals	edX	3 weeks	1	Instructor Network	Active
23.	Data Analysis and Presentation Skills :the PWC approach Specialization	Cousera	12 weeks	3	PWC	Active
24.	Introduction to Design Thinking	edx	5 weeks	2	EDX	Active
25.	Introduction to Soft Computing	NPTEL	8 weeks	2	IIT Kharagpur	Active
26.	Data Analysis	edX	4 weeks	1	University of Cape Town	Active
27.	Introduction to Android Mobile Application Development	Coursera	6 weeks	2	Meta	Active
28.	Using Databases with Python	Coursera	5 weeks	2	University of Michigan	Active

29.	Data Base Management System	NPTEL	8 weeks	2	IIT Kharagpur	Active
30.	Discrete Mathematics	NPTEL	12 Weeks	3	IIT Ropar, IIT Gandhinagar	Active
31.	Programming, Data Structures and Algorithms using Python	NPTEL	8 weeks	2	Chennai Mathematical Institute	Active
32.	Design and Analysis of Algorithms	NPTEL	8 weeks	2	Chennai Mathematical Institute	Active
33.	Introduction To Algorithms And Analysis	NPTEL	12 weeks	3	IIT Kharagpur	Active
34.	Divide and conquer ,Sorting, Searching and RandomizedAlgorithm	Coursera	4weeks	1	Standford University	Active
35.	Cloud Computing	NPTEL	8 weeks	2	IIT Kharagpur	Active
36.	Cloud Computing	Coursera	5 weeks	2	University of Illinois	Active
37.	Bitcoin and Cryptocurrency Technologies	Coursera	11 weeks	3	Princeton University	Active
38.	Ethical Hacking	Udemy	8 weeks	2	Z Security	Active
39.	Python for Cybersecurity Specialization	Coursera	7 weeks	2	Infosec	Active
40.	Introduction to Internet of Things	NPTEL	12Weeks	3	IIT Kharagpur	Active
41.	Introduction to the Internet of Things	edX	6 weeks	2	Curtin University	Active
42.	IoT Programming and Big Data	edX	5 weeks	2	Curtin University	Active
43.	Fundamentals of Network Communication	Coursera	5 weeks	1	University of Colorado	Active
44.	UML Class Diagrams for Software Engineering	edX	3 weeks	1	KU Leuven	Active
45.	Secure Software Development: Verification and More Specialized Topics	edX	8 weeks	2	Linux Foundation	Active
46.	Introduction to Software testing	Coursera	12 weeks	3	University Minesota	Active
47.	Software Project Management	NPTEL	12 weeks	3	IIT Kharagpur	Active
48.	Software Engineering	Coursera	12 weeks	3	Hongkong University of Science and Technology	Active
49.	Software Product Management Specialization	Coursera	16 weeks	4	University of Alberta	Active
50.	Entrepreneurship in Emerging Economies	edX	6 weeks	2	Havard University	Active
51.	Patent Drafting for Beginners	NPTEL	4 weeks	1	IIT Madras	Active
52.	Patent Law for Engineers and Scientists	NPTEL	12 weeks	3	IIT Madras	Active
53.	Introduction to Computational Thinking and Data Science	edX	10 weeks	3	MIT	Active
54.	Data Mining: Theories and Algorithms for Big Data	edX	14 weeks	4	MIT	Active
55.	Big Data Fundamentals	edX	10 weeks	3	University of Adelaide	Active
56.	Big Data Analytics	edX	10 weeks	3	University of Adelaide	Active
57.	Computational Thinking with Python	edX	5 weeks	2	MIT	Active
58.	IBM Full Stack Software Developer Professional Certificate	Coursera	12 weeks	3	IBM	Active
59.	Virtual Reality	Coursera	12 weeks	3	University of London	Active
60.	Machine Learning with Python: A Practical Introduction	edX	6 weeks	2	IBM	Active
61.	Machine Learning	Coursera	12 weeks	4	Standford, DeepLearning.AI	Active
62.	AI For Everyone	Coursera	4 weeks	1	Standford, DeepLearning.AI	Active
63.	Robotics: Aerial Robotics	Coursera	6 weeks	2	University of Pennsylvania	Active
64.	Introduction to Computer Vision and Image Processing	Coursera	5weeks	2	IBM	Active
65.	Deep Learning – Part 1	Coursera	12 weeks	3	Standford, DeepLearning.AI	Active

66.	Foundations of Data Structures and Algorithms Specialization	Coursera	12 weeks	3	University of Colorado	Active
67.	Machine Learning for Engineering and Science Applications	NPTEL	12 weeks	3	IIT Madras	Active
68.	Computer Vision	Edx NPTEL	12 weeks	3	IIT Kharagpur	Active
69.	Introduction to Machine Learning	NPTEL	12 weeks	3	NPTEL	Active
70.	Introduction to Machine Learning	Coursera	8 weeks	2	Duke University	Active
71.	Functional Programming in Scala	Coursera	6 weeks	2	EPFL	Active
72.	Using python to access web data	Coursera	6 weeks	2	University of Michigan	Active
73.	Python Data Structures	Coursera	2weeks	1	Python Data Structures	Active
74.	Object oriented analysis and design	coursera	8 weeks	2	University of Alberta	Active
75.	Python 3 Programming Specialization	Cousera	8 weeks	2	University of Michigan	Active
76.	Natural Language Processing	Coursera	5 weeks	2	DeepLearning.AI	Active
77.	Applied Text Mining in Python	Coursera	12 weeks	3	University of Michigan	Active
78.	Natural Language Processing	Edx	12 weeks	3	The National University of Singapore	Active
79.	Embedded Systems	NPTEL	12 weeks	3	IIT Delhi	Active
80.	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12Weeks	3	IIT Kharagpur	Active
81.	A System View of Communications: From Signals to Packets (Part 2)	edX	6 weeks	2	HKUST	Active
82.	Software Testing and Automation Specialization	Coursera	12 weeks	3	University of Minnesota	Active
83.	Software Testing and Management	NPTEL	8 weeks	2	IIIT Bangalore	Active
84.	Building Fintech Startups in Emerging Markets	Coursera	4 weeks	1	University of Cape Town	Active
85.	Teamwork and Collaboration	edX	3 weeks	1	RIT	Active
86.	Leadership Skills	Coursera	4 weeks	1	IIMA	Active
87.	Cybersecurity and the Internet of Things	Coursera	5 weeks	2	University System of Georgia	Active
88.	IoT System Design: Software and Hardware Integration	edX	4 weeks	1	Waseda University	Active
89.	Blockchain and Fin Tech: Basics, Applications, and Limitations	edX	6 weeks	2	University of Hong Kong	Active
90.	Block Chain Specialization	Cousera	8 weeks	2	University of Buffalo	Active
91.	A System View of Communications: From Signals to Packets (Part 3)	edX	5 weeks	2	HKUST	Active
92.	Internet of Things	NPTEL	12 weeks	3	IIT Kharagpur	Active
93.	Computational Thinking for Modeling and Simulation	edX	6 weeks	2	MIT	Active
94.	Mathematics For Machine Learning: Multivariate Calculas	Coursera	6 weeks	2	Imperial College London	Active
95.	Becoming an Entrepreneur	edX	6 weeks	2	MIT	Active
96.	Marketing Fundamentals	edX	4 weeks	1	Babson College	Active
97.	IBM Data Science Professional Certificate	Coursera	8 weeks	2	IBM	Active
98.	Python for Data Science	NPTEL	4 weeks	1	IIT Madras	Active
99.	Artificial Intelligence	NPTEL	12 weeks	3	IIT Madras	Active
100.	Model Thinking	Coursera	6 weeks	2	University of Michigan	Active
101.	Deep Neural Networks with PyTorch	edX	12 weeks	3	IBM	Active
102.	Deep Learning Specialization	Coursera	12 weeks	3	DeepLearning.AI	Active
103.	Machine learning with Tensor Flow on Google Cloud Platform Specialization	Cousera	4 weeks	1	GOOGLE CLOUD	Active
104.	Applied Machine Learning with Python	Cousera	3 weeks	1	University of Michigan	Active
105.	Convolution Neural Network	Cousera	4 weeks	1	DeepLearning.AI	Active
106.	Sequence Model	Cousera	2 weeks	1	DeepLearning.AI	Active

107.	Deep Learning	edX	6 weeks	2	IBM	Active
108.	Introduction to Deep Learning	edX	16 weeks	4	University of Purdue	Active
109.	Reinforcement Learning	edX	8 weeks	3	University of Alberta	Active
110.	Neural Networks and Deep Learning	Coursera	16 weeks	4	DeepLearning.AI	Active
111.	Cloud Computing for Enterprises	edX	8 weeks	2	Univ. of Maryland	Active
112.	Cloud Computing Management	edX	8 weeks	2	Univ. of Maryland	Active
113.	Cloud Computing Infrastructure	edX	8 weeks	2	Univ. of Maryland	Active
114.	Data Engineering on Google Cloud Platform Specialization	Coursera	4 weeks	1	GOOGLE CLOUD	Active
115.	Security in Google Cloud Platform Specialization	Coursera	4 weeks	1	GOOGLE CLOUD	Active
116.	AWS Fundamentals Specialization	Coursera	5 weeks	2	AWS	Active
117.	Google Cloud Platform Big Data and Machine Learning Fundamentals	Coursera	4 weeks	1	GOOGLE CLOUD	Active
118.	Remote Sensing and GIS	NPTEL	12 weeks	3	IIT Guwahati	Active
119.	Remote Sensing and Digital Image Processing of Satellite Data	NPTEL	8 weeks	2	IIT Roorkee	Active
120.	Leadership Development for Engineers	Coursera	6 weeks	2	Rice University	Active
121.	Computer Forensics	edX	8 weeks	2	RIT	Active
122.	LSE: Data Analysis for Management	edX	4 weeks	1	LSE	Active
123.	Human-Computer Interaction I: Fundamentals & Design Principles	edx	8 weeks	2	GTx	Active
124.	Social Networks	NPTEL	12 weeks	3	IIT Ropar	Active
125.	Fuzzy Sets, Logic and System Application	NPTEL	12 weeks	3	IIT Kanpur	Active
126.	Electronic Systems for Cancer Diagnostics	NPTEL	12 weeks	3	IIT Kanpur	Active
127.	Data Analytics with Python	NPTEL	12 weeks	3	IIT Roorkee	Active
128.	Optical Engineering	NPTEL	12 weeks	3	IIT Madras	Active
129.	Machine Learning	NPTEL	8 weeks	2	IIT Madras	Active
130.	Introduction to Machine Learning	NPTEL	12 weeks	3	IIT Kharagpur	Active
131.	An Introduction to Artificial Intelligence	NPTEL	12 weeks	3	IIT Delhi	Active
132.	Artificial Intelligence: Knowledge Representation and Reasoning	NPTEL	12 weeks	3	IIT Madras	Active
133.	Deep Learning	NPTEL	12 weeks	3	IIT Ropar	Active
134.	Data Science for Engineers	NPTEL	8 weeks	2	IIT Madras	Active
135.	Embedded Systems Design	NPTEL	12 weeks	3	IIT Kharagpur	Active
136.	Introduction to Internet of Things	NPTEL	12 weeks	3	IIT Kharagpur	Active
137.	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12 weeks	3	IIT Kharagpur	Active
138.	Introduction to Block Chain Technology and Applications	NPTEL	8 weeks	2	IIT Kanpur	Active
139.	User-Centric Computing for Human-Computer Interaction	NPTEL	8 weeks	2	IIT Guwahati	Active
140.	Reinforcement Learning	NPTEL	12 weeks	3	IIT Madras	Active
141.	VLSI Physical Design	NPTEL	12 weeks	3	IIT Kharagpur	Active
142.	Randomized Algorithms	NPTEL	12 weeks	3	IIT Guwahati	Active
143.	Embedded System Design with ARM	NPTEL	8 weeks	2	IIT Kharagpur	Active

***Mandatory Additional
Requirements
(MAR)
as per MAKAUT***

Dated: 12.03.2019

Mandatory Additional Requirements for earning AICTE/non-AICTE UG Degree

In partial modification with the notice dated 11 June 2018 regarding Mandatory Additional Requirement (MAR) for earning UG degree, the following modifications/clarifications have been made, which would be effective from the present semester.

- Previously no division of activity points of MAR which are to be earned by the students, has been scheduled year wise. A student should acquire a total of minimum 100/75 activity points throughout 4 year/3 year curriculum which should be acquired by earning a minimum of 20 activity points and maximum of 30 activity points in each year of his/her study, which is necessary for uniform distribution of MAR activities throughout the entire period of the academic curriculum of the students.
- MAR activities for the students admitted up to the session 2018-19 and for the new session starting from 2019-20, will be in accordance with the following table.

Level of Entry in B.Tech Course	Total duration for earning Points	Minimum Points to be earned
1st Year starting from the academic year 2019-20 onwards	1 st to 4 th Year	100
2nd Year starting from the academic year 2019-20 onwards (Lateral Entry)	2 nd to 4 th Year	75

Table – I

Every student, who is admitted to the 4 years B.Tech program prior to the academic year 2019-20, is required to earn minimum number of Activity Points as per Table II in addition to the required academic grades, for getting MAKAUT, WB's B.Tech degree.

Current Semester	Total Minimum Number of Activity Points to be earned During the full course
2 nd	100
4 th	75
6 th	50

Table –II

- The courses under MOOCs which have been already taken into consideration i.e., 20 credit courses for awarding B.Tech degree with Honours and 16 credit courses for non-AICTE courses are not to be considered again for awarding activity points for MAR.
- In addition to the existing activity point allotment for 12 weeks and 8 weeks MOOCs courses of short duration (4 weeks/2 weeks) can also be done. 10/5 activity points will be allotted, based on the short course duration of 4weeks/2 weeks respectively. The courses with duration ranging from 18-40 hours must also get proper weightage. (See the following table for details)

Weeks/Hours	Activity Points	Maximum Activity Points
12weeks/40hours	20	40
8weeks/30hours	16	
4weeks/20hours	10	
2weeks/10hours	5	

Table-III

- Any MOOCS already done or registered before the introduction of MAR system is not to be considered again for awarding activity points for MAR. Those courses should not be taken into consideration with retrospective effect.
- A student can also select MOOCs from the MOOCs basket/repository as designed by the University for earning activity points for MAR. But the same course cannot be counted for Honours. There should not be any overlapping of MOOCs with regard to MAR and Degree with Honours.
- If any student is unable to get certificate from MOOCs platform after auditing the course, the college will extend facility for awarding point after evaluation in consultation with the University.
- The activity points allotted per research publication (Vide Serial No.9 of Table-V) shall carry equal full weights among joint authors, if any, to encourage the students in research work.
- In addition to SWAYAM/NPTEL/Spoken Tutorial the names of all available MOOCs can be included. At present, SWAYAM/NPTEL/Spoken Tutorial have only been mentioned (Vide Serial No. 1 of Table V).
- In Serial No. 15 of Table-V, 'Student Chapter' should be read as 'Active Participation in Student Chapter', that is, whether the concerned student is an active member of the same.
- A student may earn activity point, being a member of other professional bodies and by participating as a resource person.
- A separate dedicated server is needed for huge data on students' evaluation on the part of the colleges. Digital versions of all certificates regarding MAR can be uploaded in the college.
- Every student should upload his/her MAR activity data/certificate in the social media, viz., Facebook/Instagram, which can be counted as part of the documentary evidence.
- Activities must be open-ended, that is, there can be many activities, other than the specified list by MAKAUT. College authorities may introduce new activities, with the prior approval of the University.
- The University has introduced new activities as part of MAR, which would encourage entrepreneurship ability of the students. Such activities are listed in the following table.

New MAR Activities (In addition to the existing list, Vide Serial No. 22, Table-V)

	Name of the Activity	Points	Maximum Points Allowed
Self-Entrepreneurship Programme			
a)	To Organize Entrepreneurship Workshop and Programmes	10	20

b)	To take part in Entrepreneurship Workshop and get certificate	5	10
c)	Video Film-Making on Entrepreneurship	10	20
d)	Submit Business Plan on any Project	10	20
e)	To work for start-up/as entrepreneur	20	40

Table-IV

- There must be a Single Point of Contact (SPOC) in each college, who will keep correspondences with the University on MAR activities and his/her name is to be informed to the University. In addition, there should also be a nominated SPOC on behalf of the University for liaison with the colleges.
- Random sample visits and check-ups of individual institutes, as well as digital survey may be conducted from time to time to ensure proper implementation of MAR.
- The colleges should maintain MAR files for individual students, preferably in digital format, which can be inspected periodically by the University authorities.
- Different levels of activities in relief camps should carry different weightage for allotting activity points in MAR (Vide Serial No. 5 of Table-V).
- Institutions should not raise any subscription from the students in the name of MAR activities.

Notes:

- 1) Every student shall participate in the co-curricular and extra-curricular activities and produce documentary proof to the designated Faculty Members appointed by the Head of the Department/Principal/Director in the respective college. Thereby the student should earn the required points before he/she appears for the Final Examinations.
- 2) A student's result of his/her Final Examinations will be withheld until he/she completes the minimum activity points by the end of his/her Degree Programme.
- 3) In every semester, every student is required to prepare a file containing documentary proofs of activities, done by him/her. This file will be duly verified and activity points will be assigned by the teachers as appointed above, at the end of every semester.
- 4) Each institution will form a three members committee, the composition of which is to be notified to the University. The committee will finalize the activity points for each student before entering them into the Online Point Entry System (at the URL, as specified by the COE of the University).
- 5) Every student has to earn at least 75, 100 or 125 activity points for 3, 4 or 5 year courses respectively. The points earned by the students will be reflected in their mark sheets.

Table V provides a List of Activity Heads and Sub-Activity Heads along with their capping of the activity points that can be earned by the students during the entire course duration.

SL.		Points	Maximum Points Allowed
1.	MOOCs (SWAYAM, NPTEL, Spoken Tutorial, EdX, Coursera, etc.)	20 (per course)	40
2.	Tech Fest/Fest/Teachers' Day/Fresher's Welcome		
	a) Organizer	5	10
	b) Participant	3	6
3.	Rural Reporting	5	10
4.	Tree Plantation and up keeping (per tree)	1	10
5.	Participation in Relief Camps		
	a) Collection of funds/materials for the Relief Camp	5	40
	b) To be a part of the Relief Work team	20	
6.	Participation in Debate/Group Discussion/Tech Quiz/Quiz	10	20
7.	Publication of Wall Magazine in institutional level (magazine/article/internet)	10	20
8.	Publication in Newspaper, Magazine and Blogs	10	20
9.	Research Publication (per publication)	15	30
10.	Innovative Projects (other than course curriculum)	30	60
11.	Blood donation	8	16
	Blood donation camp organization	10	20
12.	Participation in Sports/Games		
	a) College level	5	10
	b) University level	10	20
	c) District level	12	24
	d) State level	15	30
	e) National/International Level	20	20
13.	Cultural Programme (Dance, Drama, Elocution, Music etc.)	10	20
14.	Member of Professional Society	10	20
15.	Student Chapter	10	20
16.	Relevant Industry Visit & Report	10	20
17.	Activities in different Clubs (Photography Club, Cine Club, Gitisansad)	5	10
18.	Participation in Yoga Camp (Certificate to be submitted)	5	10
19.	Adventure Sports with Certification	10	20
20.	Training to under-privileged/differently able	15	30
21.	Community Service & Allied Activities	10	20
22.	Self-Entrepreneurship Programme		
	a) To Organize Entrepreneurship Workshop and Programmes	10	20
	b) To take part in Entrepreneurship Workshop and get certificate	5	10
	c) Video Film-Making on Entrepreneurship	10	20
	d) Submit Business Plan on any Project	10	20
	e) To work for start-up/as entrepreneur	20	40

Table-V

***Syllabus Under Autonomy
With effective from
Academic Year
2023-2024
(R23)***

Course Name: Programming for problem solving
Course Code: CS101
Contact (Periods/Week):3L/Week
Total Contact Hours: 36
Credits: 3

Course Outcome(s):

CO1: To identify the working principle of input and output devices of Computers memorize the basic terminology used in computer programming.

CO2: To express programs in C language and use different data types for writing the programs.

CO3: To implement programs using the dynamic behavior of memory by the use of pointers. CO4: To explain the difference between call by value and call by address.

CO5: To write programs using basic data files and developing applications for real world problems.

CO-PO-PSO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2						2	3	2	3	3
CO2	2	2	3	3	3							3	2	2	3
CO3	2	3	2	2	2							3	2	3	2
CO4	3	2	2	3	3							2	2	2	2
CO5	2	2	2	1	1						2	3	3	3	3

Course Content:

Module-1: Fundamentals of Computer (9L)

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.

Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in signed magnitude signed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using 1's complement and 2's complement). Representation of Characters-ASCII Code, Basics of Compiler, Interpreter and Assembler

Problem solving – Basic concept of Algorithm. Representation of algorithm using flowchart and pseudo code, Some basic examples.

Module-2: Introduction to C Programming (5L)

Overview of Procedural vs Structural language; History of C Programming Language. Variable and Data Types: The C characters identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational operators, Logical operators, increment and decrement operators, bitwise operators, Assignment operators, conditional operators, special operators-type Conversion, C expressions, precedence and associativity. Input and Output: Standard input and output, formatted output–printf, formatted input scanf.

Module-3: Branch and Loop (5L)

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder. Switch Case: break and continue; switch-case, concept of go to and labels Loops- while, for, do while.

Module-4: Program Structures (4L)

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.

Storage Class in C: Storage Class-auto, external, static and registers to rage class, scope rules and lifetime of variables

C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer (7L)

Arrays: One dimensional array, Two-dimensional arrays Passing an array to a function Pointers: Pointers, Pointer and Array, Pointer and functions.

Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String. Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum (3L)

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C (3L)

Files handling-opening and closing a file indifferent mode, formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. **Kanetkar Y.- Let us C, BPB Publication, 15th Edition**

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad– MASTERING C, TMH, 2nd Edition

Course Name: Engineering Chemistry

Course Code: CH(CS)101

Total Contact Hours: 24

Credits: 2

Prerequisites:

COURSE OBJECTIVE

- To understand the basic principles of elements, organic reactions, drug synthesis and technological aspects of modern chemistry
- To apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems
- To analyze and evaluate quality parameters of water and its treatment
- Apply the knowledge of free energy, energy storage device, semiconductors, fuels and corrosion to design environment friendly & sustainable devices
- Apply the knowledge of different instrumental techniques to analyze unknown engineering materials.

COURSE OUTCOME

CO1. Able to understand the basic principles of elements, organic reactions drug synthesis and computational chemistry

CO2. Able to apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems

CO3. Able to analyze and evaluate water quality parameters and its treatment

CO4. Able to the knowledge of free energy, energy storage device, fuels and corrosion to design environment friendly & sustainable devices

CO5. Able to apply the knowledge of different instrumental techniques to analyze unknown engineering materials

CO v/s PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	2	2	2	-	-	-	-	-	2	2
2	3	3	3	3	-	-	2	-	-	-	2	2
3	3	3	-	-	-	-	3	-	-	-	3	2
4	3	3	3	2	-	-	3	-	-	-	3	2
5	3	3	3	3	2	-	-	-	-	-	2	2

COURSE CONTENT

Module 1 - Elements and their properties (6L)

1. Elements and their properties(3L)

Bohr's theory for one electron system, Hydrogen spectrum, Quantum numbers, atomic orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle, Electronic configuration and Magnetic properties.

2. Periodic Table for Engineers(3L)

Modern Periodic table, Periodic properties, study of advanced functional materials like Silicones, Silicates, Zeolite and alloys like steel, mischmetall, Neodymium alloy and their applications.

Module 2 - Energy devices and Semiconductors (6L)

1. Use of free energy in chemical equilibria(3L)

Laws of Thermodynamics, Enthalpy, Entropy, Spontaneity, Electrochemical Cell, Dry Cell, Mercury Cell, Lead Storage batteries, Ni-Cd Cells, Fuel Cells, Solar Cells, Nernst equation and applications, Electrochemical sensors

2. Crystals and Semiconductors(3L)

Crystals and their defects, Stoichiometric and Non-stoichiometric defects, Band theory and Doping, n-type and p-type semiconductors, Superconductors

Module 3 –Industrial Applications of Chemistry (8L)

1. Advanced Polymeric materials (3L)

Classification, Engineering Plastics, conducting polymers, bio polymers, polymer composites

2. Industrial corrosion(2L)

Classification, Effects of corrosion, Preventive measures

3. Analysis of Water Quality (1L)

Physicochemical and Biological parameters

4. Nano materials(1L)

Synthesis of Nano materials, Applications in modern devices

5. Basic Computational Chemistry(1L)

Introduction of computational chemistry and their applications

Module 4 – Organic Reaction Products and their spectroscopic analysis (4L)

1. Organic Reactions(2L)

Substitution, Elimination and Addition reactions

2. Drug designing and synthesis(1L)

Paracetamol, Aspirin

3. Spectroscopic Analysis (1L) UV – Visible Spectra, IRspectra

Course Name: Engineering Mathematics -I

Paper Code: M(CS)101

Contact (L: T: P): 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, and calculus.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in matrix algebra and calculus. 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.

Course Outcomes (COs):

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

CO1: Recall the properties related to matrix algebra and calculus.

CO2: Determine the solutions of the problems related to matrix algebra and calculus.

CO3: Apply the appropriate mathematical tools of matrix algebra and calculus for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra and calculus.

CO-PO/PSO Mapping:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	2	-	-	-	-	-	-	-	1
CO	2.75	2.25	1.5	2	-	-	-	-	-	-	-	1.25

Weightage Values: Strongly mapped: '3', moderately mapped: '2', weakly mapped: '1', Not mapped: '-'

Course Content:**Module I: Linear Algebra (11L)**

Echelon form and normal (canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigen values and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Power series; Taylor's series.

Module III: Multivariable Calculus (Differentiation) (13L)

Function of several variables; Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function; Jacobian; Maxima and minima of functions of two variables.

Module IV: Multivariable Calculus (Integration) (7L)

Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Course Name: Professional Communication

Paper Code: HU101

Contact: 2:0:0

Total Contact Hours: 24

Credit: 2

Pre-requisites:	Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.
Course Objectives	The course aims to impart domain and industry-specific communications skill in a globalized context and to promote the understanding of business communication practices and cross cultural dynamics.
Course Outcomes:	By pursuing this course the students shall be able to
	1. Define, describe and classify the modalities and nuances of communication in a workplace context.
	2. Review, appraise and understand the modes, contexts and appropriacy of communicating across cultures and societies.
	3. Identify, interpret and demonstrate the basic formats, templates of business and official communication.
	4. Identify, compare and illustrate reading strategies and basic writing strategies.
	5. Interpret, analyze and evaluate semantic-structural, interpersonal and multicultural dynamics in business communication.

Course Content:

Module1:

Verbal and Nonverbal communication

4L

Definition, Relevance and Effective Usage

Components of Verbal Communication: Written and Oral Communication

Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics

Paralanguage

Barriers to Effective Communication

Module2:

Workplace Communication Essentials and Cross Cultural Communication

4L

Communication at the Workplace—Formal and Informal Situations

Language in Use—Jargon, Speech Acts/Language Functions, Syntactical and Grammatical Appropriacy

Cultural Contexts in Global Business: High Context and Low Context Cultures Understanding Cultural

Nuances and Stereotyping Achieving Culturally Neutral Communication in Speech and Writing

Module3:

4L

Reading Strategies and Basic Writing Skills

Reading: Purposes and Nature of Reading

Reading Sub-Skills—Skimming, Scanning, Intensive Reading

Reading General and Business Texts (Reading for Comprehension and Detailed Understanding)

Basic Writing Skills—Paragraph and Essay writing, writing technical documents

Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Module4: 4L**Report Writing**

Nature and Function of Reports
 Types of Reports
 Researching for a Business Report
 Format, Language and Style
 Report Documentation

Module5:**Employment Communication**

- a. Writing Business Letters—(Enquiry, Order, Sales, Complaint, Adjustment, Job Application, Offer) 2L
- b. Creating an Employee Profile—Preparing a CV or Résumé.**
- Creating a Digital/Online Profile—LinkedIn (Résumé/Video Profile) 2L
- c. Writing Other Interoffice Correspondence--E-mails: types, convention, and etiquette, Memo, Notices and Circulars 2L
- d. Preparing Meeting Documentation—Drafting Notice and Agenda of Meetings, Preparing Minutes of Meetings. 2L

References:-

1. Meenakshi Raman and Sangeetha Sharma. **Technical Communication. 3rd edition. New Delhi: Oxford University Press, 2015.**
2. Mark Ibbotson. Cambridge English for Engineering. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. Business Communication: Connecting in a Digital World. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. Writing Reports. Oxford: Oxford University Press, 2002.
6. Judith Leigh. CVs and Job Applications. Oxford: Oxford University Press, 2002.
7. Judith Leigh. Organizing and Participating in Meetings. Oxford: Oxford University Press, 2002.
8. Michael Swan. Practical English Usage. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.
10. Diana Booher. E-writing: 21st Century Tools for Effective Communication.

Links:-

1. Purdue University's Online Writing Lab (OWL) - <https://owl.purdue.edu/>
2. Business English Pod - <https://www.businessenglishpod.com/>

CO-PO Mapping

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

Course Name: Values and Ethics

Course Code: HU102

Contacts: 2:0:0

Total Contact Hours: 24

Credit: 2

Prerequisite: None

Module: 1 Introduction:(4L)

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, and Social

Types of values-Social, Psychological, Aesthetic, Spiritual, and Organizational

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Module 2: Universal Human Harmony. (4L)

Basic Human Aspirations, Happiness and Prosperity, Self-Exploration, Self and the Body Understanding the harmony in the Nature.

Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation innature.

Values Crisis in contemporary society Nature of values: Value Spectrum of a good life (Maslow's Pyramid)

Module: 3 Ethical Concerns: (6L)

Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics. Rapid Technological growth and depletion of resources,Reports ofthe Club ofRome.

Problems of Technology transfer- Technology assessment impact analysis -Human Centered Technology.

Module: 4 Ethics of Profession: (4L)

Work Ethics and Work Values, Business Ethics, Human values in organizations: Social and ethical responsibilities of Technologists. Codes of professional ethics.

Types of Ethical issues-Internal Ethics of Business–

Whistle Blowing, Impact of Ethics on Business Policies and Strategies– Ethical Leadership – Characteristics

Module: 5 Self Development AND Gender Awareness (6L)

Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender

Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender- based Division and Valuation of Labour. Gender Development Issues, Identifying Gender Issues

Text Books:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultdge Press.(GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR orWGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff.(2011).

4. The Women, Gender and Development Reader. 2nd Edition. Zed Press(WGD)
5. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2ndEd)
6. DeborahJohnson, EthicalIssuesinEngineering, PrenticeHall, EnglewoodCliffs, NewJersey1991.
7. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

Course Outcomes:

CO 1	Understand the significance of values, various approaches to ethics and its applications in life and profession.
CO2	Able to distinguish Self and the Body, to understand Harmony in the Self
CO3	To identify and eradicate environmental concerns through technology
CO4	Demonstrate work ethics and analyse business strategies
CO5	Ability to understand gender terminologies and to identify gender issues

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

Paper Name: Constitution of India

Paper Code: HU103

Credit: 01

No. of lectures: 12

Module 1: History of Making of the Indian Constitution: History. Drafting Committee, (Composition & Working) **3L**

Philosophy of the Indian Constitution: Preamble Salient Features

Module2: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy **6L**

The Right to Equality

The Right to Freedom: I (Article 19)

The Right to Freedom: II (Articles 20, 21 and 22) The Right against Exploitation

The Right to freedom of

Religion Cultural and

Educational rights The Right to

Property

The Right to Constitutional Remedies

Fundamental Duties

Module-3: Organs of Governance: 3L

Parliament - Composition - Qualifications and Disqualifications - Powers and Functions – Executive- President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

Text / Reference Books:

- 1) Indian Constitution by D. D. Basu, The Publisher, LexisNexis
- 2) Constitution of India by Subhas C Kasyap, Vitasta Publishing
- 3) The Constitution of India, P. M Bakshi, Universal Law Publishing Co. Ltd, New Delhi, 2003.
- 4) Indian Constitution Text Book - Avasthi, Avasthi, Publisher: LAKSHMINARAINAGARWAL
- 5) Introduction to the Constitution of India, Brij Kishore Sharma, PHI

Course Name: Programming for problem solving

Lab Course Code: CS191

Contact Hours: 3L/Week

Total Contact Hours: 36

Credits: 1.5

Course Outcomes	Name of Course Outcomes
CO1	To identify the working of different operating systems like DOS, Windows, Linux
CO2	To express programs in C language
CO3	To implement programs connecting decision structures, loops
CO4	To experiment with user defined functions to solve real time problems
CO5	To write C programs using Pointers to access arrays, strings, functions, structures and files

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2						2	3	2	3	3
CO2	2	2	3	3	3							3	2	2	3
CO3	2	3	2	2	2							3	2	3	2
CO4	3	2	2	3	3							2	2	2	2
CO5	2	2	2	1	1						2	3	3	3	3

Course Content:

Module- 1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Codeblock.

Module-2: Problem based on

- Basic datatypes
- Different arithmetic operators.
- Printf() and scanf() functions.

Module-3: Problem based on conditional statements using

- if-else statements
- different relational operators
- different logical operators

Module-4: Problem based on

- a) **for**loop
- b) **while**loop
- c) **do-while**loop

Module-5: Problem based on

- a) How to write a menu driven program using switch-case statement
- b) How to write a function and passing values to a function
- c) How to write a recursive function.

Module-6: Problem based on

- a) How to use array (both 1-D and 2-D).
- b) How to pass an array to a function.

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

- a) How to handle compound variable in C
- b) How to handle file in C
- c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. Kanetkar Y.-Let us C, BPB Publication, 15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India K R Venugopal & S R Prasad—MASTERING C, TMH, 2nd Edition

Course Name: Professional Communication Lab

Course Code: HU191

Contact: (0:0:2)

Total Contact Hours: 26

Credit: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:

By pursuing this course the students will be able to:

CO1: Recognize, identify and express advanced skills of Technical Communication in English through Language Laboratory.

CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.

CO3: Articulate and present the skills necessary to be a competent Interpersonal communicator. CO4: Deconstruct, appraise and critique communication behaviors.

CO5: Adapt, negotiate and facilitate with multifarious socio-economical and professional arenas with effective communication and interpersonal skills.

Course Contents:

Module 1: Introduction to the Language Lab

- a. The Need for a Language Laboratory
- b. Tasks in the Lab
- c. Writing a Laboratory Notebooks

Module 2: Active Listening

- a. What is Active Listening?
- b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
- c. Listening in Business Telephony

Module 3: Speaking

- a. Speaking—Accuracy and Fluency Parameters
- b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
- c. Fluency-focused activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
- d. Accuracy-focused activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
- e. Group Discussion: Principles and Practice
- f. Giving a Presentation—Learning Presentation Basics and Giving Micro Presentations

Module 4: Lab Project Work

- a. Writing a Book Review
- b. Writing a Film Review
- c. Scripting a Short Presentation (2minutes)
- d. Making a short video CV (1-2minutes)

References:

1. IT Mumbai, **Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasi Kumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

CO-PO Mapping

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

Course Name: Engineering chemistry lab**Paper Code: CH (CS) 191****Total Contact Hours: 24****Credit: 1****Course Objective**

- Study the basic principles of pH meter and conductivity meter for different applications
- Analysis of water for its various parameters & its significance in industries
- Learn to synthesis Polymeric materials and drugs
- Study the various reactions in homogeneous and heterogeneous medium

Course Outcome

CH191.1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CH191.2: Able to analyse and determine the composition and physical property of liquid and solid samples when working as an individual and also as a team member

CH191.3: Able to analyse different parameters of water considering environmental issues

CH191.4: Able to synthesize drug and sustainable polymer materials.

CH191.5: Capable to design innovative experiments applying the fundamentals of modern chemistry

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	3	1	-	2	3	-	-	-	-	1
2	2	2	1	1	-	1	-	-	-	1	-	1
3	-	-	-	-	-	-	-	-	3	3	2	2
4	2	1	2	2	-	-	1	-	-	-	-	2

5	3	3	3	3	1	1	1	1	-	-	2	2
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COURSE CONTENT

1. Determination of the concentration of the electrolyte through conductance measurement.
2. Determination of water quality measurement techniques.
3. Determination of the concentration of the electrolyte through pH measurement.
4. Estimation of Cu in brass
5. Estimation of Fe₂O₃ in Cement
6. Isolation of graphene from dead dry batteries and their use for temporary soldering.
7. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
8. Estimation of corrosion in a given sample metal.
9. Preparation of Si-nano crystals for future memory devices.
10. Green Synthesis of ZnO based Polymer Nano composites.
11. Synthesis of polymers for electrical devices and PCBs.
12. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
13. Drug design and synthesis
14. Rheological properties of the Newtonian fluids
15. Innovative Experiments

Course Name: Workshop and Manufacturing

Lab Course Code: ME(CS)191

Contact: 0:0:3

Credits: 1.5

Prerequisite: Physics & Mathematics (10+2 Level)

CO1: Gain basic knowledge of Workshop Practice and Safety useful for our daily living.

CO2: Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc.

CO3: Apply and performing operations like such as Marking, Cutting etc used in manufacturing processes.

CO4: Analyze the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.

CO5: Gethandson practice of in Welding and apply various machining processes which give a lot of confidence to manufacture physical prototype sin project works.

Course Content:

3P

(i)Theoretical discussions:

1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding(arc welding & gas welding),brazing
5. Electrical Electronics
6. Metal casting
7. CNC machining ,Additive manufacturing, 3D Printing
8. Plastic molding &Glass Cutting

(ii)Workshop Practice:

At least 6 Modules should be covered

Module 1-Machinshop

6P

Typical jobs that may be made in this practice

- i. To make a pin from mild steel rod in lathe.
- ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and/or milling machine.

Module 2-Fitting shop

6P

Typical job that may be made in this practice **Module:** To make a Gauge from MS plate.

Module 3 –Carpentry Shop

6P

Typical job that may be made in this practice **Module:** To make wooden joints and/or a pattern or like.

Module 4-Welding & Soldering shop

6P

Typical job that may be made in this practice **Module:**

- i. Arc Welding: To joint two thick (approx 5mm) MS plates by manual metal arc welding.
- ii. Gas Welding: To joint two thin mild steel plates or sheets by gas welding.
- iii. House wiring, soft Soldering

Module 5–Smithy & Casting

6P

Typical job that may be made in this practice **Module**:

- i. A simple job of making a square rod from a round bar or similar.
- ii. One/two green sand and mud stop prepare, and a casting bed demonstrated.

Module 6 – CNC Machining & Laser Cutting

6P

Typical job that may be made in this practice **Module**:

- i. At least one sample shape on mild steel plate should be made using CNC Milling / CNC Lathe Machine
- ii. At least one sample shape on glass should be made using laser cutting machine.

Module 7 – 3D Printing

6P

- i) Exposure to a 3D printing machine,
- ii) 3D printing of at least one sample model using available materials.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K.,
Hajra Choudhury A.K. and Nirjhar Roy S.K., – Elements of Workshop Technology II, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., – Manufacturing Technology II, Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, – Processes and Materials of Manufacture II, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting / Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO/PSO Mapping:

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

1 st Year 2 nd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS201	Data Structures	3	0	0	3	3
2	ENGG	Minor	EE(CS)201	Basic Electrical & Electronics Engineering	3	0	0	3	3
3	SCI	Multidisciplinary	PH(CS)201	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M(CS)201	Engineering Mathematics –II	3	0	0	3	3
5	HUM	Value added course	HU204	Environmental Science	2	0	0	2	2
6	HUM	Value added course	HU205	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS291	Data Structures Lab	0	0	3	3	1.5
2	ENGG	Minor	EE(CS)291	Basic Electrical & Electronics Engineering Lab	0	0	3	3	1.5
3	HUM	Ability Enhancement Course	HU292	Design Thinking	0	0	2	2	1
4	SCI	Skill enhancement course	PH(CS)291	Engineering Physics Lab	0	0	3	3	1.5
5	ENGG	Skill enhancement course	ME(CS)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
Total of Theory & Practical								29	22

Course Name: Data Structures
Course Code: CS201
Contact (Periods/Week):=3L/Week
Total Contact Hours: 36
Credits: 3

Course Objectives:

1. To learn the basics of abstract datatypes.
2. To learn the principles of linear and nonlinear datastructures.
3. To build an application using sorting and searching.

Course Outcomes	Name of Course Outcomes
CO1	To identify how the choices of data structure & algorithm methods impact the performance of program.
CO2	To express problems based upon different data structure for writing programs.
CO3	To implement programs using appropriate data structure & algorithmic methods for solving problems.
CO4	To explain the computational efficiency of the principal algorithms for sorting, searching, and hashing.
CO5	To write programs using dynamic and static data structures and building applications for real world problems.

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2		2	3						1	3	1	1	1
CO 2	3	2	2	2	2							2	3	2	2
CO 3	2	3	3	2	3						1	2	3	3	3
CO 4	2	2	2	3	1							1	2	1	2
CO 5	2	3	3	3	2						1	2	3	3	3
	2.40	2.40	2.50	2.40	2.20							2.00	2.40	2.00	2.20

Course Content:**Module 1: Introduction [4L]**

Concepts of data and information; Concept of Abstract Data Type, Data Structure and Data Type. Classification of Data Structures- Primitive and Non-Primitive Data Structure, Linear and Non-Linear Data Structure. Need of Data Structures. (1L)

Concept of algorithms and programs, Different methods of representing algorithm; Algorithm analysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Small Oh(o), Big Omega(Ω), Small Omega(ω) and Theta(Θ) notation (definition and significance).(3L)

Module 2: Non-Restricted Linear Data Structure[9L]

List or Linear List: Definition and Example, List as ADT. Representation of Linear List- Sequential Representation and Linked Representation.

Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array representation of polynomial using array, Representation of Sparse matrix using array.

Linked List: Introduction to linked representation, Implementation of different types of linked list- Singly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List.

Application of Linked list- Representation of polynomial.

Module 3: Restricted Linear Data Structure [6L]

Stack: Definition of Stack, implementations of stack using array and linked list, Applications of stack- infix to postfix conversion, Postfix Evaluation

Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.

Queue: Definition of Queue; Implementation of queue using array-physical, linear and circular model; Implementation of queue using linkedlist.

Deque - Definition and different types of dequeue.

Module 4: Nonlinear Data structures [9L]

Trees and Binary Tree:

Basic terminologies; Definition of tree and binary tree. Difference between tree and binary tree, Representation of binary tree (using array and linked list)

Binary tree traversal (pre-, in-, post- order); Threaded binary tree- definition, insertion and deletion algorithm; Binary search tree- Definition, insertion, deletion, searching algorithm;

Height balanced binary tree: AVL tree- definition, insertion and deletion with examples only.

m –Way Search Tree: B Tree – Definition, insertion and deletion with examples only; B+ Tree – Definition, insertion and deletion with examples only.

Heap: Definition (min heap and max heap), creation, insertion and deletion algorithm.

Application of heap (priority queue and sorting).

Graphs: Definition and representation (adjacency matrix, incidence matrix and adjacency list).

Graph traversal– Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge).

Module 5: Sorting and Searching [8L]

Sorting Algorithms: Definition and need of sorting, different types of sorting algorithm

(internal, external, stable, in-place, comparison based); Factors affecting sorting Methods,

Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort – algorithm with analysis (time complexity) Searching: Factors affecting searching Methods; Sequential search

–algorithm with analysis (time complexity); improvement using sentinel.

Binary search and Interpolation Search algorithm with analysis (time complexity)

Hashing: Introduction and purpose of Hashing and Hash functions (division, folding and mid-square), Collision resolution techniques.

Text book:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design in C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
4. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson.

MODULE 6: Introduction to IC:**8L**

Integrated circuit-Basic idea, classifications, advantages, disadvantages; OPAMP(IC741)-Pin configuration and equivalent circuit; Characteristics of OPAMP(IC741); Inverting & Non- Inverting Amplifier; Adder, Subtractor, Differentiator & Integrator Circuit.

Textbooks:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II (Ac & DC Machines)-B.L. Theraja & A.K. Theraja, S. Chad, 23rd Edition, 1959
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New Age International (P) Limited Publishers, Senenth Edition, 2006
3. Basic Electrical & Electronics Engineering by J.B. Gupta, S.K. Kataria & Sons, 2013
4. Basic Electrical and Electronics Engineering-I by Abhijit Chakrabarti and Sudip Debnath, McGraw Hill, 2015
5. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
6. DP Kothari and IJ Nagrath, "Basic Electrical & Electronics Engineering", Tata McGraw Hill, 2020.

Reference Books

1. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. T.K. Nagsarkar, M.S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hughes, "Electrical and Electronic Technology", Pearson Education".
4. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
5. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
6. Bernard Grob, Basic Electronics, McGraw Hill.
7. Chinmoy Saha, Arindham Halder and Debarati Ganguly, Basic Electronics-Principles and Applications, Cambridge University Press, 2018.

CO-PO Course Articulation Matrix Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	1	-	-	-	-	-	-	2	2
CO2	3	3	2	1	-	-	-	-	-	-	2	2
CO3	3	2	2	1	-	-	-	-	-	-	1	2
CO4	2	3	2	1	-	-	-	-	-	-	2	1

Course Name: Engineering Physics

Course Code: PH(CS)201

Contact: (3:0:0)

Total Contact Hours: 36

Credits: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of courses in Physic-I is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students' should be able to

CO	Description
CO1	explain basic principles of laser and optical fibers.
CO2	understand the properties of Nano material.
CO3	analyze different crystallographic structures according to their co-ordination number and packing factors.
CO4	analyze the structure, function and characteristics of different storage devices.
CO5	justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	--	--	--	--	--	--	--	2
CO2	3	3	2	2	--	--	--	--	--	--	--	2
CO3	3	3	2	2	--	--	--	--	--	--	--	1
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	3	2	2	--	--	--	--	--	--	1

Course Content:

Module 1 (12L)

Modern Optics

1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and

equations, working principle of laser, meta stable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L

1.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems.3L

1.03-Holography-Theory of holography, viewing of holography, applications 3L

Module 2 (6L) Solid State Physics

2.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems.

3L

2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

Module 3 (8L) Quantum Mechanics

3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment, related numerical problems.

4L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement).

4L

Module 4 (4L)**Physics of Nano materials**

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment, medical).

Module 5 (6L)**Storage and display devices**

Different storage and display devices-Magnetic storage materials, Hard disc (examples related to computers compared with semiconductor storage viz. Pendrive), Operation and application of CRT, CRO, Liquid crystal display (LCD), LED, OLED, Plasma display, Thin film transistor display).

Recommended Text Books for Physics I:**Text Books:**

1. Refresher courses in physics (Vol.1, Vol.2 & Vol.3)-C.L.Arora (S.Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt.Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.

Course Name: Engineering Mathematics - II

Paper Code: M(CS)201

Contact (L: T: P): 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard calculus.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. 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.

Course Outcomes (COs):

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

CO1: Recall the properties related to ordinary differential equations, Laplace transform and numerical techniques.

CO2: Determine the solutions of the problems related to ordinary differential equations, Laplace transform and numerical techniques.

CO3: Apply appropriate mathematical tools of ordinary differential equations, Laplace transform and numerical techniques for the solutions of the problems.

CO4: Analyze engineering problems by using ordinary differential equation, Laplace transform and numerical Methods.

CO-PO/PSO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	2	-	-	-	-	-	-	-	1
M(CS) 201	2.75	2.25	1.5	2	-	-	-	-	-	-	-	1.25

Weightage Values: Strongly mapped: '3', Moderately mapped: '2', Weakly mapped: '1', Not mapped: '0'.

Course Content:**Module I: First Order Ordinary Differential Equations (ODE) (9L)**

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation. **Solution of first order and higher degree ODE:** solvable for y , solvable for x and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE) (8L)

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations.

Module III: Laplace Transform (LT) (12L)

Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t^n f(t)$, LT of $f(t)t$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods (7L)

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation. **Numerical integration:** Trapezoidal rule, Simpson's 1/3 rule. **Numerical solution of ordinary differential equation:** Euler method, Fourth order Runge - Kutta method.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New Age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations, 1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Course Name: Environmental Science

Paper Code: HU204

Contact (L: T: P): 2 : 0 : 0

Total Contact Hours: 24

Credit: 3

Course Objective(s)

This course will enable the students to,

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome

CO	Statement
C01	Able to understand the natural environment and its relationships with human activities
C02	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk
C03	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues
C04	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

CO - PO Mapping

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Able to understand the natural environment and its relationships with human activities	2	2	3	-	-	2	3	3	-	-	1	2

2	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk	3	3	3	1	1	2	3	3	-	-	1	2
3	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues	3	3	3	2	1	2	3	3	-	-	1	2
4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.	1	1	1	1	2	2	3	3	-	-	1	2
AVERAGE		2	2	2	1	1	2	3	3	-	-	1	2

Module 1 - Resources and Ecosystem (6L)

1. Resources (2L)

Types of resources, resistance to resources, Human resource, Population Growth models: Exponential Growth, logistic growth

2. Ecosystem (3L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Food chain, Food web.

3. Energy and Environment(1L)

Conventional energy sources, coal and petroleum, Green energy sources, solar energy, tidal energy, geothermal energy, biomass

Module 2 – Environmental Degradation (9L)

1. Air Pollution and its impact on Environment (3L)

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (3L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD, COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal poisoning and toxicity.

3. Land Pollution and its impact on Environment (2L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes

4. Noise Pollution and its impact on Environment (1L)

Types of noise, Noise frequency, Noise pressure, Noise intensity, Noise Threshold limit, Effect of noise pollution on human health.

Module 3 – Environmental Management (6L)

1. Environmental Impact Assessment (1L)

Objectives of Environmental management, Components of Environmental Management, Environmental Auditing, Environmental laws and Protection Acts of India

2. Pollution Control and Treatment (2L)

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator, etc., Waste Water Treatment, Noise pollution control.

3. Waste Management (3L)

Solid waste management, Open dumping, Land filling, incineration, composting, E-waste management, Biomedical Waste management.

Module 4 – Disaster Management (3L)

1. Study of some important disasters (2L)

Natural and Man-made disasters, earthquakes, floods drought, landside, cyclones, volcanic eruptions, tsunami, Global climate change. Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

2. Disaster management Techniques (1L)

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. Basic Environmental Engineering and Elementary Biology (For MAKAUT), Gourkrishna Dasmohapatra, Vikas Publishing.
2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.
3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.
2. Environmental Science (As per NEP 2020), Subrat Roy, Khanna Publisher

Course Name: Indian knowledge System

Course Code: HU205

Credit: 01

No. of lectures: 12

Module-1 (3L)

An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.

The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life. Indian philosophical systems: Different schools of philosophy.

Module-2 (3L)

Salient features of the Indian numeral system - Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers.

Highlights of Indian Astronomy: Historical development of astronomy in India

Module-3 (3L)

Indian science and technology heritage - Metals and metalworking - Mining and ore extraction - Physical structures in India - Irrigation and water management - Dyes and painting technology - Surgical Techniques - Shipbuilding

Module-4 (3L)

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, Traditional Knowledge in agriculture, Traditional societies depend on it for their food and healthcare needs.

References:

1. Introduction to Indian knowledge system: concepts and applications-Mahadevan B.Bhat, Vinayak Rajat, Nagendra PavanaR.N., PHI
2. Traditional Knowledge system in India, Amit Jha, Atlantic Publishers
3. S. N. Sen and K. S. Shukla, History of Astronomy in India, Indian National Science Academy, 2nd edition, New Delhi, 2000

Course Name: Data Structures Lab
Course Code: CS291
Contact (Periods/Week): 3L/Week
Total Contact Hours: 36
Credits: 1.5

Course Outcomes	Name of Course Outcomes
CO1	To identify the appropriate data structure as applied to specified problem definition.
CO2	To summarize operations like searching, insertion, deletion, traversing mechanism used on various data structures.
CO3	To implement practical knowledge of data structures on the applications.
CO4	To illustrate how to store, manipulate and arrange data in an efficient manner.
CO5	To write programs to access queue and stack using arrays and linked list, binary tree and binary search tree.

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	1	1	1
CO2	3	2	2	3	3	-	-	-	-	-	3	2	3	2	2
CO3	2	3	3	-	2	-	-	-	-	-	-	2	3	3	3
CO4	2	2	1	3	2	-	-	-	-	-	2	3	2	1	2
CO5	2	2	3	1	2	-	-	-	-	-	-	3	3	3	3
	2.4	2.4	2.4	2.3	2.4	-	-	-	-	-	2.5	2.4	2.4	2	2.2

Course Content:

Module 1: Implementing Non-Restricted Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Restricted Linear Data Structure like- Implementation of list as data structure using array. Implementation of list as data structure using linked list of different types. Implementation of polynomial as data structure using array and linked list. Implementation of sparse matrix as data structure using array.

Module 2: Implementing Restricted Linear Data Structure [3 Lab]

Problem based on Implementation of Restricted Linear Data Structure like- Implementation of stack as data structure using array. Implementation of stack as data structure using linked list. Implementation of queue as data structure using array (physical, linear and circular model). Implementation of queue as data structure using linked list. Converting infix to post-fix and evaluating post-fix expression using stack. Implementing Tower-of-Hanoi problem.

Module 3: Implementing Non-Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Linear Data Structure like Implementation of Binary Tree as data structure using array and linked list. Implementation of Binary Search Tree (BST) as data structure using linked list. Implementation of Heap as data structure using array. Implementation of Priority Queue as data structure using Heap.

Module 4: Implementing Sorting and Searching algorithm [5 Lab] Problem based on

Implementation of Sorting and Searching algorithm

Implementation of Bubble sort using appropriate data

structure. Implementation of Selection sort using appropriate data structure.

Implementation of Insertion sort using appropriate data structure. Implementation of Quick sort using appropriate data structure.

Implementation of Merge sort using appropriate data structure.

Implementation of Heap sort using appropriate data structure.

Implementation of Radix sort using appropriate data structure.

Implementation of Sequential Search using appropriate data structure.

Implementation of Binary Search using appropriate data structure.

Implementation of hashing with collision resolution using linear and quadratic probing.

Text books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications.
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press.

Reference books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private.
3. Limited Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson.
4. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson

Course Name: Basic Electrical & Electronics Engineering Lab

Course Code: EE(CS)291

L-T-P: 0-0-3

Total Lecture: 36

Credit: 1.5

CO	Statement
CO1	To Analyze a given network by applying KVL and KCL.
CO2	To Examine the Operation of DC Motor.
CO3	To Examine the Operation of Basic Electronics Devices and ICs.
CO4	To design simple electronics circuits.

List of Experiments: -

1. Familiarization with different passive and active electrical & electronic components.
2. Familiarization with different Electrical & Electronics Instruments.
3. Verification of KVL and KCL.
4. Forward and reversal of DC shunt motor.
5. Speed control of DC shunt motor.
6. Study of the P-N junction diode V-I characteristics (Forward & Reverse Bias).
7. Study of the Characteristics of Zener diode (Forward & Reverse Bias).
8. Study of the Input and Output characteristics of BJT in CE mode.
9. Determination of offset voltage, offset current & bias current of OPAMP (IC741).
10. Determination of CMRR and slew rate of OPAMP (IC741).
11. Determination of inverting and non-inverting gain of OPAMP (IC741).
12. Extramural Experiment.

Textbooks:

1. Handbook of Laboratory Experiments in Electronics Engineering Vol. 1, Author Name: A.M. Zungeru, J.M. Chuma, H.U. Ezea, and M. Mangwala, Publisher -Notion Press
Electronic Devices and Circuit Theory by Robert Boylestad Louis Nashelsky, 7th Edition, Prentice Hall
2. Experiments Manual for use with Grob's Basic Electronics 12th Edition by Wes Ponick, Publisher-McGraw Hill, 2015
3. Laboratory Manual for 'Fundamentals of Electrical & Electronics Engineering': A handbook for Electrical & Electronics Engineering Students by Manoj Patil (Author), Jyoti Kharade (Author), 2020
4. The Art of Electronics, Paul Horowitz, Winfield Hill, Cambridge University Press, 2015.
5. A Handbook of Circuit Math for Technical Engineers, Robert L. Libbey CRC Press, 05-Jun-1991

Reference Books

1. Basic Electrical and Electronics Engineering, Author:S. K. Bhattacharya, Publisher: Pearson EducationIndia,2011
2. Practical ElectricalEngineering
3. By Sergey N. Makarov, Reinhold Ludwig, Stephen J. Bitar, Publisher: Springer International Publishing,2016
4. Electronics Lab Manual (Volume 2) By Navas, K. A. Publisher: PHI Learning Pvt. Ltd. 2018
5. Practical Electronics Handbook, Ian R. Sinclair and John Dunton, Sixth edition 2007, Published by ElsevierLtd.

CO-PO Course Articulation Matrix Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	2	-	2	-	-	2	-	2	3
CO2	3	3	2	3	-	2	-	-	3	-	2	2
CO3	3	2	2	3	-	2	-	-	2	-	3	3
CO4	3	3	2	2	-	2	-	-	3	-	2	3

Course Name: Engineering Physics Lab

Code: PH(CS)191

Contact Hours: 0:0:3

Credit: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students' will be able to

CO1 : demonstrate experiments allied to their theoretical concepts
CO2 : conduct experiments using LASER, Optical fiber.

CO3 : participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO4 : analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovative experiment.

CO5: Design solutions for real life challenges.

CO-PO Mapping:

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

Course Content:

General idea about Measurements and Errors (One Mandatory):

1. Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
2. Experiments on Classical Physics (Any 4 to be performed from the following experiments):
3. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
4. Determination of Young's modulus of different materials.
5. Determination of Rigidity moduli of different materials.
6. Determination of wavelength of light by Newton's ring method.
7. Determination of wavelength of light by Laser diffraction method.
8. Optical Fibre-numerical aperture, power loss.
9. Experiments on Quantum Physics (Any 2 to be performed from the following experiments):
10. Determination of Planck's constant using photoelectric cell.
11. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
12. Determination of Stefan's Constant.
13. Study of characteristics of solar cell.
14. Perform at least one of the following experiments:

15. Calibration of an oscillator using Lissajous Figure.
16. Determination of specific charge of an electron (e/m) by J. J. Thomson Method.

**In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Study of dispersive power of material of a prism.
2. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
4. Determination of the angle of optical rotation of a polar solution using polarimeter.
5. Any other experiment related to the theory.

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

Course Name: Design thinking

Course Code: HU292

Credit: 01

L:T:P:: 0:0:2

Module 1: Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. **2**

Module 2: Memory: process, Sensory memory, STM and LTM, Problems in retention, Memory enhancement techniques. **4**

Module 3: Emotions: Experience & Expression Understanding Emotions, Empathy, And Concept of Emotional Intelligence. **2**

Module 4: Basics of Design Thinking Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test. **6**

Module 5: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving **4**

Unit 6: Prototyping & Testing -Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing **2**

Module-7: Design thinking for strategic innovations Growth –Change- Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience -Value redefinition - Extreme Competition – Standardization —Strategy– Business Model design. **4**

References:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) second Edition,2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press,2009.
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons2013
4. George,E,Dieter,Linda,C,Schmidt.(2017).EngineeringDesign,McGrawHillpublisher,4thedition

Course Name: Engineering Graphics & Design Lab

Course Code: ME(CS)291

Contact: 0:0:3

Credits: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes: Upon successful completion of this course, the student will be

able to: CO1: Learn the basics of drafting

CO2: Understand the use of drafting tools which develops the fundamental skills of industrial drawings.

CO3: Apply the concept of engineering scales, dimensioning and various geometric curves necessary to understand design of machine elements.

CO4: Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.

CO5: Evaluate the design model to different sections of industries as well as for research & development.

Course Contents:

Basic Engineering Graphics: (3P)

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.

Module 1: Introduction to Engineering Drawing (6P)

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections (6P)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids (6P)

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics: (3P)

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics: (3P)

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog

boxesandwindows,Shortcutmenus(ButtonBars),Zoomingmethods,Selectanderaseobjects].

Module 5: CAD Drawing, Customization, Annotations, layering (6P)

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printingdocuments.

Module 6: Demonstration of a simple team design project (3P)

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age Internationalpublishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna PublishingHouse
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMHPublication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2			2									2	2	2
CO2	2			2									2	2	2
CO3	3			2									2	2	2
CO4	3			3									3	3	2
CO5	3	2		3	2								3	3	2

2 ND YEAR 3 RD SEMISTER									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	CS302	Design and Analysis of Algorithms	3	1	0	4	4
3	SCI	Minor	M(CS)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CS)301	Digital Logic and Electronics	3	0	0	3	3
A. PRACTICAL									
1	ENGG	Major	CS391	Computer Organization and Architecture Lab	0	0	3	3	1.5
2	ENGG	Major	CS392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(CS)391	Digital Electronics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CS393	IT Workshop Lab (SciLab/MATLAB/C++)	0	1	3	4	2.5
Total of Theory, Practical								26	20

Course Name: Computer Organization and Architecture

Course Code: CS301

Contact: 3:0:0

Total Contact Hours: 36L

Credits: 3

Prerequisite: Digital Electronics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of computer architecture and its performance measurement, parallel processing, Flynn's classification and Amdahl's law and apply this knowledge in designing solutions for real life engineering problems.
CO2	Summarize the basic concept of pipeline, instruction pipeline, arithmetic pipeline hazards detection and prevention and use this knowledge for designing and implementing mathematical and engineering problems leading to lifelong learning.
CO3	Identify the concept of Instruction-Level Parallelism to solve engineering problems.
CO4	Illustrate and compare the concept of Multiprocessor architecture and parallel architecture and apply this knowledge for developing an approach by means of existing and new methods as a teamwork.
CO5	Understand the concept of message passing architecture and interconnection network and design an optimized model for building a new solution as a professional engineering practice as a team.

Course Contents:

Module 1[8L]:

Introduction to CPU and concepts of ALU [2L], Instruction format and Instruction Cycle [1L], Addressing Modes [1L] Fixed- point multiplication -Booth's algorithm. [2L], Fixed-point division - Restoring and non-restoring algorithms [1L], Floating-point number representation-IEEE754 format and Floating-point arithmetic operation [1L].

Module 2 [7L]:

Introduction to basic computer architecture [1L], Stored Program Concepts: Von Neumann & Harvard Architecture [1L], RISC VS CISC [1L], Amdahl law [1L], Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. [2L] Micro programmed and hardwired control unit [1L].

Module 3[8L]:

Pipelining: Basic concepts, instruction and arithmetic pipeline [2L], data hazards, control hazards and structural hazards, techniques for handling hazards [2L] Pipeline vs. Parallelism, Levels of parallelism [1L], Instruction- Level Parallelism: Basic Concepts, Techniques for Increasing ILP, Superscalar, SuperPipelined and VLIW Processor Architectures [2L], Array and Vector Processors [1L]

Module 4[9L]:

Introduction to memory-RAM and ROM [1L], Register transfer, memory transfer, Tri-state bus buffer, Memory Hierarchy: Secondary memory [1L], Main Memory [1L], Cache Memory [1L], Mapping Technique in cache memory: Direct, Full Associative and Set Associative [2L], Performance Implementation in Cache Memory [1L], Virtual memory Concepts [1L], page replacement policies [1L].

Module 5[4L]:

Multiprocessor architecture: taxonomy of parallel architectures; Flynn Classification [1L], Centralized and Shared- memory architecture: synchronization [1L], Interconnection Network (Omega, Baseline, Butterfly, Crossbar) [2L].

Text Books:

1. Advanced Computer Architecture Parallelism Scalability Programmability, Tata McGraw-Hill Education Private Limited ISBN-13: 978-0-07-053070-6 ISBN-10:0-07-053070-X
2. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH

Reference Books:

1. Patterson D.A. and Hennessy, J.L.—Computer Architecture a quantitative approach, 2nd ed. Morgan Kaufman, 1996
2. Hayes J. P., —Computer Architecture & Organization, McGraw Hill
3. Siegel, H.J., —Interconnection Network for Large Scale parallel Processing, 2nd Ed. McGraw Hill, 1990
4. Design and Analysis of Parallel Algorithm—Schism G. Akl

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
CO1	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	2	2	2	3	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Design & Analysis of Algorithm

Course Code:CS302

Contact: 3:1:0

Total Contact Hours: 36L

Credits: 4

Prerequisites: To know data-structure and basic programming ability

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and illustrate the concepts of time and space complexity, worst case, average case and best-case complexities and the asymptotic notation.
CO2	To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy methods etc.
CO3	To understand and analyze various string matching and graph algorithms.
CO4	To understand, illustrate and analyze the different complexity classes
CO5	To discuss, implement and analyze, verify the efficiency of the randomized and approximation algorithms.

Course Content:

Module-1 [4L]

Algorithm Development & Complexity Analysis: [4L] Stages of algorithm development for solving a problem: Describing the problem, identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm. Time and Space Complexity, Different Asymptotic notations – their mathematical significance. Solving Recurrences: Substitution Method, Recurrence Tree Method, Master Theorem (Statement Only).

Module-2 [14L]

Algorithm Design Techniques Brute force techniques – Traveling Salesman Problem, Divide and Conquer - Matrix multiplication: Strassen algorithm, Greedy techniques - Fractional Knapsack problem, Job Sequencing with Deadline, Graph Coloring, Finding Minimum Cost Spanning Tree, Dynamic programming - 0/1 Knapsack problem, Matrix chain multiplication, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module-3 [3L]

String matching problem: Different techniques – Naive algorithm, string matching using finite automata, and Knuth, Morris, Pratt (KMP) algorithm with their complexities.

Module-4 [5L]

Graph Algorithms Single Source Shortest Path -Dijkstra Algorithm, All pair shortest path – Floyd-Warshall Algorithm. Network Flows, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module-5 [5L]

Complexity Classes: The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.

Module-6 [5L]

Approximation and Randomized Algorithms [3L], Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum. Recent Trends[2L]

Textbook:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman. 3. "Algorithm Design" by Kleinberg and Tardos.
3. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi Reference Books:
4. —Design Analysis and Algorithms by Hari Mohan Pandey.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Discrete Mathematics

Course Code: M(CS)301

Contact: 3:0:0

Total Contact Hours: 36L

Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Outcome(s):

After completion of the course students will be able to

CO1	Understand the fundamental concepts of Set Theory to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Mathematical Logic and Proof Techniques so that they can Prove theorems using Proof Techniques and Mathematical Logic Frameworks to justify a claim.
CO3	Explain or illustrate the fundamental Theory of Numbers and Identify problems where students can Use the concept appropriately to Solve them.
CO4	Explain or illustrate the fundamental principles of Algebraic Structures and Identify problems where students can Apply the concept appropriately to Solve them.
CO5	Develop ideas to Propose solutions to the problems of Graph Theory and Identify problems where students can Apply the concept appropriately and analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

Module -1[16L]

Set Theory [8L] Set: Operations and Properties of set, Finite Set, Power Set, Cardinality of finite set, Cartesian Product, Relation: Types of Relations, Properties of Binary Relation, Equivalence Relation, Partial Ordering Relation and Poset, Lattice.[4L] Combinatorics and Counting: Sum and product rule, Permutation and Combination Principle of InclusionExclusion. Pigeon Hole Principle.[2L] Generating Functions and Recurrence Relations: Recursively defined relation and functions, Discrete Numeric Function, Growth of Functions, Problems on Recurrence Relations and their solutions using different methods.[2L]

Module-2[16L]

Mathematical Logic and Proof Techniques [8L] Propositional Logic: Basics of Boolean Logic, Idea of Propositional Logic, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Inference theory of Propositional Logic.[3L] Predicate Logic: Idea of First Order Predicate Logic and Quantifiers, well-formed formula of predicate, Inference theory of Predicate Logic.[3L] Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.[2L].

Module-3 [8L]

Theory of Numbers [4L] Well-Ordering Principle, Divisibility theory and properties of Divisibility, Fundamental theorem of Arithmetic, Prime and Composite Numbers. [2L] Greatest Common Divisor and Euclidean Algorithm, Congruence, Residue Classes. [2L]

Module-4 [16L]

Algebraic Structures [8L] Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms.[5L] Elementary properties of Rings and related problems[1L] Elementary properties of Fields and related problems. [1L] Elementary properties of Vector Space and related problems. [1L]

Module-5 [16L]

Graph Theory [8L] Graph Terminologies and their properties: Degree, Connectivity, Path, Cycle, Sub-Graph, Isomorphism, Eulerian and Hamiltonian Walks, Matrix representation of graphs, Shortest Path in Graph. [2L] Graph Colouring and Matching: Colouring Vertices and Chromatic Number, Colouring Edges and Total Colouring, Independence and Chromatic Partitioning, Cliques, Perfect Graphs, Bounds on Chromatic Numbers, Chromatic Polynomials, Matching.[3L] Tree: Rooted Trees, Binary Search Tree and Tree Sorting, Spanning Tree, Weighted Trees and prefix codes. [3L]

Textbook:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw –Hill.
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co. Inc.

Reference Books:

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw –Hill.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science, TMG Edition, Tata McGraw-Hill
3. Seymour Lipschutz, Marc Lipson, Discrete Mathematics (Schaum Outlines Series), Tata McGraw -Hill.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Digital Logic and Electronics

Course Code: EC(CS)301

Contact: 3:0:0

Credit: 3

Total Contact Hours: 36L

Pre-requisite:

Basic concepts of Logic gates, Truth Tables, Concept of basic components of a digital computer.

Course Outcome(s):

CO1: To realize basic gate operations and laws Boolean algebra.
CO2: To understand basic mechanism of digital computers and digital logic behind different arithmetic and control unit operations.
CO3: To design combinational circuits and combinational functions for larger more complex circuits. CO4: To Perform different operations with sequential circuits.
CO5: To understand fundamental concepts and techniques used in Logic families and PLDs

Course Content: –

Module – 1[8L]

Binary Number System [1L]; BCD, ASCII, EBDIC, Gray codes and their conversions [1L], Introduction and laws of Boolean algebra [1L], Boolean functions, Minterm and maxterm, Prime implicants, Representation in SOP and POS forms[2L], Minimization of logic expressions by Karnaugh Map and algebraic method [3L]

Module – 2[8L]

Combinational circuits:

Adder and Subtractor (half-full adder & subtractor) [2L], Serial & Parallel Adder, Carry look ahead adder and Parity Generator[2L], Encoder, Decoder, Multiplexer [2L], Demultiplexer, Comparator, Code Converters [2L]

Module – 3[12L]

Sequential Circuits:

Flip-Flops, SR, JK, Master slave JK, D, T, characteristic Tables, Excitation tables [5L]. Basic concept of Synchronous and Asynchronous counters, Up/Down Counters, Ring counter, Johnson counter, Design of Modulo-N Counter, Counter applications [5L]. Registers (SISO, SIPO, PIPO, PISO) [2L].

Module – 4[8L]

A/D and D/A conversion techniques – Basic concepts (D/A:R-2-R only [2L], A/D: successive approximation [2L])Logic families- TTL, ECL, MOS and CMOS - basic concepts [2L],Programmable logic Array, programmable Array logic, Sequential Programmable Devices [2L].

Text Book:

1. Saliva Hanan S, Digital Circuits and Design,Oxford
2. Morries Mano- Digital Logic Design-PHI

Reference Book:

1. R.P.Jain—Modern Digital Electronics, 2/e, Mc GrawHill
2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd,Pearson

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	1	-	-	1	-
CO2	3	3	-	2	-	-	2	-	-	1	-	-
CO3	3	3	-	-	-	-	-	2	-	2	-	2
CO4	-	-	3	3	3	-	-	-	2	-	-	-
CO5	3	2	-	-	-	2	-	-	2		2	-

Course Name: Computer Organization and Architecture Lab

Course Code: CS391

Contact: 0:0:3

Credits: 1.5

Prerequisites:

Knowledge of designing different circuits in Computer Organization Lab

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate and use proper syntax in appropriate platforms for developing programs to solve problems related to Mathematics and Engineering fields leading to lifelong learning.
CO2	Apply the knowledge of algorithms in the computational area to efficient programming codes to design the problem using modern tools for solving complex engineering problems.
CO3	Outline different types of digital electronic circuits such as adder, subtract or, encoder decoder, multiplexer, demultiplexer, flip-flops, register, counter using various mapping and modern tools to prepare the most simplified circuit and optimize using various mapping and mathematical methods for solving the problem as a professional engineering practice as a team.
CO4	Apply the knowledge of digital electronic circuits to design memory and ALU and analyze the same to solve engineering-related computational problems as a team.
CO5	Interpret the result of the experiments, prepare laboratory reports based on observed output and analyze it to validate professional ethics and responsibilities and norms of the engineering practice.

List of Experiment:

1. Implement different types of Basic gates and simulate for truth table verification.
2. Implement half adder circuit and simulate for truth table verification.
3. Implement full adder circuit and simulate for truth table verification.
4. Implement half subtractor circuit and simulate for truth table verification.
5. Implement a full subtractor circuit and simulate for truth table verification.
6. Implement Multiplexer, De-Multiplexer circuit and simulate for truth table verification.
7. Implement Encoder, Decoder circuit and simulate for truth table verification.
8. Implement different types of flip flop and simulate for truth table verification.
9. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
10. Implement ALU and simulate the result.
11. Implement a RAM chip and simulate the result.
12. Innovative Experiments.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Design & Analysis of Algorithm Lab

Course Code: CS392

Contact: 0:0:3

Credit: 1.5

Prerequisite:

Programming knowledge

Course Outcomes (COs):

After attending the course students should be able to

CO1	To identify and prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
CO2	To understand and illustrate methods for analyzing the efficiency and correctness of algorithms (such as exchange arguments, recurrence, induction, and average case analysis)
CO3	To analyze and design algorithms using the dynamic programming, greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy.
CO4	To understand, compare, contrast, and choose appropriate implementation of the algorithmic design techniques to present an algorithm that solves a given problem.
CO5	To Identify and analyze criteria and specifications appropriate to new problems.

Course Content:

- A.** Implementation of various Divide & Conquer Methods; viz. Matrix Multiplication.
- B.** Implementations of various Dynamic Programming Methods, viz. Matrix Chain Multiplication Method, Travelling Salesman Problem etc.
- C.** Implementations of various Branch & Bound Techniques, viz.
- D.** Implementations of various Backtracking Methods, viz. n-Queen Problem.
- E.** Implementations of Greedy Method, viz. Fractional Knapsack Problem, Job Sequencing Problem etc.
- F.** Implementations of String-matching Algorithm viz. Naïve Algorithm, String Matching with Finite Automata etc.
- G.** Implementations of Various Graph Algorithms, viz. Dijkstra's Algorithm, Floyd Algorithm etc.
- H.** Implementation of some Real-Life Trendy Problems

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Electronics Lab

Course Code: EC (CS)391

Contact: 0:0:3

Credit: 1.5

Prerequisite:

Basic concepts of Logicgates, Truth Tables, function realization –minimization of Logic expressions by K-map, Concept of basic components of a digital computer, Binary Arithmetic

Course Outcomes (COs):

After attending the course students should be able to

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyze the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common- mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT &OPAMP.
CO5	Familiarization and basic knowledge of Integrated Circuits

Course Content:

1. A) Realization of basic gates and universalgates.
B) Realization of basic gates using universal gates.
2. Design a Half adder and Full Adder circuit using basic gates and verify itsoutput.
3. Design a Half subtractor and Full Subtractor circuit using basic gates and verify itsoutput
4. Design an Adder/Subtractor compositeunit.
5. Design of a _Carry-Look-AheadAddercircuit.
6. Realization of a)Encoder, b)Decoder c) Multiplexer, d) De-mux, e)Comparator and their Truth Tableverification.
7. Realization of RS / JK / D flip flops using logicgates.
8. Design of Shift Register using J-K / D FlipFlop.
9. Realization of Synchronous Up/Downcounters.
10. Design of MOD- NCounter
11. Study ofDAC
12. Study of logic families andPLDs

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2		2
CO4	2	2	2
CO5	2	2	2

Course Name: IT Workshop Lab (SciLab/MATLAB/C++)

Course Code: CS393

Contact: 0:1:3

Credits: 2.5

Prerequisite

Computer Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	Demonstrate a thorough understanding of modular programming by designing programs that require the use of programmer-defined functions.
CO2	Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO3	Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.
CO4	Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.
CO5	Demonstrate an understanding of the differences between C and C++ in the areas of strings, pass by reference/passing pointers, and structs by designing and implementing programs that use C strings, C++

Course Content:

1. Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file.
2. Handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler, as well as introduction to GNU & GDBscript.
3. Introduction to C++, basic loop control, executing programs.
4. Writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures & unions.
5. Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors.
6. Dealing with member functions, operator overloading and polymorphism (both static & dynamic).
7. Dealing with inheritance, derived class handling.
8. Abstract class, virtual class, overriding, template class, name-space & exception handling.
9. Dynamic memory allocation, implementation of Linked Lists, using C++.
10. MATLAB Environment, variable, constant, operators, loop, function.
11. MATLAB Toolbox, MATLAB Graphic function.
12. Reading and Writing to file, Numerical simulation.
13. Innovative experiments/Projects

Text Books

1. The C++ Programming Language by Bjarne Stroustrup Addison-Wesley publisher
2. Object-Oriented Programming in C++ b by Robert Lafore Publisher:Sams

Reference Books

1. Object Oriented Programming with C++ by Balaguruswamy McGraw Hill Education; Sixth edition Addison- Wesley publisher
2. Object-Oriented Programming in C++ b by Robert Lafore Publisher:Sams
3. MATLAB Getting StartedGuidehttps://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

2nd Year 4th Semester									
Sl No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CS401	Operating Systems	3	0	0	3	3
2	ENGG	Major	CS402	Computer Networks	3	0	0	3	3
3	ENG	Major	CS403	Formal Language and Automata Theory	3	0	0	3	3
4	SCI	Minor	M(CS)401	Probability and Statistics	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(CS)401	Principles of Management	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	CS491	Operating Systems Lab	0	0	3	3	1.5
2	ENGG	Major	CS492	Computer Networks Lab	0	0	3	3	1.5
3	ENGG	Major	CS493	Programming using Python	0	0	3	3	1.5
4	ENGG	Minor	M(CS)491	Numerical Methods Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(CS)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory, Practical								28	21

Paper Name: Operating System

Paper Code: CS401

Contact Hours/Week: 3

Credit: 3

Total Contact Hours: 36L

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of Operating System, Protection & Security and differentiate different types of Operating System.
CO2	Understand and implement process & thread; understand, apply, compare different process synchronization algorithm and inter process communication to solve engineering problems
CO3	Understand/explain/analyze different synchronization techniques, critical section problems and deadlock and apply them to solve engineering problems.
CO4	Understand/explain different memory management techniques including virtual memory management; also able to apply, compare, and implement different page replacement algorithms to solve engineering problems.
CO5	Understand/explain different I/O mechanisms, File structures and disk management techniques and solving engineering problems applying different disk scheduling algorithms.

Course Content:

Module – 1:[3L]

Functionalities of Operating System, Evolution of Operating System.

Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security. [3L]

Module – 2: [11L]

Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, Inter-process communication:

Message passing. [3L]

Threads: overview, benefits of threads, user and kernel level threads, Thread models. [2L]

CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling). [6L]

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer Networks**Course Code: CS402****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisite:**

1. Familiarity and knowledge of Operating Systems and Computer Architecture.
2. Also require a little bit of programming languages concepts like C, Java.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand basics of computer network and different architecture and topologies of computer network and analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
CO2	Understand/analyze different protocols of the data link layer and apply them to solve engineering problems.
CO3	Understand/analyze different protocols of Network and Transport Layer and apply them to solve engineering problems.
CO4	Understand/analyze different protocols of session and application layer and apply them to solve engineering problems.
CO5	Develop, Analyze, specify and design the topological and routing strategies using socket programming.

Course Contents:**Module 1: Introduction [6L]****Introduction (3L):**

Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.

Physical Layer: [3L]

Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) &

transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

Module 2: Data Link Layer [10L]

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-NandSelectiveRepeat,HDLC,PPPMediumAccessControlSub-layer,TheChannelAllocation.[5L]
Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching.[5L]

Module 3: Network Layer [10L]

IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting,DesignIssues,Store-and-ForwardPacketSwitching,Virtual-CircuitandDatagramNetworks, ARP,IP,ICMP,IPV6,BOOTPandDHCP–DeliveryprotocolsOtherProtocolssuchasmobileIPinwireless

Network. [5L]

Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing for Mobile Hosts. [5L]

Module 4: Transport layer: [6L]

Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion controlinTCP:CongestionControl:OpenLoop,ClosedLoopchokepackets;Qualityofservice:techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.[5L]
Advanced topic such as Remote Procedure Call, Delay Tolerant Networks. [1L]

Module 5: Application Layer [3L]

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module 6: Socket Programming [1L]

Introduction to Socket Programming, UDP socket and TCP Socket

Text books:

1. B. A.Forouzan —DataCommunicationsand Networking(3rdEd.)— TMH
2. S. Tanenbaum —ComputerNetworks(4th Ed.)–Pearson Education/PHI
3. W. Stallings —DataandComputer Communications (5th Ed.)– PHI/PearsonEducation
4. Zheng & Akhtar, Network for Computer Scientists & Engineers,OUP

Reference books:

- 1.Kuroseand Rose– –Computer Networking -Atop-downapproach featuring the internet– PearsonEducation
1. Leon,Garica,Widjaja—Communication Networks|–TMH
2. Walrand —Communication Networks|– TMH.
3. Comer—InternetworkingwithTCP/IP, vol. 1,2,3(4th Ed.)|– PearsonEducation/PHI

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2				2	2		3
CO2	3	3	3	3	3				2	2		3
CO3	3	3	3	3	3				2	2		3
CO4	3	3	3	3	3				2	2		3
CO5	2	3	3	3	3				2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Formal Language and Automata Theory

Course Code: CS403

Contacts: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

1. Digital Logic
2. Computer organization
3. Computer Fundamentals

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of Finite State Automata to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Regular Expressions and its relation with DFA so that they can Develop regular expression for a specified language and Validate it.
CO3	Understand the fundamental concepts of Context Free Grammar so that they can Design grammar for a specified language and Validate it.
CO4	Explain or Illustrate the fundamental operating principles of Push Down Automata and Use it appropriately to Solve problems.
CO5	Understand the operating principles of Turing Machine and Design Turing Machines to Propose solution to the related problems appropriately and validate the effectiveness as well as limitations of computations making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Contents:**Module-1: [9L]**

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, [1L]

Introduction to Finite State Model (FSM), Design of sequence detector, Finite State Machine, Finite Automata, Deterministic Finite Automation (DFA) and Non-deterministic Finite Automation (NFA), Transition diagrams, Transition tables and Language recognizers. [3L]

NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion. [2L]

Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill-Nerode Theorem [2L]

Limitations of FSM, Application of Finite Automata [1L]

Module-2: [7L]

Finite Automata with output – Moore & Mealy machine. Representation of Moore & Mealy Machine, Processing of the String through Moore & Mealy Machine, Equivalence of Moore & Mealy Machine – Inter-conversion. [2L]

Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy Machine [1L]

Minimization of incompletely specified machine – Merger Graph, Merger Table, Compatibility Graph [2L]

Lossless and Lossy Machine – Testing Table, Testing Graph [2L]

Module-3: [5L]

Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden's Theorem statement and proof [1L]

Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA [2L]

Constructing Regular Expression for a given Finite Automata [1L]

Pumping Lemma of Regular Sets. Closure properties of regular sets [1L]

Module-4: [9L]

Grammar Formalism-Context Free Grammars, Derivation trees, sentential forms. Rightmost and leftmost derivation of strings, Parse Tree, Ambiguity in context free grammars. [1L]

Minimization of Context Free Grammars. [1L], Removal of null and unit production [1L] Chomsky normal form and Greibach normal form. [1L]

Pumping Lemma for Context Free Languages. [1L]

Enumeration of properties of CFL, Closure property of CFL, Ogden's lemma & its applications [1L], Regular grammars – right linear and left linear grammars [1L]

Pushdown Automata: Pushdown automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA [1L]

Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. [1L]

Equivalence of CFL and PDA, inter-conversion. [1L]

Module-5: [5L]

Turing Machine: Turing Machine, definition, model [1L]

Design of TM, Computable functions [1L], Church's hypothesis, counter machine [1L] Types of Turing machines [1L]

Universal Turing Machine, Halting problem [1L]

Textbook:

1. Introduction to Automata Theory Languages and Computationl, Hopcroft.E. and Ullman J.D., Pearson Education.

Reference Books:

1. Formal Languages and Automata Theoryl,C. K. Nagpal,Oxford
2. -SwitchingandFiniteAutomata Theoryl,ZviKohavi, 2ndEdition, TataMcGrawHill

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	2	2	2	2								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	3	3	3	3					2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Probability and Statistics

Course Code: M(CS)401

Contacts: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard algebra and calculus.

Course Outcome(s):

After completion of the course students will be able to

CO1: Recall the distinctive principles of probability and statistics.

CO2: Understand the theoretical workings of theory of probability and tests of hypotheses.

CO3: Apply statistical methods to compute and explain point estimators and interval estimators for mean, variance and proportion.

CO4: Analyze statistical data from engineering experiments.

Course Content

Module 1 (Probability and Random Variables) [15L]

The axioms of probability , Conditional probability, Baye_s theorem, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Module 2 (Two dimensional random variables) [5L]

Joint distributions, Marginal and conditional distributions, Covariance , Correlation and linear regression , Transformation of random variables , Central limit theorem (for independent and identically distributed randomvariables).

Module 3 (Sampling Distribution) [3L]

Distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems

Module 4 (Estimation) [4L]

Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.

Module 5 (Testing of Hypotheses) [9L]

Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi square goodness of fit test and its applications, problems.

Course Name: Principles of Management

Course Code: HU(CS)401

Contacts: 2:0:0

Total Contact Hours: 24

Credits: 2

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concepts and technologies used in the field of management information Systems
CO2	Have the knowledge of the different types of management information systems
CO3	Understand the processes of developing and implementing information systems.
CO4	Be aware of the ethical, social, and security issues of information systems.
CO5	An ability to effectively integrate IT-based solutions into the user environment

Course Content:

Module-1: Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow(4L)

Module - 2: Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO, SWOT analysis, McKinsey’s 7S Approach. Organizing for decision making: Nature of organizing, span of control, Organizational structure –line and staff authority. Basic control process -control as a feedback system – Feed Forward Control –Requirements for effective control – control (4L)

Module - 3: Group dynamics: Types of groups, characteristics, objectives of Group Dynamics. Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership(4L)

Module – 4: Work Study and work measurement: Definition of work study, Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling(4L)

Module - 5: Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy (2L)

Module - 6: Quality management: Quality definition, Statistical quality control, acceptance sampling, Control Charts –Mean chart, range chart, c chart, p chart, np chart, Zero Defects, Quality circles,, Kaizen & Six Sigma, ISO -9000 Implementation steps, Total quality management(6L)

Text Books:

1. Essentials of Management, by Harold Koontz & Heinz Weihrich TataMcGraw
2. Production and Operations Management-K.Aswathapa,K .Shridhara Bhat,Himalayan PublishingHouse

References:

1. Organizational Behavior, by Stephen Robbins Pearson Education, NewDelhi
2. New era Management, Daft, 11th Edition, Cengage Learning
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2							3	
CO2	3	2	2	2							3	
CO3	3	3	2	2							3	
CO4	3	2	2	2							3	
CO5	3	2	2	2							3	

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Operating Systems Lab

Course Code: CS491

Allotted Hours: 36L

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

Course Content:

1. **Essential Linux Commands[9P]:** Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes(use functions pipe, popen, pclose), named Pipes (FIFOs, accessingFIFO)
2. **Shell Programming [6P]:** Creating a script, making a script executable, shell syntax (variables, conditions,control structures, functions, andcommands).
3. **Process [3P]:** Starting new process, replacing a process image, duplicating a processimage.
4. **Semaphore [3P]:** Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).
5. **POSIX Threads[6P]:** Programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit,pthread_attr_init, pthread_cancel).
6. **Shared Memory [9P]:**Create the shared memory , Attach the shared memory segment to theaddress spaceofthecallingprocess,Readinformationfromthestandardinputandwritetothesharedmemory, Readthecontentofthesharedmemoryandwriteontothestandardoutput,Deletethesharedmemory

Books:

1. Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPBPublications
2. Beej's Guide to UnixIPC
3. W. Richard Stevens, UNIX Network Programming, 2nd edition, PrenticeHall

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3				3			
CO2	3	3	3	3	3				3			
CO3	3	3	3	3	3				3			
CO4	3	3	3	3	3				3			
CO5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer Networks Lab

Course Code: CS492

Allotted Hours: 36L

Prerequisites:

1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To design and implement small size network and to understand various networking commands.
CO2	To provide the knowledge of various networking tools and their related concepts.
CO3	To understand various application layer protocols for its implementation in client/server environment
CO4	Understand the TCP/IP configuration for Windows and Linux
CO5	Learn the major software and hardware technologies used on computer networks

Course Contents:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations. [6L]
2. Socket Programming using TCP and UDP [18L]
3. Implementing routing protocols such as RIP, OSPF. [2L]
4. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS [4L]
5. Server Configuration: only web server (If time permit, Instructor can do more than that) [6L]

Textbooks:

1. TCP sockets in C Programs - Practical guide for Programmers By Micheal, J Donahoo and Kenneth L calvert.
2. Socket Programming by Raj Kumar Buyaa.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3							2
CO2	3	3	3	3	3							2
CO3	3	3	3	3	3							2
CO4	3	3	3	3	3							2
CO5	2	3	2	2	3							2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
C01	3	3	3
C02	3	3	3
C03	3	3	3
C04	3	3	3
C05	3	3	3

Course Name: Numerical Methods Lab

Course Code: M(CS)491

Allotted Hours: 30L

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Outcomes (COs):

After attending the course students should be able to

CO1	Describe and explain the theoretical workings of numerical techniques with the help of C
CO2	Compute basic command and scripts in a mathematical programming language
CO3	Apply the programming skills to solve the problems using multiple numerical approaches.
CO4	Analyze if the results are reasonable, and then interpret and clearly communicate the
CO5	Apply the distinctive principles of numerical analysis and the associated error measures.

Course Content:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tri diagonal matrix algorithm, Gauss-Seidel iterations. LU Factorization method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method
5. Assignments on ordinary differential equation: Euler's method, Euler's modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab/Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group) /Python.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2			3			
CO2	3	3	2	2	3	2			3			
CO3	3	3	2	2	3	2			3			
CO4	3	3	2	2	3	2			3			
CO5	3	3	2	2	3	2			3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

3 rd Year 5 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 501	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CS 502	Database Management Systems	3	0	0	3	3
3	ENGG	Major	CS 503	Object Oriented Programming using Java	3	0	0	3	3
4	ENGG	Major	CS 504 A CS 504 B CS 504 C	Compiler Design Cryptography and Network Security Computer Graphics	3	0	0	3	3
5	HUM	Minor	HU(CSE)501	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 591	Artificial Intelligence Lab	0	0	3	3	1.5
7	ENGG	Major	CS 592	Database Management Systems Lab	0	0	3	3	1.5
8	ENGG	Major	CS 593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	PRJ	Internship	CS581	Internship	0	0	2	2	2
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

Course Name: Artificial Intelligence

Course Code: CS501

Contact:3:0:0

Total Contact Hours: 36

Credits:3

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

- The objective of the course is to enable students to
- Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
- Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
- Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
- Design AI-Frameworks for Inferencing based on knowledgebase.

- Analyze the effectiveness of an AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes(s):

CS501.1 To Understand and explain the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS501.2 To Identify and formulate an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Agent Design Framework within the scope of Artificial Intelligence paradigm.

CS501.3 To Explore relevant literature and apply the concept of Heuristic Techniques or Inferencing Models of Artificial Intelligence to solve problems.

CS501.4 To Develop Inferencing Models for proposing solutions to the problems of Artificial Intelligence

CS501.5 To Implement Inferencing Models of Artificial Intelligence through developing feasible algorithms and investigate their effectiveness by analyzing their performances in solving the relevant problems.

Course Content:

Module-1: Introduction to Artificial Intelligence [1L]

Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

Module-2: Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [5L]

Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching.

Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.

Module-3: Heuristic Techniques for Goal Searching [8L]

Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search.

Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.

Module-4: Adversarial Search for Game Playing [2L]

Basic Concepts, Minimax Search, Alpha-Beta Pruning.

Module-5: Knowledge Representation and Inference using Propositional Logic and Predicate Logic [5L]

Propositional Logic: Knowledge Representation and Inference using Propositional Logic

Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module-6: Slot-and-Filler Structure for Knowledge Representation [2L]

Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames.

Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.

Module-7: Reasoning under Uncertainty [5L]

Bayesian Inference and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inference, Overview of Hidden Markov Model.

Planning [5L]

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for Planning, Planning Graphs and GRAPHPLAN Algorithm.

Introduction to Natural Language Processing [1L]

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.

Module-8: Introduction to Machine Learning [2L]

Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K. and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

Reference Books:

1. Padhy, N. P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

CO PO Mapping:

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

Course Name: Database Management System

Paper Code: CS502

Contact (Periods/Week): 3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome(s):

On completion of the course students will be able to:

CO1 To understand the basic concepts and utility of Database management system

CO2 To Design an Entity Relationship (E-R) Diagram and relational model for an application.

CO3 To Analyze and create the relational database based on normalization

CO4 To determine whether the transaction satisfies the ACID properties.

CO5 To Implement and maintain the database of an organization

Module1:**Introduction[3L]**

Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module2:**Entity-Relationship and Relational Database Model[11L]**

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

Module3:**SQL and Integrity Constraints[6L]**

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module4:**Relational Database Design [8L]**

Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Case Study

Module5:**Internal of RDBMS[9L]**

Physical data structures, Query optimization: join algorithm, statistics and cost based optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock based protocols; two phase locking, Dead Lock handling.

Module6:**File Organization & Index Structures[6L]**

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.

2. Elmasri Ramez and Navathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.

Reference:

1. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing.
2. Ramakrishnan: Database Management System, McGraw-Hill

CO-PO Mapping:

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2							
CO2	3	3	3	2	2							
CO3	3	3	3	3	3	2	1					
CO4	3	3	3	2	3	2	2					
CO5	3	2	3	2	3	2	2				1	1

Course Name: Object Oriented Programming using Java

Course Code: CS503

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite: Partial Object Oriented Programming using C++

Course Outcome(s):

CO1: Design the process of interaction between Objects, classes & methods w.r.t. Object Oriented Programming.

CO2: Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.

CO3: Analyze various activities of different string handling functions with various I/O operations.

CO4: Discuss basic code reusability feature w.r.t. Inheritance, Package and Interface.

CO5: Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:**Module 1: [2L]Introduction:**

Object Oriented Analysis (OOA) & Object Oriented Design (OOD) - Concepts of object oriented programming language, Relationships among objects and classes - Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class. [1L]; Object Oriented Programming concepts - Difference between Java and C++; Different features of Java [1L];

Module 2: [10L]Java Basics:

Basic concepts of java programming - Advantages of java, Byte-code & JVM, Data types, Different types of Variables. [1L]; Java Operators & Control statements [1L]; Java ops. [1L]; Array. [1L];
; Creation of class, object, method. [1L]; Constructor - Definition, Usage of Constructor, Different types of Constructor. [1L]; finalize method and garbage collection, Method & Constructor overloading. [1L]; this keyword, use of objects as parameter & methods returning objects. [1L]; Call by value & call by reference. [1L]; Static variables & methods. Nested & inner classes. [1L].

Module 3: [5L]**Basic String handling & I/O:**

Basic string handling concepts - Concept of mutable and immutable string, Methods of String class - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length(), substring(). [1L]; toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods, Methods of String buffer class - append(), capacity(), charAt(), delete(), deleteCharAt(). [1L]; ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString(). [1L];
; Command line arguments, basics of I/O operations - keyboard input using BufferedReader [1L]; Scanner class in Java I/O operation [1L];

Module 4: [8L]**Inheritance and Java Packages:**

Inheritance - Definition, Advantages, Different types of inheritance and their implementation. [1L]; Super and final keywords, super() method. [1L]; Method overriding, Dynamic method dispatch. [1L]; Abstract classes & methods. [1L]; Interface - Definition, Use of Interface. [1L]; Multiple inheritance by using Interface. [1L]; Java Packages - Definition, Creation of packages. [1L]; Java Access Modifiers - public, private, default and protected, Importing packages, member access for packages. [1L]

Module 5: [11L]**Exception handling, Multithreading and Applet Programming:**

Exception handling - Basics, different types of exception classes. Difference between Checked & Unchecked Exception. [1L]; Try & catch related case studies. [1L]; Throw, throws & finally. [1L]; Creation of user defined exception. [1L]; Multithreading - Basics, main thread [1L]; Thread lifecycle. [1L]; Creation of multiple threads - yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive(). [1L]; Thread priorities, thread synchronization. [1L]; Interthread communication, deadlocks for threads [1L]; Applet Programming - Basics, applet life cycle, difference between application & applet programming [1L]; Parameter passing in applets. [1L]

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference" – 9th Ed. – TMH
2. E. Balagurusamy – "Programming With Java: A Primer" – 3rd Ed. – TMH.

Reference Books:

1. R. K Das – "Core Java for Beginners" – VIKAS PUBLISHING.
- Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India.

CO-PO Mapping:

PO \ CO	CO&PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	-	-	-	-	-	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	-	2	-	1	-	-	-
CO4	2	-	2	2	-	-	-	-	-	-	-	-
CO5	2	-	3	1	2	-	-	-	2	-	2	-

Course Name: Compiler Design**Course Code: CS504A****Contact: 3:0:0****Total Contact Hours: 36****Credit: 3****Prerequisites:**

1. Mathematics
2. Concept of programming languages
3. Data structures
4. Computer architecture
5. Formal languages and automata theory
6. Some advanced math might be required if you adventure in code optimization.

Course Objective(s):

- To make the student understand the process involved in a compiler
- To create an overall view of various types of translators, linkers, loaders, and phases of a compiler

- To understand the concepts of syntax analysis, various types of parsers especially the top-down approach
- To create awareness among students about various types of bottom-up parsers,
- To understand the syntax analysis and, intermediate code generation, type checking, the role of symbol table and its organization, Code generation, machine independent code optimization and instruction scheduling

Course Outcome(s):

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

CO1: Illustrate the basic concept of compilers and discuss on the components as well as the strengths and weaknesses of various phases of designing compiler. [CO1]

CO2: Explain the role of finite automata in compiler design. [CO2]

CO3: Design and analyse algorithms for syntactic or parsing techniques and semantic analysis of the process of designing compilers. [CO3]

CO4: Formulate the theories of creating simple compilers using C programming languages. [CO4]

Course Contents:

Module-1 [7L]

Compilers, Cousins of the Compiler, Analysis-synthesis model, Phases of the compiler, Role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specification of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).

Module-2 [10L]

The role of a parser, Context free grammars, Writing a grammar, Topdown Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR, Canonical LR), Parser generators (YACC), Error Recovery strategies for different parsing techniques, Syntax directed translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom-up evaluation of inherited attributes.

Course Name: Cryptography and Network Security**Course Code: CS504B****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisites**

1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discrete Mathematics concepts

Course Objective(s):

- To impart concepts on cryptography and Network security
- To gain knowledge of the standard algorithms used to provide confidentiality, integrity, and authenticity
- To recognize the various key distribution and management systems for security of a cryptosystem

Course Outcomes:

After completion of course, students would be able

CS504B.1: To understand the basic concepts in cryptography

CS504B.2: To apply the deployment of different encryption techniques to secure messages in transit across data networks

CS504B.3: To discuss various techniques used to assure Integrity and Authentication

CS504B.4: To analyze diverse security measures and issues in practice.

Course Contents**Module-1 [7L]**

Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security model[1L]

Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography) [3L]

Finite Fields and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm[1L]

Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem[1L]

Testing for primality -The Chinese remainder theorem - Discrete logarithms [1L]

Module-2 [9L]

Data Encryption Standard- Block cipher principles, block cipher modes of operation[2L]

Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm[3L]

Public key cryptography: Principles of public key cryptosystems, The RSA algorithm[2L]

Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography [2L]

Module-3 [6L]

Authentication requirement, Authentication function, MAC, Hash function [2L]

Security of hash function and MAC, MD5, SHA, HMAC, CMAC [2L]

Digital signature and authentication protocols, DSS, ElGamal, Schnorr [2L]

Module-4 [7L]

Authentication applications, Kerberos, X.509 [1L]

Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles [1L]

SET for E-Commerce Transactions [1L]

Intruder, Intrusion detection system [1L]

Virus and related threats, Countermeasures [1L]

Trusted systems, Practical implementation of cryptography and security [2L]

Module-5 [7L]

E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source [1L]

Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME [2L]

IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP) [1L]

Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding) [1L]

Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication [1L]

PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction [1L]

Textbooks

[1] Kahate, A. (2013). Cryptography and network security. Tata McGraw-Hill Education.

[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York, NY: McGraw Hill Education (India) Private Limited.

Reference Books

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.

[2] Daras, N. J., & Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253-287). Springer.

[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson Education India.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS504B .1	3	1	2	1	1	-	-	-	3	2	1	1	3	1	1
CS504B .2	3	2	3	2	3	-	-	-	2	1	1	1	3	1	1
CS504B .3	1	3	2	3	2	-	-	-	2	3	1	1	3	1	3
CS504B .4	2	3	1	3	1	-	-	-	1	1	1	1	3	1	3

Course Name: Computer Graphics
Course Code: CS504C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

Mathematics, Computer Fundamentals & Principle of Computer Programming

Course Outcomes

On successful completion of the learning sessions of the course, the learner will be able

- CS504C.1: To remember the foundations of computer graphics and different display technology and devices.
 CS504C.2: To analyze the concept of geometric, mathematical and algorithmic approach necessary for programming computer graphics.
 CS504C.3: To explain clipping with the comprehension of windows, view-ports in relation to images display on screen.
 CS504C.4: To experiment and compare different hidden surface illumination methods

Course Content:

Module – 1: [4L] Introduction: Objective, applications, GKS/PHIGS, normalized co-ordinate system, aspect ratio.

Module -2:[4L] Graphics System: Vector and raster graphics, various graphics display devices, graphics interactive devices, segmented graphics, attribute table.

Module -3 :[4L] Raster Scan Graphics: Line drawing algorithms, circle/ellipse drawing algorithms, polygon filling algorithms.

Module -4 :[4L] Geometric Transformation: Homogeneous co-ordinate system, 2D and 3D transformations, projection— orthographic and perspective.

Module – 5 :[4L] Curves and Surfaces: Curve approximation and interpolation, Lagrange, Hermite, Bezier and BSpline curves/surfaces and their properties, curves and surface drawing algorithms.

Module – 6:[4L] Geometric modelling: 3D object representation and its criteria, edge/vertex list, constructive solid geometry, wire-frame model, generalized cylinder, finite element methods.

Module – 7 :[4L] Clipping :Window and viewport, 2D and 3D clipping algorithms.

Module –8:[4L] Hidden Lines and Hidden Surfaces:Concept of object- and image-space methods, lines and surface removal algorithms.

Module – 9 :[4L] Intensify, Coloring and Rendering:RGB, YIQ, HLS and HSV models and their conversions, gamma correction, halftoning. Illumination models, polygon mesh shading, transparency, shadow, texture.

Text Books

1. D. Hearn and P. M. Baker: Computer Graphics, 2nd ed. Prentice Hall of India, New Delhi, 1997.
2. W. M. Newman and R. F. Sproull: Principles of Interactive Computer Graphics, McGraw Hill, New Delhi, 1979.

Reference Books

1. F. S. Hill: Computer Graphics, McMillan, New York, 1990.
2. D. P. Mukherjee: Fundamentals of Computer Graphics and Multimedia, Prentice Hall of India, New Delhi, 1999.
3. J. D. Foley et al.: Computer Graphics, 2nd ed., Addison-Wesley, Reading, Mass., 1993.

4. W. K. Giloi: Interactive Computer Graphics: Data Structure, Algorithms, Languages, Prentice Hall, Englewood Cliffs, 1978.

CO–POMapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS504C .1	3	1	3	3	2	-	-	-	-	-	3	3	3	3	3
CS504C .2	3	3	3	2	1	-	-	-	-	-	2	1	2	3	2
CS504C .3	-	2	2	2	2	-	-	-	-	-	1	3	3	3	3
CS504C .4	2	3	1	3	1	-	-	-	-	-	1	3	3	3	3

Course Name: Economics for Engineers

Course Code: HU(CSE)501

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Pre-requisites:

MATH–College Algebra, Pre-Calculus Algebra and Trigonometry.

Course Outcomes:

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

HU(CSE)501.1: Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.

HU(CSE)501.2: Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.

HU(CSE)501.3: Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.

HU(CSE)501.4: Evaluate the profit of a firm, carry out the break even analysis and employ this tool to make production decision.

HU(CSE)501.5: Discuss and solve advanced economic engineering analysis problems including taxation and inflation.

Course Contents:

Module1: Introduction[3L]

ManagerialEconomics-Relationshipwithotherdisciplines-Firms: Types,Objectivesandgoals-ManagerialDecisions-Decision Analysis.

Module2:DemandandSupplyAnalysis[5L]

Demand-Typesofdemand-determinantsofdemand-Demandfunction-DemandElasticity-Demandforecasting-Supply-Determinantsof supply-Supplyfunction-Supply Elasticity.

Module3:Cost Analysis[5L]

Elementof costs, Marginalcost,MarginalRevenue,Sunkcost,Opportunitycost,Break-evenanalysis –PVratio.

Module4:ElementaryeconomicAnalysis[4L]

Inflation-Meaningofinflation,types,causes,measures to controlinflation.

National Income-Definition,Conceptsofnationalincome,Methodofmeasuringnationalincome.

Module5:FinancialAccounting [5L]

ConceptsandDefinitionofAccounting,Journal,Ledger,TrialBalance.TradingA/C,Profit& Loss A/C and BalanceSheet.

Module6:InvestmentDecision[2L]

Time value of money-Interest- Simple and compound, nominal and effective rate of interest,Cashflow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worthmethod, Future worth method, Annual worth method, Internal rate of return method, Cost benefitanalysisforpublicprojects.

Textbooks:

1. Riggs,BedworthandRandhwa,“EngineeringEconomics”,McGrawHillEducationIndia
2. PrinciplesofEconomics,DevigaVengedasalam;KarunagaranMadhavan,OxfordUniversityPress

ReferenceBooks:

1. EngineeringEconomybyWilliamG.Sullivan,ElinM.Wicks,C.PatricKoelling,Pearson
2. R.PaneerSeelvan,“EngineeringEconomics”, PHI
3. Ahuja,H.L.,“PrinciplesofMicroEconomics”,S.Chand&CompanyLtd
4. Jhingan,M.L.,“MacroEconomicTheory”
5. MacroEconomicsbyS.P.Gupta, TMH
6. HaniffandMukherjee,Modern Accounting, Vol-1, TMG
7. ModernEconomicTheory –K.K.Dewett(S.Chand)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU(CSE)501.1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
HU(CSE)501.2	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-
HU(CSE)501.3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
HU(CSE)501.4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
HU(CSE)501.5	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Course Name: Artificial Intelligence
Lab Course Code: CS591
Contact: 0:0:3
Total Contact
Hours: 36
Credits: 1.5

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

The objective of the course is to enable students to

- Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
- Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
- Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
- Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
- Implement Artificial Intelligence based ideas as an executable PROLOG program through developing intelligent heuristic strategies.

Course Outcomes(s):

CO1 : To **Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** its utilitarian importance in current technological context leading towards lifelong learning.

CO2: To **Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.

CO3 : To **Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG..

CO4 : To **Develop** ideas and **propose** expert systems offering solutions to the challenging problems of Artificial Intelligence.

CO5 : To **Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.

Course Content:

WEEK-

1: Introduction to PROLOG Programming along with the IDE and its Basic Components
 Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy.

WEEK-2:Arithmetic,BooleanExpression,DecisionMakingStrategies

Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, and Decision-Making Strategies.

WEEK-3:RecursionandLoopingthroughRecursion

Assignments for understanding implementation of Recursion and Looping through Recursion.

WEEK-4:ListofDataItemsinPROLOG

Assignments for understanding the utility of List in solving various problems.

WEEK-5:BlindSearchTechniques–BFS,DFS

Implementation of BFS and DFS Algorithms for Goal Searching to solve Puzzles (8-Puzzle, Water Jug Puzzle)

WEEK-6:HeuristicSearchTechniques–A*Search

Implementation of A* Search Algorithm for Goal Searching to solve Puzzles (8-Puzzle, Route Finding Puzzle)

WEEK-7:ConstraintSatisfactionProblemSolving

Implementation of Backtracking Strategies to solve Constraint Satisfaction Problems (Graph Coloring Problem, 8-Queens Problem)

WEEK-8:GamePlaying

Implementation of Adversarial Search Algorithm with alpha-beta pruning strategy for Game Playing (Tic-Tac-Toe)

WEEK-9:DiscussiononProjectProblemsandAllocation(ProblemDescriptionReportSubmission)**WEEK-****10:DesigningSolutionModelandProposalReportSubmissionWEE****K-11:ProjectImplementation,VerificationandDocumentation****WEEK-12:ProjectDemonstrationandProjectReportReview****Textbook:**

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence- A Modern Approach, 3rd edition, Prentice Hall.
3. Rich, E., Knight, K. and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata Mc Graw Hill.

Course Name: Database Management System

Course Code: CS592

Contact:3P/Week

Credits:1.5

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objective(s):

- To learn the data models, conceptualize and depict a database system
- To learn the fundamental concepts of SQL queries.
- To understand the concept of designing a database with the necessary attributes.
- To know the methodology of Accessing, Modifying and Updating data & information from the relational databases
- To learn database design as well as to design user interface and how to connect with database.

Course Outcome(s):

On completion of the course students will be able to

CO1: Understand the database management system and database language

CO2: Understand and apply the SQL queries related to management of data and transaction processing.

CO3: Explain about query processing techniques involved in query optimization

CO4: Understand PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers

CO5: Design and build the commercial database systems.

Module1

Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)

Module2

Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) and apply the normalization techniques.

Module3

Creation of Tables using SQL-

Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables.

Module4

Practicing DML commands- Insert, Select, Update, Delete.

Module5

Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc., Practicing Subqueries (Nested, Correlated) and Joins (Inner, Outer and Equi).

Module6

PracticeQueriesusingCOUNT,SUM,AVG,MAX,MIN,GROUPBY,HAVING,VIEWS
 CreationandDropping,PracticingonTriggers-
 creationoftrigger,Insertionusingtrigger,Deletionusingtrigger, Updatingusing trigger

Module7

Procedures-
 CreationofStoredProcedures,ExecutionofProcedure,andModificationofProcedure,PL/SQL,Cursors-
 DeclaringCursor, OpeningCursor,Fetching thedata,closingthe cursor.

Table2:MappingofCourseOutcomeswithPos(&PSOs)

CO#	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	2									
CO2	3	3	3	3	2	1					1	1			
CO3	3	3	2	3	3	2				1	1	1			
CO4	3	3	3	3	3	1	1			1	1	1			
CO5	3	3	3	3	3	2	1	1	3						

Course Name: Object Oriented Programming using Java
Course Code : CS593
Contact:0:0:3
Credits:1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related Programming Paradigms
3. Problem Solving Techniques with proper logic Implementation.

Course Objective(s):

- It demonstrates that how can you change the implementation of an object without affecting any other code by increasing data security and protecting unwanted data access. (Encapsulation).
- It allows you to have many different functions, all with the same name, all doing the same job, but depending upon different data. (Polymorphism).
- It guides you to write generic code: which will work with a range of data, so you don't have to write basic stuff over and over again. (Generics).
- It lets you write a set of functions, then expand them in different direction without changing or copying them in anyway. (Inheritance)

Course Outcome(s):

CO1: Create the procedure of communication between Objects, classes & methods.

CO2: Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.

CO3: Analyze distinct features of different string handling functions with various I/O operations.

CO4: Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface. **CO5:**

Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:

Module 1: Java Basics:

1. Simple Java programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming on this keyword, call by value & call by reference, static variables & methods, inner classes.

Module2: BasicString handling &I/O:

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length(), substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
3. Programming on Command line arguments.
4. Programming using keyboard input by implementing BufferedReader & Scanner classes.

Module3: Inheritance, Interface and Java Packages:

1. Programming on Simple Inheritance, super and final keywords, super() method.
2. Programming on method overriding, dynamic method dispatch, abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user-defined package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

Module4: Exception handling, Multithreading and Applet Programming:

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.
2. Programming on creating child threads (i) by extending thread class (ii) by implementing Runnable interface, creating child threads by assigning thread priorities.
3. Programming on creating simple applet to display some message, creating applet to add 2 integers, creating applet to do GUI based programming.

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference" – 9th Ed. – TMH
2. E. Balagurusamy – "Programming With Java: A Primer" – 3rd Ed. – TMH.

Reference Books:

1. R. K Das – "Core Java for Beginners" – VIKAS PUBLISHING.
Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India

CO-PO Mapping:

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 601	Web and Internet Technology	3	0	0	3	3
2	ENGG	Major	CS 602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CS 603	Software Engineering	3	0	0	3	3
4	ENGG	Major	CS 604 A CS 604 B CS 604 C	Mobile Computing Natural Language Processing Cloud Computing	3	0	0	3	3
5	ENGG	Minor	CS 605	Cyber Law and Ethics	3	0	0	3	3
B.PRACTICAL									
6	ENGG	Major	CS 691	Web and Internet Technology Lab	0	0	3	3	1.5
7	ENGG	Major	CS 692	Machine Learning Lab	0	0	3	3	1.5
8	ENGG	Major	CS 693	Software Engineering Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

Course Name: Web and Internet Technology

course Code: CS601

Contact (Periods/Week):3L/Week

CreditPoint:3

No.ofLectures:36

Course Objective(s):

- To impart the design, development, and implementation of Static and Dynamic Web Pages.
- To develop programs for Web using Scripting Languages and .net framework.
- To give an overview of Server Side Programming in Web.

Course Outcome(s):

CO1 To understand the notions of World Wide Web (www), Internet, HTTP Protocol, Client-Server, etc.

CO2 To develop interactive web pages using HTML, DHTML, CSS and information interchange formats like XML

CO3 To design web applications using scripting languages like JavaScript, CGI.

CO4 To produce the server-side programming concepts using servlet,

JSP. CO5 To acquire the knowledge on security related concept and web crawler

Course Contents:

Module1:[6L]

Introduction(1L): Overview, Network of Networks, Intranet, Extranet, and Internet.

World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP,

HTTP. Review of TCP/IP(1L): Features, Segment, Three-

Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6.

IP Subnetting and addressing(1L): Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables.

Internet Routing Protocol(1L): Routing-

Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast.

Electronic Mail(1L): POP3, SMTP, Clients - Servers Communication.

Module-2:[9L]

HTML, DHTML & CSS : Introduction, Elements, Attributes, Heading, Paragraph, Formatting[1L]; Link, Table, List, Block, Layout, Html Forms, and input [1L]; IFrame, Colors[1L], Image Maps and attributes of image area[1L];

Introduction to CSS, basic syntax and structure of CSS, different types internal, external and inline CSS [1L];

Basic Introduction of DHTML, Difference between HTML and DHTML, Document Object Model (DOM)[1L].

Extended Markup Language (XML): Introduction, Difference between HTML & XML, XML-Tree[1L]; Syntax, Elements, Attributes, Validation and parsing, DTD[2L].

Module 3:[15L]

Java Scripts: Basic Introduction, Statements, comments, variable, operators, datatypes[1L]; condition, switch, loop, break[1L]; Javascript functions, objects, and events[1L].

CGI Scripts: Introduction, Environment Variable, GET and POST Methods[1L].

Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request, Response, Get and post [1L]; Cookies and Session[1L].

Java Server Page (JSP):

JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSP Scriptlet Tag [1L]; JSP implicit object (request and response)[1L]; Variable declaration, methods in JSP [1L]; JSP directive (Taglib and Include), Java Bean- inserting Java Bean in JSP [1L]; JSP Action tags (Forward & Include)[1L]; Creating ODBC data source name, Introduction to JDBC, prepared statement and callable statement [1L].

Module-4:[6L]

Threats [1L]: Malicious code- viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.

Network security techniques: Password and Authentication; VPN, IP Security [1L], security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH)[1L].

Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.

Search Engine and Web Crawler: Definition, Metadata, Web Crawler [1L], Indexing, Pagerank, overview of SEO [1L].

Textbooks:

1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI.

Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)

2. "Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication. (Topics covered: JavaScript)

3. "Head First Servlet's & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)

4. Cryptography and Network Security by William Stallings Publisher: Pearson Education India (Topics covered: Threats, Security techniques, Firewall)

Recommended books:

1. "Programming the World Wide Web", Robert W. Sebesta, Fourth Edition, Pearson Education, 2007.

2. "Core Web Programming"- Second Edition- Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001

Course Name: Machine Learning
Course Code:CS602
Contact(Periods/Week):3L/Week
CreditPoint:4
No.ofLectures:36

Prerequisite:

1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization; Statistics; Calculus.

Course Objective(s)

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explores supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcome(s)

CO1: Have a good understanding of the fundamental issues

and challenges of machine learning: data, model selection, model complexity, etc.

CO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches.

CO3: Understand how to evaluate models generated from data.

CO4: Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Module1:[8L]

Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module2:[5L]

Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)

Module3:[4L]

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module4:[7L]

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module5:[7L]

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module6:[4L]

Recent trends in various learning techniques of machine learning and classification methods.

Text Book

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

References:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3							2
CO2		3	3	2								1
CO3	2	3	3	3								1
CO4	2	2	3	3	2							

Course Name: Software Engineering

Course Code: CS 603

Contact:3:0:0

Total Contact Hours:

36Credits:3

Prerequisites:

ProgrammingforProblemSolving

Course Outcome(s):

CO1: To understand the basic concept of Software Engineering and mathematical knowledge and apply them in design solutions to engineering problems including specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

CO2: To analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project

CO3: To design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CO4: To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice teamwork.

CO5: Identify and Use modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

Course Content:

Module-1:[6L]

Introduction: Software Engineering, Characteristics, Components, Application, Definitions. Software Project Planning-Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation: COCOMO (Basic, intermediate, Complete) model.

Module-2:[6L]

Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

Module-3:[8L]

Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques.

Module-4:[7L]

Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

Module-5:[9L]

Software project management, Project planning and control, cost estimation, projectschedulingusing PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management,ISOandSEICMMI,PSPandSixSigma.Computeraidedsoftwareengineering,softwaremaintenance,softwarereuse, Component-based softwaredevelopment.

TextBooks:

1. FundamentalsofSoftwareEngineeringby RajibMall,–PHI-3rd Edition,2009.
2. SoftwareEngineering-PankajJalote(Wiley-India)

ReferenceBooks:

1. SoftwareEngineering–AgarwalandAgarwal(PHI)
2. SoftwareEngineering, byIanSommerville,PearsonEducation Inc.,New Delhi,(2009).
3. SoftwareEngineering: APractitioner’sApproach”,byRogerS.Pressman,McGraw-Hill.(2005)

CO–POMapping:

CO–PO&PSOMapping															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-	-	3	2	3	3	3	2	3

Name of the Paper: Mobile Computing

Paper Code: CS604A

Contact: =3L/Week

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. Basic concept of computer network and communication engineering
2. Basic programming knowledge

Course Objective(s)

The objective of the course is to make the students able to –

- Understand and illustrate the basic concepts and principles in mobile computing
- Understand and demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.
- Identify and develop mobility and bandwidth management in cellular network

- Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
- Predict and explain the technical issues related to recent mobile computing environment

Course Outcome(s):

On completion of the course students will be able to

CS604A.1: Illustrate the concepts and working of modern communication technologies.

CS604A.2: Demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.

CS604A.3: Develop mobility and bandwidth management in cellular network

CS604A.4: Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies

CS604A.5: Predict the technical issues related to recent mobile computing environment.

Course Content:

Module 1: Introduction [6L]:

Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and internetworking), bandwidth management, energy management, security; Brief introduction about different generations of wireless communication technology – 1G, 2G, 3G, 4G, 5G.

Module 2: Mobile Data Communication [5L]

Mobile Data Communication, WLANs (Wireless LANs) IEEE 802.11 standard, Bluetooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.

Module 3: Mobility Management in Cellular Networks [4L]

Call setup in PLMN (location update, paging), GPRS, Call setup in mobile IP networks; Handoff management; Mobility models- random walk, random waypoint, Brownian, map-based, group-based.

Module 4: Bandwidth Management in Cellular Mobile networks [3L]

Mathematical formulation of the channel assignment problem (CAP); CAP and generalized graph colouring; Benchmark instances; Lower bound on bandwidth, Genetic algorithms for channel assignment- concept of critical block in a hexagonal cellular network, coalesced CAP, fast near-minimal channel assignment algorithm.

Module 5: Localization of Nodes in a Mobile Network [4L]

Different approaches, Indoor and outdoor localizations, LOS and NLOS signals, Outdoor localization techniques – triangulation (TOA-based, AOA-based), errors due to inaccuracies in coordinates of beacon nodes and in measurements, selection of beacon nodes; Location region identification- computational geometric technique.

Module 6: Message Communication in Ad Hoc Networks [6L]

Collision avoidance mechanism (different schemes for a deterministic transmission schedule), collision resolution mechanism – successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in ad hoc networks – proactive, reactive and hybrid approaches, different protocols - DSDV, DSR, AODV, TORA, ZRP

Module 7: Energy-efficient Communication [3L]

Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

Module 8: Secure Wireless Communication [4L]

Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm, Lightweight cryptographic algorithms; antijamming techniques.

Text books:

1. K. Sinha, S.Ghosh and B. P. Sinha, Wireless Networks and Mobile Computing. CRC Press : New York, 2015.
2. J. Schiller, Mobile Communication, Pearson
3. Yi-Bing Lin & Imrich Chlamtac, Wireless and Mobile Networks Architectures, John Wiley & Sons, 2001
4. Raj Pandya, Mobile and Personal Communication systems and services, Prentice Hall of India, 2001
5. 5. XiangYang Li, Wireless Adhoc and Sensor Networks, Cambridge University Press.

Recommended books:

1. Research articles published on secure wireless communication (authentication, mitigation of DoS, DDoS, eavesdropping) published in leading journals.
2. Mark Ciampa, Guide to Designing and Implementing wireless LANs, Thomson learning, Vikas Publishing House, 2001.
3. P.Stavronlakis, Third Generation Mobile Telecommunication systems, Springer Publishers.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS604A.1	3	2	2	2	2	1	1			3	2	3			
CS604A.2	3	3	3	3	2	1	1			3	2	3			
CS604A.3	3	3	2	3	2	1	1			3	2	3			
CS604A.4	3	3	2	2	2	1	1			3	2	3			
CS604A.5	3	3	3	3	2	1	1			3	2	3			

Course Name: Natural Language Processing

Course Code: CS604B

Contact (Periods/Week): 3L/Week

Credit Point: 3

No. of Lectures: 35

Prerequisite:

1. Solid background in Linear algebra, Probability and Statistics, Artificial Intelligence and Neural Networks.
2. Good Exposure of Python packages.

Course Objective(s)

1. To explore Text Data using various industry standard tools.
2. To explore the Feature Engineering for Text Representation
3. To build the model for Clustering and Classifying Text
4. To implement Machine Learning and Deep Learning techniques.

Course Outcome(s)

On completion of the course, students will be able to

CS604B.1. Understand the basic concepts of text data using various industry standard tools.

CS604B.3. Understand the approaches to build models, Clustering and Classifying Text.

CS604B.4. Understand the different techniques in Machine learning and Deep Learning.

Module 1: Natural Language Processing Basics

8L

What is Natural Language Processing? Different Phases of Natural Language Processing; Linguistics: Language Syntax and Structure, Words, Phrases, Clauses, Grammar, Dependency Grammar, Constituency Grammar, Word-Order Typology; Lemmas and Word forms, Homonyms, Homographs and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Representation of Semantics; Text Corpora: Corpora Annotation and Utilities, Accessing Popular Corpora; Parts of Speech Tagging: Training and Building POS Taggers; HMM Part-of-Speech Tagging; NER-Tagging; Relationship Extraction, Temporal Information Extraction, Event Extraction, Template Filling; Conditional Random Fields (CRFs); Shallow Parsing, Chunking; Building Dependency and Constituency Parsers, Application of NLP.

Module 2: Feature Engineering for Text Representation

9L

Pre-processing the Text Corpus; N-gram Language Models, Smoothing; Traditional Feature Engineering Models; Extracting Features for New Documents; Topic Models in Gensim, LDA, LSI, Hierarchical Dirichlet process; Advanced Feature Engineering Models, Word Embedding, Word2Vec Model, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; Semantic Analysis: Exploring WordNet, Understanding Synsets, Analyzing Lexical Semantic Relationships, Semantic Relationships and Similarity, Word Sense Disambiguation.

Module 3: Clustering and Classifying Text

9L

Clustering text: Text Similarity, Analyzing Term Similarity, Analyzing Document Similarity; Classifying text: Classification Models, Evaluating Classification Models, Building and Evaluating of the Text Classifier; Sentiment Analysis: Text Pre-processing and Normalization, Unsupervised Lexicon-Based Models, Classifying Sentiment with Supervised Learning, Text Summarization, Question & Answering

Module 4: Deep Learning Architectures for Sequence Processing

9L

Language Models Revisited; Getting words in order with convolutional neural networks (CNNs), Recurrent Neural Networks, Stacked and Bidirectional RNNs; LSTMs and GRUs; Attention, Transformers; Encoder-Decoder Model, Machine Translation; Beam Search; Text Classification using CNNs and LSTM; Chatbots

Text Books:

1. Bhargav Srinivasa-Desikan, "Natural Language Processing and Computational Linguistics", Packt Publishing
2. Dipanjan Sarkar, "Text Analytics with Python", Apress, ISBN-13 (pbk): 978-1-4842-4353-4
3. Daniel Jurafsky, James H. Martin, "Speech and Language Processing", Pearson Education India, Third Edition.
4. Sumit Raj, "Building Chatbots with Python", Apress, ISBN-13 (pbk): 978-1-4842-4095-3

Reference Books:

1. Francois Chollet, "Deep Learning with Python", Manning Publications; 1st edition
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, "Practical Natural Language Processing", O'Reilly
3. Hobson Lane, Cole Howard, Hannes Max Hapke, "Natural Language Processing in Action", Manning Publications

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS604B.1	3	3	3	3	3	-	-	-	2	1	2	2
CS604B.2	3	3	2	2	3	-	1	-	1	-	2	2
CS604B.3	3	3	3	3	3	1	-	-	2	-	2	2
CS604B.4	3	3	3	3	3	3	1	1	2	2	3	2

Paper Name: Cloud Computing**Code: CS604C****Contacts: 3:0:0****Credits: 3****Total Contact hours: 36L****Prerequisite**

1. Should have the basic knowledge of Operating Systems.
2. Should be aware of the fundamental concepts of Networking.
3. Should have knowledge of heterogeneous systems and resource management.

Course Objective(s):

- To learn the workflow of cloud business model and optimized resource allocation.
- To gain knowledge of cloud service and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
- To learn virtualization techniques, load balancing, and work strategy of different cloud infrastructure.
- To know the security and privacy issues in cloud infrastructure

Course Outcomes:

After completion of course, students would be able:

CS604C.1: To identify the business model concepts, architecture and infrastructure of cloud computing, including cloud service models and deployment models.

CS604C.2: To journaling some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other business applications

CS604C.3: To articulate and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.

CS604C.4: To categorize the core issues of cloud computing such as security, privacy, interoperability, and its impact on cloud application.

Course Contents:**Module 1: Definition of Cloud Computing and its Basics [8L]**

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and

advantages of Cloud Computing [3]

Cloud Architecture: Cloud Infrastructure, Architecture of each components, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing. [2]

Services and Applications by Type [3]

IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos.

PaaS – Basic concept, tools and development environment with examples

SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform

Identity as a Service (IDaaS) Compliance as a Service (CaaS)

Module 2: Use of Platforms in Cloud Computing [6L]

Concepts of Abstraction and Virtualization [2L]

Virtualization technologies: Types of virtualization, Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern-Based Environment, Transactional-Based Environment

Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2L]

Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance Concepts of Platform as a Service [2L]

Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development. Use of PaaS Application frameworks.

Module 3: Cloud Service Models [6L]

Use of Google Web Services [2L]

Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.

Use of Amazon Web Services [2L]

Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services [2L]

Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module 4: Cloud Infrastructure [10L]

Types of services required in implementation – Consulting, Configuration, Customization and Support

Cloud Management [3L]

An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)

Live Migration of Virtual Machines: [2L]

Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration.

Concepts of Cloud Security [3L]

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management.

Auditing and Compliance in Cloud Environment: [2L]

Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.

Module 5: Concepts of Services and Applications [6L]

Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [6]

Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2]

Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1]

Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Textbooks:

1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013

2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Cloud Computing: A Practical Approach, Anthony T. Velte, Tata Mcgraw-Hill

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS604C .1	3	3	3	3	2	-	-	-	-	-	-	2	3	1	1
CS604C .2	3	3	3	3	3	-	-	-	2	-	-	-	3	1	1
CS604C .3	3	3	3	3	3	-	-	-	1	-	-	2	3	1	1
CS604C .4	3	2	2	3	3	-	-	-	1	-	-	1	3	1	2

Course Name: Cyber Law and Ethics

Course Code: CS605

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

1. Familiarity in computer Networking.
2. Basic concepts about network security.

Course Objective(s) :

- To understand, explore and acquire acritical understanding of Cyber Law.
- To learn the basics of a Cyber security
- To develop competencies for dealing with frauds and deceptions (Confidence Tricks, Scams)

Course Outcomes:

On completion of the course students will be able

CS605.1: To understand the Social and Intellectual Property Issues Emerging From Cyberspace.

CS605.2: To gather the knowledge of information technology act and legal Frame Work of Right to Privacy, Data Security and Data Protection.

CS605.3: To implement the relationship between commerce and cyberspace

CS605.4: To review the different network security threats and countermeasures.

CS605.5: To adapt the advanced security issues and technologies.

Course Contents:

Module – 1: Introduction of Cybercrime [5]

Cybercrime, Forgery, Hacking, Software Piracy, Computer Network intrusion
Criminals plan attacks, passive attack, Active attacks, cyber stalking.

Module – 2: Cybercrime Mobile & Wireless devices[8]

Security challenges in mobile devices, cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.

Module -3: Tools and Methods used in Cyber-crime[7]

Proxy servers, Password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: Buffer over flow Attacks, Scripts Kiddies and Packaged Defense.

Module – 4: Cybercrime & Cyber security[6]

Phising methods, ID Theft; Online identity method Legal aspects, Indian laws, IT act, Public key certificate, Design of Cyber Security Policy of an Organization ,Unictral Model Law
Jurisdiction to prescribe/Legislative Jurisdiction; Jurisdiction to adjudicate to enforce; Cyber Jurisdiction in Civil, Criminal & International Cases.

Module -5: Cyber Ethics[5]

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

Text Books:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)

Recommended Books:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions", IGI Global, 2009.
2. Jonathan Rosenoer, "Cyber law: the Law of the Internet", Springer-Verlag, 1997
3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003) .

CO PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS605.1	1	3	1	1	1	3	-	3	-	-	-	3	-	1	-
CS605.2	3	3	1	2	3	-	-	3	-	-	-	3	1	2	-
CS605.3	2	3	3	3	1	1	-	1	-	1	-	3	2	2	1
CS605.4	2	2	3	3	2	-	-	-	-	-	-	3	2	3	2
CS605.5	3	2	3	3	3	1	-	2	-	-	-	3	3	3	2

Course Name: Web and Internet Technology Lab**Course Code:CS691****Contact (Periods/Week):3P/Week****Credit Point: 1.5****No. of Lectures:30****Prerequisite:**

Fundamentals of Programming

Course Objective(s):

- To impart the design, development and implementation of Static and Dynamic Web Pages
- To develop programs for Web using Scripting Languages and .net framework
- To give an overview of Server Side Programming in Web

Course Outcome(s):

CO1: To develop interactive web pages using HTML, DHTML, CSS and image map
 CO2: To procure the knowledge of information interchange formats like XML
 CO3: To validate fields of web pages using scripting languages like JavaScript
 CO4: To acquire the server side programming concepts using servlet, JSP

List of Experiments:

1. Write a single html program through which you can explain a) anchor tag, b) 'img' tag with 'src' attribute, c) paragraph d) heading.
2. Write a single html program through which you can draw a table which consists of 3 row and 4 columns where 1st row contains 4 different column fields of a student's

information with red text color and Calibri font style with font 12. Rest cells of whole table contain values with blue text color and Times New Roman font style with font 10.

3. Write a single HTML program where 1st paragraph can collect its specified style from internal style sheet describes inside that HTML program and 2nd paragraph can collect its specified style from another file (external style sheet).
4. Write a single HTML program which implements image map concept using 'usemap' and <map>.
5. Write an HTML program to find out Celsius temperature of a given Fahrenheit temperature using JavaScript.
6. Write an XML parsing technique through which parse a text string into an XML DOM object and extract the info from it with JavaScript.
7. Write an HTML program to find out the power of (m, n) using a function using JavaScript.
8. Write a simple JavaScript program to print the weekday and time.
9. Write a simple JSP program through which you can print even and odd numbers separately within a given range.
10. Create an Online Registration form for individual user of a website using Servlet.

Textbooks:

1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: HTML, CSS, image map, XML)
2. "Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication. (Topic covered: JavaScript)
3. "Head First Servlets & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)

Recommended books:

1. "Programming the World Wide Web", Robert W. Sebesta, Fourth Edition, Pearson Education, 2007.
2. "Core Web Programming"- Second Edition- Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001.
3. "Web Technologies", Black Book, Dreamtech Press

CO– PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2		2	3	2								
CO3		2	2									
CO4	1	2	3	2								
CO5	1		3	2								

Course Name: Machine Learning Lab

Course Code: CS692

Contact:0:0:3

Total Contact Hours: 36

Credits:1.5

Course Objective(s):

This course will enable students to

- Make use of Datasets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice

Course Outcome(s):

The students should be able to:

- CO1. Understand the implementation procedures for the machine learning algorithms. CO2. Design Java/Python programs for various Learning algorithms. CO3. Apply appropriate datasets to the Machine Learning algorithms. CO4. Identify and apply Machine Learning algorithms to solve real world problems.

List of Lab Experiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate dataset for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering a few test datasets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your dataset.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can

use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	4	4								3	
CO2		4	4	3	4	3						
CO3		3		3	3	3						
CO4	3	4		4		3						

Course Name: Software Engineering Lab

Course Code: CS 693

Contact: 3:0:0

Total Contact Hours:

36 Credits: 1.5

Prerequisites:

Programming for Problem Solving

Course Outcome(s):

CO1: To understand the basic knowledge of how to apply Software Engineering and mathematical knowledge and designing solution to software engineering problem including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

CO2: To analyze the cost-benefit trade-off, functional, non-functional and technical requirements through a productive working relationship with various stakeholders of the project.

CO3: Design solutions to the one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CO4: To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice teamwork.

CO5: To identify and use of modern software engineering tools necessary for software project management, time management and software reuse, and an ability to engage in lifelong learning.

Course Content:

Module-1: [6L]

Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admissions system) .DFD of standard application problems.

Module-2: [6L]

Software Requirement Analysis: Describe the individual Phases/ **Modules** of the project, Identify deliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Estimation of project size using Function Point (FP) for calculation.

Cost Estimation models. L

Module-3: [6L]

Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose. (For standard application problems)

Module-4:[9L]

Software Development, Coding Practice and Debugging, Design Test Script/Test Plan(both BlackboxandWhiteBox approach)

Module-5:[9L]

Software project management,Project planning and control, configuration control, cost estimation,projectschedulingusingPERTandGANTTcharts,cost-timerelationsusingstandardtools.

TextBooks:

1. FundamentalsofSoftwareEngineering byRajibMall,–PHI-3rd Edition,2009.
2. SoftwareEngineering–PankajJalote(Wiley-India)

ReferenceBooks:

1. SoftwareEngineering–AgarwalandAgarwal(PHI)
2. SoftwareEngineering, byIanSommerville,PearsonEducation Inc.,New Delhi,(2009).
3. SoftwareEngineering: APractitioner’sApproach”,byRogerS.Pressman,McGraw-Hill.(2005)

CO–POMapping:

CO– PO&PSOMapping															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	3	2
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-	-	3	2	3	3	3	2	2

4 th Year7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 701	Neural Networks and Deep Learning	3	0	0	3	3
2	ENGG	Major	CS 702 A CS 702 B CS 702 C	Advanced Algorithms Advanced Computer Architecture Advanced Operating Systems	3	0	0	3	3
3	ENGG	Minor	CS 703 A CS 703 B CS 703 C	Information Theory and Coding Ad-Hoc and Sensor Networks Data Mining and Data Warehouse	3	0	0	3	3
4	HUM	Minor	HU(CSE)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
5	ENG G	Major	CS 791	Neural Networks and Deep Learning Lab	0	0	3	3	1.5
6	ENG G	Major	CS 792 A CS 792 B CS 792 C	Advanced Algorithms Lab Advanced Computer Architecture Lab Advanced Operating Systems Lab	0	0	3	3	1.5
7	PRJ	Project	CS 793	Major Project-I	0	0	12	12	6
Total of Theory, Practical and Mandatory Activities/Courses								29	20

Course Name: Neural Networks and Deep Learning

Course Code: CS701

Contact (Periods/Week): 3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, NumPy, Pandas, Matplotlib, Scikit-learn

Course Objective(s):

To introduce the fundamental techniques and principles of Neural Networks

To study the different models in ANN and their applications

To familiarize deep learning concepts with CNN and RNN

Course Outcome(s):

On completion of the course students will be able to

CS701.1: Understand the basic concepts in Neural Networks and Deep Learning and applications.

CS701.2: Understand the Shallow & Deep Neural Networks.

CS701.3: Understand the Convolution Neural Network models for Images.

CS701.4: Understand the Recurrent Neural Network models for Sequence data.

Module 1: Introduction to Neural Networks and Deep Learning [8L]

What is a Neural Network? Supervised Learning with Neural Networks, why is Deep Learning taking off? Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation Graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Vectorization, Vectorizing Logistic Regression, Vectorizing Logistic Regression's Gradient Output.

Module 2: Shallow Neural Network & Deep Neural Network [9L]

Neural Networks Overview, Neural Network Representation, computing a Neural Network's Output, Vectorizing Across Multiple Examples, Activation Functions, why do you need Non-Linear Activation Functions? Derivatives of Activation Functions, Gradient Descent for Neural Networks, Backpropagation Intuition, Random Initialization, Deep L-layer Neural Network, Forward Propagation in a Deep Network, getting your Matrix Dimensions Right, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyperparameters.

Module 3: Foundations of Convolutional Neural Networks [9L]

Computer Vision, Edge Detection Example, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, Why Convolutions? Classic Networks, ResNets, Why ResNets Work? Networks in Networks and 1X1 Convolutions, Inception Network, MobileNet Architecture, EfficientNet, Using Open-Source Implementation, Transfer Learning, Data Augmentation; Object Localization, Landmark Detection, Object Detection, Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Non-max Suppression, Anchor Boxes, YOLO Algorithm, Semantic Segmentation with U-Net, Transpose Convolutions, U-Net Architecture.

Module 4: Sequence Models [9L]

Why Sequence Models? Notation, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs, Language Model and Sequence Generation, Sampling Novel Sequences, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), Long Short Term Memory (LSTM), Bidirectional RNN, Deep RNNs, Word Representation, Using Word Embeddings, Properties of Word Embeddings, Embedding Matrix, Learning Word Embeddings, Word2Vec, GloVe Word Vectors, Sentiment Classification, Debiasing Word Embeddings, Basic Sequence Models, Picking the Most Likely Sentence, Beam Search, Refinements to Beam Search, Error Analysis in Beam Search, Attention Model, Speech Recognition, Trigger Word Detection, Transformer Network Intuition, Self-Attention, Multi-Head Attention.

Text Books:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer; 1st ed. 2018 edition
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", published by MIT Press

Reference Books:

1. Francois Chollet, "Deep Learning with Python", Manning Publications; 1st edition
2. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition
3. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jess, "Neural Network Design (2nd Edition)".

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS701.1	-	2	3	3	3	-	-	-	-	-	1	2
CS701.2	-	2	2	2	1	-	-	-	-	-	-	1
CS701.3	-	2	3	3	3	3	-	-	-	-	2	-
CS701.4	3	2	2	2	1	3	2	-	-	-	3	2

Course Name: Advance Algorithm

Course Code: CS702A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Design & Analysis of Algorithm (CS402)

Course Objective(s):

The aim is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them

Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Course Outcome(s):

After completion of the course students will be able to

CS702A.1 Analyze the complexity/performance of different algorithms.

CS702A.2 Determine the appropriate data structure for solving a particular set of problems.

CS702A.3 Categorize the different problems in various classes according to their complexity.

CS702A.4 Achieve an insight of recent activities in the field of the advanced data structure.

CS702A.5 Design and build solutions for a real-world problem by applying relevant distributions

Course Content:

Module-1 [4L]

Sorting:

Review of various sorting algorithms, topological sorting

Graph:

Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), DFS and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Module-2 [6L]

Matroids:

Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching:

Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Module-3 [16L]

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

Shortest Path 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 modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT):

In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schönhage-Strassen Integer Multiplication algorithm

Amortized Analysis:

Aggregate, Accounting, and Potential Method

Module-4[10L]

Linear Programming:

Geometry of the feasibility region and Simplex algorithm

NP-completeness:

Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Problem Solving Application

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text book:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos. 4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Reference Books:

1. "Algorithm Design" by Kleinberg and Tardos.
2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

CO-PO Mapping:

COs	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS702A.1	3	3	3	3	-	-	-	-	-	-	-	2	2	2	3
CS702A.2 .2	3	3	3	3	-	-	-	-	-	-	-	2	2	3	3
CS702A.3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
CS702A.4 .4	3	3	3	3	-	-	-	-	-	-	-	3-	3	2	3
CS702A.5 .5	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

Paper Code: CS702B

Contact (Periods/Week):3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. Familiarity with the functionalities of basic digital computer system.
2. Fundamentals of Computer Architecture.

Course Objective(s):

- To understand the Concept of Parallel Processing and its applications
- To implement the Hardware for Arithmetic Operations
- To analyse the performance of different scalar Computers
- To understand the Pipelining Concept for a given set of Instructions
- To learn the performance of pipelining and non-pipelining environment in a processor

Course Outcomes(s):

CS702B.1 To acquire the knowledge of parallelism and pipelining

CS702B.2 To develop knowledge of parallel processing

CS702B.3 To combine the concept and design techniques of interconnection network

CS702B.4 To acquire the knowledge of shared memory architecture

CS702B.5 To describe the fundamentals of embedded system architecture

Module 1: Introduction to Advanced Computer Architectures [5L]

Different types of architectural classifications – instruction vs. data (SISD, SIMD, MISD, MIMD), serial vs. parallel, pipelining vs. parallelism; Pipelining: Definition, different types of pipelining, hazards in pipelining.

Concept of reservation tables, issue of multiple instructions with minimum average latency (MAL).

Module 2: Parallel Processing & ILP [8L]

RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Review of instruction-level parallelism-Super pipelining, Superscalar architecture, Diversified pipelines and out of order execution, VLIW architecture, Dataflow and Control Flow Architectures, Loop Parallelization

Module 3: Interconnection Networks [13L]

Desirable properties of interconnection networks, static interconnection networks – path, cycle, double-loop, star, wheel, 2D mesh and its variants, multi-mesh, tree, shuffle-exchange, cube, cube connected cycles.

Dynamic interconnection networks: concepts of blocking, rearrangeable and blocking but rearrangeable networks, various types of multistage interconnection networks (MIN)- crossbar, Clos, baseline, omega, Benes.

Module 4: Shared Memory Architecture [5L]

Fundamentals of UMA, NUMA, NORMA, COMA architectures, Performance measurement for parallel architectures –Amadahl's law, Gustafson's law.

Module 5: Embedded System Architecture [5L]

Definition, Example, Classification of Embedded system, Embedded System Design Issues:

Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS).

Text Books:

1. J. L. Hennessey and D. A. Patterson: Computer Architecture: A Quantitative Approach, 5th edition, Morgan Kaufmann, 2012.
2. K. Hwang and F. A. Briggs: Computer Architecture and Parallel Processing, Tata McGraw Hill, New Delhi.

Reference Books:

1. Tse-yun Feng, A Survey of Interconnection Networks, IEEE, 1981.
2. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, 1989.
3. Raj Kamal, Embedded Systems Architectures Programming and Design, Second Edition The MacGraw-Hill(for Embedded System).

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS702B.1	3	-	-	-	-	3	2	-	-	-	2	2
CS702B.2	3	3	1	-	-	3	-	-	2	2	-	3
CS702B.3	3	3	3	2	3	3	-	2	-	-	-	1
CS702B.4	3	3	3	2	3	2	2	2	-	2	1	1
CS702B.5	3	2	2	2	2	2	-	-	3	2	2	2

Course Name: Advanced Operating Systems**Course Code: CS702C****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisites:** Operating Systems**Course Outcome(s):**

After completion of the course students will be able to

- CS702C.1** Demonstrate understanding of design issues of advanced operating systems and compare different types of operating systems.
- CS702C.2** Analyze the design aspects and issues of distributed operating systems.
- CS702C.3** Demonstrate understanding of different architectures used in Distributed Operating System.
- CS702C.4** Demonstrate understanding of different architectures used in Multiprocessor Operating System.
- CS702C.5** Formulate the solutions to schedule the real time applications.

Course Content:**Module 1:**

Architectures of Distributed Systems: System Architecture Types, 1L
 Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.2L
 Theoretical Foundations: Inherent Limitations of a Distributed System, 1L
 Lamports Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.2L

Module 2:

Distributed Mutual Exclusion: The classification of Mutual Exclusion Algorithms 2L

Non-Token-Based Algorithms: Lamports Algorithm 1L

The Ricart-Agarwala Algorithm, Maekawas Algorithm, 1L

Token-Based Algorithms: Suzuki-Kasamis Broadcast Algorithm, 1L

Singhals Heuristics Algorithm, Raymonds Heuristic Algorithm. 2L

Module 3:

Distributed Deadlock Detection: Preliminaries, 1L

Deadlock Handling Strategies in Distributed Systems 1L

Issues in Deadlock Detection and Resolution, 1L

Control Organizations for Distributed Deadlock Detection, 1L

Centralized- Deadlock – Detection Algorithms, 1L

Distributed Deadlock Detection Algorithms, 1L

Hierarchical Deadlock Detection Algorithms 1L

Module 4:

Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, 1L

Basic Multiprocessor System Architectures 1L

Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems 1L

Operating Design Issues, Threads, Process Synchronization. 2L

Processor Scheduling 1L

Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues 2L

Module 5:

Distributed Scheduling : Issues in Load Distributing, Components of a load Distributed Algorithm, 2L

Stability, Load Distributing Algorithm, Requirements for Load Distributing, Task Migration, Issues in task migration. 2L

Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, 2L

Memory Coherence, Coherence Protocols, Design Issues 2L

Text book:

1. Mukesh Singhal and Niranjana Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.
2. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press.

Reference Books:

1. Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.
2. Jie Wu, Distributed Systems, CRC Press.
3. Hagit Attiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, McGraw-Hill.
4. Sape Mullender (ed.), Distributed Systems, Addison-Wesley

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS702C.1	3	3	3	3	-	-	-	-	-	-	-	-			
CS702C.2	3	3	3	3	-	-	-	-	-	-	-	-			
CS702C.3	3	3	3	3	-	-	-	-	-	-	-	3			
CS702C.4	3	3	3	3	-	-	-	-	-	-	-	-			
CS702C.5	3	3	3	3	-	-	-	-	3	2	-	-			

Course Name: Information Theory and Coding

Course Code: CS 703 A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Probability & Statistics

Course Objective(s):

The objective of the course is to make the students able to

- Understand the basic concept of information and apply this knowledge in designing solution.
- Understand the basic concept of coding theory and use this knowledge for designing and implementing problem.
- Understand the concept of channel models to determine the mutual information in the channels.
- Outline the concept of error detection techniques and design a model for building a new solution.
- Understand how convolutional theory works and develop a new approach.

Course Outcome(s):

After completion of the course students will be able to

CS 703 A.1: Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.

CS 703 A.2: Understand the basic concept of coding theory and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.

CS 703 A.3: Understand the concept of channel models to determine the mutual information in the channels.

CS 703 A.4: Outline the concept of error detection techniques and design a model for building a new solution as a professional engineering practice as a team.

CS 703 A.5: Understand how convolutional theory works and develop an approach to solve it by means of existing and new methods as a team work.

Course Content:

Module 1:

Information Theory [4L]

Introduction, Measure of Information, Average Information Content (Entropy) of a Zero Memory Source, Extension of Zero Memory Source, Entropy of a Source with Memory.

Module 2:

Source Coding [9L]

Introduction, Types of Codes, Prefix Codes, Source Coding Theorem, Shannon's Encoding Theorem, Huffman Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, An Overview on Speech and Image Compression.

Module 3:

Information

Channels[4L]

Introduction, Channel Models, System Entropies, Mutual Information (Trans information), Channel Capacity, Capacity of Channels, Continuous Channels.

Module 4:

Error Control Coding [8L]

Introduction, need for Error Control Coding, Types of Codes, Coding Gain, Linear Block Codes, The Hamming Codes, Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes, Cyclic Codes, Golay Codes, Shortened Cyclic Codes.

Module 5:

Burst Error Correcting Codes [6L]

Introduction, Burst Errors, Interleaved Codes, Product Codes, Fire Codes, BCH Codes, Non-Binary BCH Codes and Reed-Solomon Codes.

Module 6:

Convolution

Codes[5L]

Introduction, Convolution Encoder, Representation of Convolution Code, Transfer Function of a Convolution Code, Distance Properties of Convolution Codes, Decoding of Convolution Codes, Stack Algorithm, Known Good Convolution Codes.

Textbook:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.

Reference Books:

1. Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO–PO Mapping:

COs	P	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 703 A1.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CS 703 A.2	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CS 703 A.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	1
CS 703 A.4	3	3	3	3	-	-	-	-	3	-	-	-	3	2	3
CS 703 A.5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	3

Course Name: Ad-Hoc and Sensor Networks**Course Code: CS 703 B****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Course Objective(s):**

The student should be made to:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

Course Outcome(s):

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

CS 703 B.1: Know the basics of Ad hoc networks and Wireless Sensor Networks

CS 703 B.2: Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement

CS 703 B.3: Apply the knowledge to identify appropriate physical and MAC layer protocols

CS 703 B.4: Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CS 703 B.5: Be familiar with the OS used in Wireless Sensor Networks and build basic **Modules**

Course Content:**Module1****AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS**

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Module2**SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

Module3**WSN NETWORKING CONCEPTS AND PROTOCOLS**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

Module4**SENSOR NETWORK SECURITY**

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

Module5**SENSOR NETWORK PLATFORMS AND TOOLS**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Text Book:

1. C. Siva Ram Murthy, and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols“, Prentice Hall Professional Technical Reference, 2008.

REFERENCES:

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication – 2002.
3. Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
5. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

Online Resources:

1. www.wirelessnetworksonline.com

2. www.securityinwireless.com

3. www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf Practice Aspects 1. NS2 Simulator tool

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 703 B.1	-	3	-	2	-	-	-	3	-	-	-	-
CS 703 B.2	3	2	2	2	-	-	1	-	-	-	-	-
CS 703 B.3	3	2	-	-	3	-	-	-	1	-	-	-
CS 703 B.4	-	1	-	3	-	-	-	-	-	1	-	-
CS 703 B.5	3	1	2	2		1						

Course Name: Data Mining and Data Warehousing

Course Code: CS 703 C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Outcome(s):

After completion of the course students will be able to

CS 703 C.1: Understand and explain the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) and Data Warehousing (such as Data Cube and OLAP) recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS 703 C.2: Identify and formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.

CS 703 C.3: Explore relevant literature and apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with huge amount of data.

CS 703 C.4: Develop ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.

CS 703 C.5: Implement ideas of Data Mining and Data Warehousing through developing feasible algorithms or frameworks and investigate their effectiveness by analyzing the performances in solving the relevant problems.

Course Content:

Module-1: Introduction to Data Mining[5L]

Basic Concepts 1L

Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measure 2L

Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization 2L

Module-2: Introduction to Data Warehousing [6L]

Basic Concepts 1L

Data Warehouse Modeling: Data Cube and OLAP (Online Analytical Processing) 2L

Data Warehouse Design, Usage, Implementation 2L

Data Generalization by Attribute-Oriented Induction 1L

Module-3: Mining Frequent Patterns, Associations And Correlation Analysis [5L]

Basic Concepts, Frequent Item set Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent Item Sets Using Vertical Data Format, Correlation Analysis 4L

Pattern Mining in Multilevel and Multidimensional Space 1L

Module-4: Classification and Regression [6L]

Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L

ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods 3L

Module-5: Clustering and Outlier Analysis [5L]

Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on Connected Regions with High Density, Frequent Pattern-Based Clustering Method 4L

Outlier Analysis 1L

Module-6: Mining Data Stream, Time-Series, and Sequence Data [3L]

Basic Concepts of Data Stream Mining 1L

Mining Time Series Data 1L

Mining Sequence Patterns in Biological Data 1L

Module-7: Introduction to Graph Mining, Social Network Analysis, Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining 6L

Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach & Pattern Growth Approach) 2L

Basic Concepts of Social Network Analysis and Multi-relational Data Mining 2L

Basic Concepts of Text Mining 1L

Basic Concepts of World Wide Web (WWW) Mining 1L

Textbook:

1. Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.

2. Pardeep Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

Reference Books:

1. Pang-Ning Tan, Vipin Kumar, Michael Steinbach, "Introduction to Data Mining", Pearson Education.

2. Robert Layton, "Learning Data Mining with Python", Packt Publishing

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 703 C.1	3	2	-	-	-	-	-	-	-	-	-	3			
CS 703 C.2	2	3	-	-	-	-	-	-	-	-	-	-			
CS 703 C.3	2	2	3	2	-	-	-	-	-	-	-	-			

CS 703 C.4	2	2	2	3	-	-	-	-	-	-	-	2			
CS 703 C.5	2	2	3	3	2	2	2	-	-	-	-	2			

Paper Name: Human Resource Development and Organizational Behaviour

Paper Code: HU(CSE)701

Credits: 3

No. of lectures: 36

Course Objective(s):

- To develop an understanding of the nature, functioning and design of organisation as social collectivises.
- The basic concepts and theories underlying individual behaviour besides developing better insights into one's own self.
- To gain insight into the organizational learning processes, how they can be fostered and enhanced.
- Individual behaviour in groups, dynamics of groups and team building besides developing a better awareness of how they can be better facilitators for building effective teams as leaders themselves.

Course Outcomes

At the end of the course students are able

HU(CSE)701.1:To understand key functions in management as applied in practice.

HU(CSE)701.2:To identify and analyse major practices associated with HRD in modern work and organisations;

HU(CSE)701.3:To evaluate the connections between the HRD process and the contemporary performance management concerns of organisations

HU(CSE)701.4:To analyse the behaviour of individuals and groups in organisations in terms of the key factors that influence organisational behaviour.

HU(CSE)701.5:To assess the potential effects of organisational-level factors (such as structure, culture and change) on organisational behaviour.

HU(CSE)701.6:To evaluate the potential effects of important developments in the external environment (such as globalisation and advances in technology) on organisational behaviour

Course Contents

Module – 1 HRD-Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate. **3L**

Module -2 HRD–Micro Perspective: Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD **6L**

Module – 3 Instructional Technology for HRD: Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behaviour Modeling and Self Directed Learning; Evaluating the HRD.**5L**

Module – 4 Human Resource Training and Development: Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training Managers.**4L**

Module – 5 Organisational Effectiveness (OE): Concept; Approaches to O E; Adoptive Coping Cycle for Effectiveness; Achieving OE; Organisational Climate: Concept, Determinants of Organisational

Climate.3L

Module-6 Organization Theory: Classical Theory; Neo-Classical Theory, Modern Behavioural Theories, contingency theory, system theory, modern structural models; Organizational Culture; Creating and Sustaining Culture; Work Culture.6L

Module –7 Motivation: Types of Motives; Theories of Maslow; Herzberg, McGregor, Alderfers, Porter and Lawler’s Model; Job Enlargement, Job Enrichment, Behaviour Modification. 3L

Module– 8(a) Group & Group Dynamics - concept, importance, classification of groups, reason for group, formation, group cohesiveness. (b) Team work: meaning, concept, types, creating, and an effective team. (c) Leadership: Concept, Leader vs. Manager; Classical Studies on Leadership; Trait Theories; Behavioral Theories; Group and Exchange Theories; Contingency Theory of Leadership; Leadership Styles.6L

References:

- 1) Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005
- 2) Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.
- 3) Rao, T.V: Human Resource Development, Sage Publications, New Delhi.
- 4) Luthans, Fred: OrganisationalBehaviour, Tata McGraw-Hill Co. New Delhi, 2004.
- 5) Stephen, P. Robins: OrganisationalBehaviour, Prentice-Hall of India Pvt., Ltd., 2004.
- 6) John, W. Mewstrom& Davis, Keith : Organisational Behavior (Human Behavior at Work), Tata McGraw-Hill, New Delhi , 2002

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU(CSE)701.1	2	-	-	-	2	3	3	3	2	3	2	2	-	-	-
HU(CSE)701.2	2	-	-	2	-	-	2	-	3	-	3	-	-	-	-
HU(CSE)701.3	2	-	3	2	-	3	-	-	2	-	-	-	-	-	-
HU(CSE)701.4	-	2	-	3	2	3	-	2	-	-	-	-	-	-	-
HU(CSE)701.5	2	-	-	-	3	2	-	-	2	-	3	-	-	-	-

Course Name: Neural Networks and Deep Learning Lab

Paper Code: CS 791

Contact (Periods/Week): 0:0:3

Credit Point: 1.5

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn

Course Objective(s):

- To introduce the Keras/Tensorflow API for Neural Networks and Deep Learning.
- To build Convolutional Neural Network models using Keras/Tensorflow API
- To build Recurrent Neural Network models using Keras/Tensorflow API

Course Outcome(s):

On completion of the course students will be able to

CS 791.1: Understand the Keras/Tensorflow API in details using Python.

CS 791.2: Implement the Convolutional Neural Network models using Keras/Tensorflow API

CS 791.3: Implement the Recurrent Neural Network models using Keras/Tensorflow API

List of Experiment:

The following list of Experiments

1. Getting Started with DL in Keras
2. Deep Neural Networks for Supervised Learning: Regression
3. Deep Neural Networks for Supervised Learning: Classification
4. Tuning and Deploying Deep Neural Networks
5. Deep learning for computer vision
6. Deep learning for text and sequences
7. Going beyond the Sequential model: The Keras functional API
8. Inspecting and monitoring deep-learning models using Keras callbacks and TensorBoard
9. Text generation with LSTM
10. Generating images with variational autoencoders and Generative adversarial networks
11. Introduction to TensorFlow 2.0
12. Images and Tests with TensorFlow 2.0

Text Books:

1. JojoMoolayil, "Learn Keras for Deep Neural Networks",Apress,ISBN-13 (pbk): 978-1-4842-4239-1
2. Francois Chollet,"Deep Learning with Python",Manning Publications; 1st edition

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 791.1	3	2	3	3	3	-	-	-	-	-	1	2
CS 791.2	3	2	2	2	1	-	-	-	-	-	-	1
CS 791.3	3	2	3	3	3	3	-	-	-	-	2	-

Course Name: Advanced Algorithms Lab

Course Code: CS 792 A

Contact: 0:0:3

Credits: 1.5

Prerequisites:

1. Programming knowledge
2. Knowledge of Design and Analysis of Algorithm

Course Objective(s):

- Design and implement efficient algorithms for a specified application.
- Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.

Course Outcome(s):

After completion of the course students will be able to

CS 792 A.1: Introduce students to the advanced strategies of designing and analyzing algorithms.

CS 792 A.2: The student should be able to prefer suitable algorithms and use it for a precise problem.

CS 792 A.3: To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.

CS 792 A.4: The student should be able to prefer suitable algorithms and use it for a precise problem.

CS 792 A.5: To introduce the students to recent developments in the area of algorithmic design.

Course Content:

1. Write the following problems in any programming language. Programming Language used: C
2. **Divide and Conquer:** Implementation of finding Maximum and Minimum element from an array of integer, Quick Sort, Check the running time for different positions of pivot elements. Randomized version of quick sort using Divide and Conquer Method.
3. **Dynamic Programming:** Calculation of the minimum number of scalar multiplications needed for chain of Matrices Multiplication Technique, Implementation of Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm), Implement all pair Shortest path for a graph (FloydWarshall Algorithm)
4. **Greedy method:** Implementation of fractional Knapsack Problem, MST by Prim's algorithm, Implement MST by Kruskal's algorithm
5. **Graph Traversal Algorithm:** Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
6. **String Matching:** Implement KMP algorithm
7. **Network Flow:** Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.
8. **Modulo Representation of integers/ polynomials:** Chinese Remainder Theorem
9. **Linear Programming:** Simplex Algorithm

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS-T-591.1	3	3	3	3	-	-	-	-	-	-	3	3	2	2	3
CS-T-591.2	3	3	3	3	-	-	-	-	-	-	3	3	2	3	3
CS-T-591.3	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3
CS-T-591.4	3	3	3	3	-	-	-	-	-	-	3	3	3	2	3
CS-T-591.5	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3

Course Name: Advanced Computer Architecture Lab

CourseCode: CS 792 B

Contact:0:0:3

Credits:1.5

Prerequisites: Knowledge of designing different circuits in Computer Organization and Architecture Lab

CourseOutcome(s):

CS 792 B.1: Ability to design the basic gates

CS 792 B.2: Ability to verify the truth table.

CS 792 B.3: Implement basic knowledge of Hardware description Language.

CS 792 B.4: Design circuit using Xilinx tools.

List of Experiment:

1. HDL introduction

2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operators..
6. Implement Encoder, Decoder circuit and simulate for truth table verification.
7. Implement different types of flip flop and simulate for truth table verification.
8. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
9. Implement ALU and simulate the result.
10. Implement RAM chip and simulate the result.
11. 8-bit simple CPU design
12. 8. Interfacing of CPU and Memory
13. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 792 B.1	3	3	2	3	2	3	-	2	3	-	-	-
CS 792 B.2	3	3	3	2	3	3	-	-	-	-	-	-
CS 792 B.3	3	2	2	3	2	-	-	2	-	-	-	-
CS 792 B.4	3	3	2	2	2	3	-	-	-	-	-	-

Course Name: Advanced Operating Systems Lab

Course Code: CS 792 C

Contact:0:0:3

Total Contact Hours: 36

Credits: 1.5

Prerequisites: Operating Systems

Course Objective(s):

The objective of the course is to make the students able to -

- Understand and execute basic commands of shell script
- Apply basic operations in shell scripts which are required for different applications.
- Identify and understand concept of file systems in shell script
- able to understand the concept of creating new process from parent process.
- Able to understand concept of virtual file and execute basic commands on it

Course Outcome(s):

After completion of the course students will be able to

CS 792 C.1: Understand and implement basic services and functionalities of the operating system using system calls and able to Understand the benefits of thread over process and implement synchronized programs using multithreading concepts.

CS 792 C.2: Analyze the design aspects and issues of distributed operating systems.

CS 792 C.3: Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.

CS 792 C.4: Implement memory management schemes and page replacement schemes

CS 792C.5: Understand the concepts of deadlock in operating systems and implement them in Multiprogramming system.

Course Content:

Preliminaries of Operating System: 6P

managing users, managing systems, file managements, useful commands, Shell scripting : shell syntax, executing shell scripts.

Process : 12P

creating new process, counting maximum number of processes a system can handle at a time, handling system calls; inter process communication through pipes and message passing, zombie process, orphan process.

Process Synchronization: 6P

handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.

Signal : 6P

study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).

Text book:

1. Mukesh Singhal and Niranjana Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.

Reference Books:

1. Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.

CO – PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 792 C.1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CS 792 C.2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CS 792 C.3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CS 792 C.4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CS 792 C.5	3	3	3	3	-	-	-	-	3	3	-	-	-	-	-

Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 801 A CS 801 B CS 801 C	Real Time Systems Data Analytics Soft Computing	3	1	0	4	4
2	ENGG	Major	CS 802 A CS 802 B CS 802 C	VLSI Design & Application Bio-informatics Robotics	3	1	0	4	4
3	ENGG	Minor	CS 803 A CS 803 B CS 803 C	Introduction to IoT Image Processing Optimization Techniques	3	0	0	3	3
B.PRACTICAL									
4	ENGG	Minor	CS 893 A CS 893 B CS 893 C	Internet of Things Lab Image Processing Lab Optimization Techniques Lab	0	0	3	3	1.5
5	PRJ	Project	CS 881	Major Project-II	0	0	12	12	6
6	PRJ	Internship	CS882	Grand Viva	0	0	0	0	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

Course Name: Real Time Systems

Course Code: CS 801 A

Total Contact Hours:36

Credit:3

Prerequisites:

1. Concepts of Operating systems and Algorithm.
2. Knowledge of Distributed System basics.

Course Objective(s):

- To understand the real-time systems
- Obtain a broad understanding of the technologies and applications for emerging and exciting domain of real-time systems.
- Get in-depth hands-on experience in designing and developing a real time systems.

Course Outcome(s):

CS 801 A.1: Understand the concepts of Real-Time systems

CS 801 A.2: Recognize the characteristics of a real-time system

CS 801 A.3: Understand and develop document on an architectural design of a real-time system.

CS 801 A.4: Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.

Course Contents:

Module-1: Introduction [8L] Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc. , Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Module-2: Real Time Scheduling. [8L] Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling.

Module-3: Resources Sharing. [8L] Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, Stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre-emption Ceiling Protocol, Access control in Multiple **Module** Resources, Controlling Concurrent Accesses to Data Objects.

Module-4: Real Time Communication. [6L] Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Model of Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols

Module-5: Real Time Operating Systems and Databases. [6L] Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

Text Books

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication

Reference Books

1. Real Time Systems – Mall Rajiv, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 801 A.1	3	2	3	1	2	-	-	-	-	-	-	-
CS 801 A.2	3	2	3	3	-	-	-	-	-	-	-	-
CS 801 A.3	3	3	3	3	2	-	-	-	-	-	-	-
CS 801 A.4	3	2	3	3	2	-	-	-	-	-	-	-

Course Name: Data Analytics

Course Code: CS 801B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python.

Course Objective(s):

1. Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).
2. Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions
3. Apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.
4. Excogitate and Implement ideas to address the challenging issues of Big Data Analytics.
5. Analyze the effectiveness of various Big Data Analytics Frameworks.

Course Outcome(s):

CS 801B.1 :

Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework) underscoring the utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS 801B.2 :

Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks.

CS 801B.3 :

Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce, Hadoop and advanced SQL Frameworks.

CS 801B.4 : Excogitate ideas for proposing solutions to the challenging problems of Big Data Analytics.

CS 801B.5 : Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

Course Content:

Module – 1: Introduction to Basic Analytics [10L] Introduction: Big data overview, Analyst’s perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics. Life Cycle of Data Analytics: Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational. Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module - 2: Advanced Analytic Methods I [8L] Clustering: Overview, K-means, Determining the number of clusters, Diagnostics. Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics. Regression: Linear regression - model description, Logistic regression – model description, Other regression models. Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers.

Module – 3: Advanced Analytic Methods II [8L] Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, Moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model. Text Analysis: Steps in text analysis, Collecting raw text, Representing text, Term Frequency Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments. Map Reduce and Hadoop: Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module – 4: Advanced Analytic Methods III [10L] Technology and Tools: SQL essentials - Join, Set, Grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL. Integration of Techniques: Communicating and operationalizing an analytic project. Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code. Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Textbook:

1. EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O’Reilly, 2013.

ReferenceBooks:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real time Data Systems. Manning Publications, 2015.
2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS 801 B.1	3	2				-	-	-	-	-	-	3
CS 801 B.2	2	3			-	-	-	-	-	-	-	-
CS 801 B.3	2	2	3	2		-	-	-	-	-	-	-

CS 801 B.4	2	2	2	3		-	-	-	-	-	-	2
CS 801 B.5	2	2	3	3	2	2	2	-	-	-	-	2

Course Name: Soft computing

Course Code: CS801C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Discrete Mathematics, Probability and Statistics

Course Outcome(s):

After completion of the course students will be able to

CS801C.1: Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.

CS801C.2: Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.

CS801C.3: Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems

CS801C.4: Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem. CS-D-602.5: To understand the concept and techniques of designing and implementing of soft computing methods in real world problem.

Course Content:

Module-1: Introduction to Soft Computing:[8L]

An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics. Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing

Module-2: Fuzzy sets and Fuzzy logic [7L]:

Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Module -3: Artificial Neural Networks [9L]:

Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network. Back

propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module -4: Genetic Algorithms [7L]:

Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

Module -5: Hybrid Systems [5L]:

Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:

- 1.“Neural Networks, Fuzzy logic, and Genetic Algorithms”, S. Rajasekaran & G. A. V. Pai , PHI.
- 2.“Principles of Soft Computing”, S.N.Sivanandam, S.N Deepa, wiley publications.
- 3.“Neural Networks”, S. Haykin, Pearson Education, 2ed, 2001.
- 4.“An Introduction to Genetic Algorithm”, Mitchell Melanie, Prentice Hall, 1998.

Reference Books:

1. “Genetic Algorithms in Search, Optimization and Machine Learning”, David E. Goldberg, Addison Wesley, 1997.
- 2.“Intelligent Hybrid Systems”, D. Ruan, Kluwer Academic Publisher, 1997.

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 801 C.1	3	3	3	3	-	-	-	-	-	-	-	2
CS 801 C.2	3	3	3	3	2	2	-	-	-	-	-	2
CS 801 C.3	3	3	3	3	2	2	-	-	-	-	-	2
CS 801 C.4	3	3	3	3	2	-	-	-	-	-	-	2
CS 801 C.5	3	3	3	3	-	2	-	-	2	2	-	2

Course Name: VLSI Design & Application

Course Code: CS802A

Contacts: 3:0:0

Credits: 3

Total Contact Hours: 36

Prerequisite:

Concept of courses Solid State Devices; Analog Electronic Circuit; Digital Electronic and Circuit

Course Objective(s):

Objective of the course is:

To understand the basic concepts of designing combinational and sequential circuits and the design of VLSI ICs

To motivate students to design VLSI circuits in the area of digital, analog

To encourage for the design of IC with low power and high speed.

To study various programmable logic devices like PLDs and FPGA.

Course Outcome(e):

The students will be able to

CS802A.1: Understand scale of integration and VLSI design flow and VLSI Design steps.

CS802A.2: Calculate and analyze the different parameters related to the different MOS devices and to design the combinational and sequential logic circuits.

CS802A.3: Describe fabrication steps of IC and construct stick diagram & layout of CMOS inverter and basic gates based on Layout design rules.

CS802A.4: Understand the VHDL basics and to construct the combinational and sequential logic circuits.

Course Content**Module –1: Introduction to VLSI Design: [9L]**

Historical perspective development of VLSI from discrete electronic circuit to VLSI.IC, MSI, LSI, Microelectronics & VLSI. Types of VLSI Chips (General purpose, ASIC, PLA, FPGA), photo-resist Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS proc VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioural, Structural, Physical), Y-Chart, Digital VLSI Design Steps.

Module-2: MOS structure: [2L]

E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flat band voltage, Potential balance & Charge balance, Inversion, MOS capacitances. Three Terminal MOS Structure: Body effect. Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation). Scaling in MOSFET, General scaling, Constant Voltage & Field scaling.] CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.

Module-3: Micro-electronic Processes for VLSI Fabrication: [10L]

Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative ess, p-well CMOS process, Twin tub process, Silicon on insulator Layout Design Rule: Stick diagram with examples, Layout rules.

Module –4: Hardware Description Language:[6L]:

VHDL or Verilog Combinational & Sequential Logic circuit Design.

Text Books:

1. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education
2. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang&Y.Leblebici, TMH.

Reference Books:

1. Microelectronic Circuits , Sedra & Smith , Oxford
2. Introduction to VLSI Circuits and System , Uyemura , Wiley

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS802A.1	2	2	3	1	1	-	-	1	2	1	1	1
CS802A.2	3	2	1	2	1	-	-	1	2	1	1	2
CS802A.3	3	3	3	2	1	-	-	1	2	1	1	2
CS802A.4	2	2	1	1	1	-	-	1	2	1	1	2

Course Name: Bio-informatics

Course Code: CS802B

Contact (Periods/Week): L-T-P=3-0-0

Credit Point: 3

No. of Lectures: 35

Course Objective(s):

The student should made to: Be familiar with the modeling techniques. Learn microarray analysis. Exposed to Pattern Matching and Visualization.

Outcomes:

The students will be able to upon completion of the course, The students will be able to Develop models for biological data Apply pattern matching techniques to bioinformatics data – protein data genomic data. Apply micro array technology for genomic expression study

Course Outcome(s):

CS802B.1 To acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications

CS802B.2 To develop idea in MOLECULAR BIOLOGY

CS802B.3 To understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks

CS802B.4 To acquire the knowledge of the DNA SEQUENCE ANALYSIS

CS802B.5 To analyse the performance of different types of Probabilistic models used in Computational Biology.

Couse Content:

Module -1: [7L] INTRODUCTION TO MOLECULAR BIOLOGY:

Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept. Concepts of RNA : Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation, Introduction to Metabolic Pathways. Introduction to Bioinformatics. Recent challenges in Bioinformatics.

Module -2: [10L]

Introduction to Genomic data, Data Organization and Sequence Databases: Sequence Data Banks - Introduction to sequence data banks - protein sequence data bank. Signal peptide data bank, Nucleic acid sequence data bank - GenBank, AIDS virus sequence data bank. RRNA data bank, structural data banks - protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank - Metabolic pathway data : Microbial and Cellular Data Banks. Introduction to MSDN (Microbial Strain Data Network): Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different **Modules**: GenBank; OMIM, Taxonomy browser, PubMed;

Module 3: [8L] DNA SEQUENCE ANALYSIS DNA Mapping and Assembly :

Size of Human DNA ,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Secondary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. Tertiary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Module -4: [10L] Introduction Probabilistic models used in Computational Biology:

Probabilistic Models; Gene Regulatory Method Application of HMM in Bio informatics : Genefinding, profile searches, multiple sequence alignment and regulatory site identification. Applications in Biotechnology : Protein classifications, Fold libraries, Protein structure prediction: Fold recognition

(threading), Protein structure predictions : Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling& Dynamics, Drug Designing.

Text Book:

Yi-Ping Phoebe Chen (Ed), “BioInformatics Technologies”, First Indian Reprint, Springer Verlag, 2007.

References Book:

1. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2005

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS802B.1	3	-	-	-	-	1	1	-	-	-	-	-
CS802B.2	-	1	2	1	-	-	-	-	-	1	-	1
CS802B.3	1	2	-	2	2	-	-	-	1	-	-	-
CS802B.4	2	-	-	-	-	2	2	-	-	1	1	-
CS802B.5	-	3	-	1	-	3	-	1	-	-	2	-

Course Name: Robotics

Course Code: CS802C

Contacts: 3L

Credits: 3

Allotted hours: 35L

Prerequisite:

Microprocessor & Microcontroller

Computer Organization & Architecture

Course Objective(s):

To study microcontroller operations for robotics

To study how different interfaces are implemented in a microcontroller.

To learn how Microchip PIC micro PIC16F627 can be erased and reprogrammed

To learn how different sensors, outputs, and peripherals can be wired to a microcontroller to work cooperatively and create a high-level control program.

To design robots in a real time environment.

Course Outcome(s):

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

CS802C.1 To describe and explain the microcontrollers used the in robots.

CS802C.2. To design the software and build the prototype of robots.

CS802C.3. To apply localization and mapping aspects of mobile robotics.

CS802C.4. To demonstrate self-learning capability.

Course contents:

Module 1[5L]

Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of

transmissions, Purpose of sensors, internal and external sensors, commonsensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Module 2 [8L]

Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Module 3[8L]

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators.

Module 4[9L]

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.

Module 5[5L]

Introduction and some well-known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modelling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics, and static stability of a three-wheeled WMR 's on uneven terrain, Simulations using MATLAB and ADAMS.

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).

Textbooks:

Myke Predko, —Programming Robot Controllers— McGrawHill, 1st edition, 2003.

Reference books:

Michael Slater, —Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.

Myke Predko, —Programming and customizing the 8051- micro-controller, Tata McGraw-Hill, New Delhi, 2000.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS802C.1	3	3	-	1	1	-	-	-	-	-	-	-
CS802C.2	2	3	-	1	-	-	-	-	-	-	-	-
CS802C.3	2	3	3	-	-	-	-	-	-	-	-	-
CS802C.4	2	2	-	-	-	-	-	-	-	-	-	3

Course Name: Introduction to IoT

Course Code: CS803A

Contact (Periods/Week):3L/Week

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:

On completion of the course students will be able to

CS 803 A.1: Understand and differentiate the concepts of Internet of Things and Internet

CS 803 A.2: Identify appropriate MAC protocols and routing protocols while solving a problem

CS 803 A.3: Analyze and compare the basic protocols in wireless sensor network and IoT

CS 803 A.4: Solve different real life problems in different domains based upon the concept of IoT and sensor network

CS 803 A.5: Implement basic IoT applications on embedded platform.

Course Content:

Module 1: [7L]

Fundamental of IoT

The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module 2: [6L]

Wireless Sensor Network

Network & Communication aspects, Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Module 3: [7L]

IoT and M2M

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4: [7L]

IoT Architecture

Introduction, Architecture Reference Model- Introduction, Reference Model, and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5: [5L]

IoT Applications for Value Creations

Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6: [4L]

Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text books:

- 1.Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
- 2.Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference books:

- 1.Cuno Pfister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 978-1-4493-9357-1
- 2.Waltenegus Dargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 803 A.1	3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CS 803 A.2	3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CS 803 A.3	3	3	3	2	2	-	1	-	-	-	-	-	1	2	-
CS 803 A.4	3	3	3	3	3	2	2	-	-	-	-	-	3	-	-
CS 803 A.5	3	3	3	3	3	2	2	-	2	2	1	1	3	-	-

Course Name: Image Processing**Course Code: CS803B****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisite:**

1. Fourier analysis
2. Linear algebra
3. Probability

Course Objective(s):

- To learn discrete Fourier transform and its properties
- To study the monochrome and color image fundamentals
- To learn the analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing.
- To learn image compression and segmentation techniques.

Course Outcomes:

After completion of course, students would be able

CS803B.1: To acquire the knowledge of basic pre-processing techniques in monochrome and color images.

CS803B.2: To develop skill in concepts of image enhancement like linear and non linear spatial filters using MATLAB.

CS803B.3: To understand the concept and techniques of simple image processing projects using different methods of restoration.

CS803B.4: To acquire the knowledge of the various segmentation algorithms for practical applications.

CS803B.5: To analyze the performance of Lossless and Lossy compression techniques in images.

Course Contents:

Module -1: Introduction:[5L]

Digital Image Fundamentals : Overview, Computer imaging systems , Digital Image Representation, Fundamental steps in Image Processing [1L], Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display [1L]. Digital Image Formation: A Simple Image Model, Use and Analysis of Color Models in Image Processing [2L], Sampling & Quantization - Uniform & Non-uniform [1L].

Module -2: Mathematical Preliminaries : [5L]

Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure [1L]; Distance Measures, Arithmetic/Logic Operations, Discrete Signals and Systems [1L]- A Review – Fourier Transformation, Properties of The Two Dimensional Fourier Transform [2L], Discrete Fourier Transform, Discrete Cosine & Sine Transform [1L].

Module 3: Image Enhancement : [6L]

Spatial Domain: Gray level transformations – Histogram processing [2L] Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain [2L]– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters [2L].

Module -4: Image Restoration, Segmentation and Filtering :[14L]

Image Restoration and Segmentation:Image restoration: noise removal: mean & adaptive filters, degradation model, inverse filter [2L]. Discrete Formulation, Algebraic Approach to Restoration Unconstrained & Constrained [1L]; Constrained Least Square Restoration, Restoration by Homomorphic Filtering [1L], Geometric Transformation - Spatial Transformation, Gray Level Interpolation [1L]. Image Segmentation : Point Detection, Line Detection, Edge detection, Combined detection [2L],

Module -5: Edge Linking, Boundary Detection and Image compression : [5L]

Edge Linking & Boundary Detection- Local Processing, Global Processing via The Hough Transform [2L]; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding[2L]; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging [2L], Image compression: system model, lossless methods, lossy methods [2L]

Module -6: Image Representation and Recognition :[5L]

Image Representation and Recognition :Boundary representation – Chain Code – Polygonal approximation [1L], signature, boundary segments – Boundary description [1L] – Shape number- Fourier Descriptor [1L], moments- Regional Descriptors –Topological feature [1L], Texture – Patterns and Pattern classes – Recognition based on matching [1L].

Text Books:

1. Chanda&Majumder , Digital Image Processing & Analysis, PHI

Reference books:

1. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition, PHI Learning Pvt. Ltd.,2011.
2. Rafael C. Gonzales and Richard E. Woods, Digital Image Processing, Third Edition, Pearson Education,2010.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS803B.1	3	-	-	2	-	1	1	-	-	-	-	-	3	3	1
CS803B.2	-	1	2	1	-	-	-	-	-	-	-	1	3	3	1
CS803B.3	1	2	-	3	2	-	-	-	1	-	-	-	3	3	3
CS803B.4	2	-	-	-	-	1	-	-	-	1	1	-	3	3	3
CS803B.5	-	3	-	2	-	1	-	1	-	-	-	-	3	3	3

Course Name: Optimization Techniques

Course Code: CS803C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

Basic Knowledge of Function, plotting of Equation and inequations, Formulation of Mathematical Problem. Finding maximum and minimum from row or column or from Matrix.

Course Objective:

Purpose of this course to develop models and then analyze the model using the techniques of Operations

Research, Decision making under uncertainty and risk.

Course Outcomes(s):

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

CS803C.1: Recall the distinctive characteristics of different types of decision-making problem to formulate and solve a real-world problem a prototype of mathematical problem.

CS803C.2: Understand the theoretical workings of appropriate decision making approaches and tools to identify the optimal strategy in competitive world.

CS803C.3: Apply the principles of different Methods/Model of Operations Research to solve practical problems.

CS803C.4: Analyze different engineering problems linked with Optimization Technique.

Course Content:

Module 1:

Linear Programming Problem(LPP): Basics of Linear Programming Problem(LPP) and its Applications. General Mathematical Formulation of LPP; Definitions: Convex set, Solution, Feasible Solution, Basic and Non-Basic Variables, Basic Feasible Solution, Degenerate and Non-Degenerate solution, Optimum/Optimal Solution; Solution of LPP by Graphical Analysis/Method, Simplex Method, Charnes' Big M-Method; Duality Theory. **4L+3L+3L=10L**

Module 2:

Transportation Problem, Assignment Problem. **6L**

Module 3:

Game Theory: Introduction; Two person Zero Sum game, Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance. **5L**

Module 4:

Network Optimisation Models: CPM PERT (Arrow network), Time estimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and slack. Critical path, Probability of meeting scheduled date of completion of project. Calculation of CPM network. Various floats for activities. **5L**

Module 5:

Sequencing: Johnson's Algorithm (1957) For **n** Jobs and **two** machines, **n** Jobs and **three** machines. **2L**

Module 6:

Queuing Theory: Introduction and Basic Structure of Queuing Theory; Basic Definitions and Notations; Birth-and-Death Model (Poisson / Exponential distribution); Poisson Queue Models: (M/M/1);(∞ /FIFO)and(M/M/1):(N/FIFO) and Problems. **5L**

Module 7:

Inventory Control: Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models. **3L**

Project Domain:

1. Study on Real life Problem Solve by Simplex Method.
2. Study on Real life Distribution Problem Solve by Transportation Problem.
3. Study on Real life Game / Marketing Problem Solve by Game Theory.
4. Study on Real life Network / Queueing Problem Solve by PERT/CPM and Queueing Theory.
5. Study on Real life Inventory Control Problem Solve by Inventory Control.

Text Books:

1. Operations Research by Kanti Swaroop and P.K. Man Mohan, Sultan Chand and Sons
2. Linear Programming and Theory of Games by Ghosh and Chakraborty, Central Book Agency
3. Linear Programming and Theory of Games by P.M.Karak, ABS Publishing House
4. Operations Research, D.K.Jana & T.K.Roy, Chhaya Prakashani Pvt. Ltd.
5. Operations Research, Kalavati, VIKAS
6. Operations Research, Humdy A Taha, PHI / Pearson

Reference Books:

1. Operations Research Theory and Applications by J.K.Sharma, Macmillan India Limited.
2. Operations Research, Vijayakumar, Scitech
3. Operations Research by S.D. Sharma, Kedar Nath Ram Nath Publishers.
4. Operations Research by A.P. Verma, S. K. Kataria & Sons.
5. Operations Research by P.K. Gupta & Hira, S.Chand
6. Operations Research by V.K. Kapoor

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CS803C.1	3	2	-	-	-	-	-	-	-	-	-	1
CS803C.2	3	2	-	-	-	-	-	-	-	-	-	1
CS803C.3	3	2	2	-	-	-	-	-	-	-	-	1
CS803C.4	2	3	1	-	-	-	-	-	-	-	-	1

Course Name: Internet of Things Lab

CourseCode:CS803A

Contact:0:0:3

Credits:1.5

Prerequisite: Sensors, System Integration, Cloud and Network Security

Course Outcome:

After learning the course, the student will be able:

CS803A .1: Understand internet of Things and its hardware and software components

CS803A .2: Interface I/O devices, sensors & communication modules

CS803A .3:Remotely monitor data and control devices

CS803A .4:Develop real life IoT based projects

List of Experiments:

1. Definition, Characteristics, and Features of IoT.
2. Familiarization with Arduino IDE and writing a program using Arduino IDE for LED blinking.
3. Study of LM35 temperature sensors and write programs to monitor them with Arduino with Thing Speak.
4. Study of DHT-11 sensors and write programs to monitor them with Arduino with Thing Speak
5. Study of ultrasonic sensors and write programs to monitor them with Arduino with Thing Speak
6. Familiarization with NodeMCU and writing a program using it for LED blinking.
7. Study of LM35 temperature sensors and write programs to monitor them using Node MCU
8. Study of DHT-11 sensors and write programs to monitor them using Node MCU
9. Study of ultrasonic sensors and write programs to monitor them using NodeMCU
10. Setup Raspbian on the Raspberry Pi and write a program to blink an LED using Python.
11. Interfacing digital sensors and relay boards with Raspberry Pi & ESP8266
12. Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.
13. Define and Explain Eclipse IoT Project.
14. Introduction to Blink Application and implementation of small projects
15. Introduction to Cisco Packet Tracer
16. Case Study: Intelligent Traffic systems (case study), Smart Parking (case study), Smart water management (case study), Any other innovative experiment

List of Open Source Software/learning website:

- <https://github.com/connectIOT/iottoolkit>
- <https://www.arduino.cc/>

Mapping of COs with POs and PSOs:(Detailed:High:3;Medium:2;Low:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CS80 3A .1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CS80 3A .2	2	3	3	3	3	1	1	1	2	2	3	3	3	1	3
CS80 3A .3	3	3	2	3	3	2	2	2	3	3	3	3	2	1	3
CS80 3A .4	3	3	2	2	2	1	1	1	1	1	2	3	2	2	3

Course Name: Image Processing Lab

Course Code: CS893B

Contact: 0:0:3

Credits: 1.5

Prerequisite: Should have prior knowledge on syntaxes of programming like C++, JAVA.

Course Objective(s)

- To learn discrete Fourier transform and its properties
- To study the monochrome and color image fundamentals
- To learn the analytical tools and methods which are currently used in digital image processing as

- applied to image information for human viewing.
- To learn image compression and segmentation techniques.

Course Outcomes:

On completion of the course students will be able to

CS893B.1: Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.

CS893B.2: Analyze images in the spatial domain.

CS893B.3: Analyze images in the frequency domain through the Fourier transform.

CS893B.4: Design and implement with MATLAB algorithms for digital image processing operations such as point processing, histogram processing,

CS893B.5: Spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.

Experiments:

- W.A.P in MATLAB to extract different attributes of an Image.
- W.A.P in MATLAB program for Image Negation.
- W.A.P in MATLAB for Power Law Transformation.
- W.A.P in MATLAB for Histogram Mapping and Equalization.
- W.A.P in MATLAB for Image Smoothing and Sharpening.
- W.A.P in MATLAB for Edge Detection using Sobel, Prewitt and Roberts Operators.
- W.A.P in MATLAB for Morphological Operations on Binary Images.
- W.A.P in MATLAB for Pseudo Colouring of images.
- W.A.P in MATLAB for Chain Coding applied on images.
- W.A.P in MATLAB for DCT/IDCT Computation.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS893B.1	2	-	-	2	-	1	3	-	-	-	-	-	3	3	3
CS893B.2	-	1	3	1	-	-	-	-	-	1	-	-	3	3	3
CS893B.3	1	2	-	-	-	3	-	-	1	-	2	-	3	3	3
CS893B.4	2	-	2	-	-	1	-	-	-	1	1	-	3	3	3
CS893B.5	-	2	-	3	-	1	-	1	-	1	-	-	3	3	3

Course Name: Optimization Techniques Lab

Course Code: CS893C

Contact: 0:0:3

Credits: 1.5

Course Objective(s):

- To introduce the optimization techniques using both linear and non-linear programming.
- To focus on the convex optimization though some techniques will be covered for non-convex function optimization.
- To frame engineering minima maxima problems in the framework of optimization problems.

