Course Curriculum and Syllabus

(As per NEP - 2020)

For

5 Years Integrated
B. Tech. (CSE) and M. Tech. (CSE) with Specialization in Machine Learning and Data Science

Effective from Session 2022-2023

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

CENTRAL UNIVERSITY OF JHARKHAND

RANCHI 835 222, JHARKHAND

About the Department

Department of Computer Science and Engineering is at the heart of the Central University of Jharkhand, preparing graduates for career leadership; taking up interdisciplinary research in academia and high technology industry responsibilities alike. The department of Computer Science and Engineering started with the vision to pursue digital transformation of the social, geographical and economic landscape, narrowing the gap of conventional wisdom through computing interfaces.

It is the departmental ambition to be internationally recognized as a leader in Computer Science, a department with coherent activities within research, education, development and industry cooperation. The research in the department is focused on major thrust areas of Computer Science like Artificial Intelligence, Machine Learning, Deep Learning, Natural Language Processing, Image Processing, Soft Computing, Computer Vision, Cognitive Robotics, Network Security, Cloud Computing, Data Mining, Data Science, Mobile Computing, Information Security and on other interdisciplinary relevant areas.

Currently the department favors the intake of students in its M.Tech (CSE) course offering a healthy environment for enabling graduates towards a path they prefer furnishing ample opportunities both in academia and industry. Full time Ph.D positions are pursued by high quality individuals with a motivation for change and progress through their future contributions in the area of computer science as a whole with its applications so diverse and inherent essential. From the year 2022/23 the department has started the intake for 5 years Integrated B. Tech. (CSE) and M. Tech. (CSE) with specialization in Machine Learning and Data Science

Mission of the Department

- To create a lively environment for the students and faculty for personal and professional growth with high technical competencies and ethical standards.
- To continuously upgrade the curriculum and laboratory facilities to train the students in the cutting-edge technology for better employability.
- To involve the students in individual as well as team projects for solving challenging problems in Computer Science, Computer Engineering and ICT related applications.
- To create a center of excellence on frontier areas of research.
- To facilitate consultancy work by the faculty for industry and the public sectors.
- To cater the need of computer awareness and to digitally empower the weaker section of the society through outreach and engagements.

Program Name: Integrated B. Tech (Computer Science and Engineering) and M. Tech. (Computer Science and Engineering) with specialization in Machine Learning and Data Science.

Eligibility Criteria for Admission:

Qualified 10+2 candidates (with PCM) Passed 10+ 2 or equivalent examination withPhysics, Mathematics and Chemistry subjects with a minimum 50% marks or equivalent grade for General Category and 45 % or equivalent grade for SC/ST/OBC (non-creamy layer)/ PWD.

About the Programme

The Department has started offering a five years Integrated Degree programme for its students as per NEP 2020 curriculum. The design of the course curriculum has largely derived the interpretations and meaning for the program from the guidelines provided under the NHEQF (National Higher Education Quality Framework), AICTE Model Curriculum for UG Degree Courses. The programme curriculum would undergo periodic reviews, upgrades and changes, bearing in mind the rapid change in industry and R&D demands. The programme is meant to largely cater to the latest industry and R&D demands by imparting cutting edge knowledge and providing valuable industrial experience to the students. Under this programme, a provision for multiple entry and exit at various levels has been incorporated to fulfill the mandate of NEP 2020. A student can get an Undergraduate Certificate, Undergraduate Diploma, B. Voc., B. Tech. at different levels of exit, otherwise, Integrated Degree (B. Tech. + M. Tech.) directly at the end of 5 years after completing the mandatory course and credit requirements. The Department also offers a minor specialization course of 18-20 credits in Computer Science and Engineering along with an integrated programme. The students who will undergo the additional minor specialization courses of 18-20 credits, will be awarded B. Tech. (HONOURS) in the concerned discipline. The following degree provisions are also included as per NEP at different levels of exit option after successful completion of mandatory credit requirements for the degree.

1. "***Undergraduate Certificate***" degree in the concerned discipline will be awarded in case of opting exit after 1 year.
   (Mandatory Credit Required =06, Students can opt these credits from the Bridge Courses)
2. "***Undergraduate Diploma'***" degree in the concerned discipline will be awarded in case of opting exit after 2 years.
   (Mandatory Credit Required =06, Students can opt these credits from the Bridge Courses)
3. "***Bachelor's Degree in Vocation (B. Voc.)***" degree will be awarded in the concerned discipline in case of opting exit after 3 years.
   (Mandatory Credit Required =06, Students can opt these credits from the Bridge Courses)
4. "***B. Tech***." degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science in case of opting exit after 4^{th} year. Students need to gain total credits required in the range of 162-167.
5. "***B.Tech. (Honours)***" degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science in case of opting exit after 4^{th} year,

if the student gains additional 18 to 20 credits; these credits can be earned from list of Minor Specialization Course. Students need to gain total credits required in the range of 182-187. The students will be awarded honours degree only if he/she secures 7.50 or above CGPA.

6. "**Integrated B. Tech and M. Tech.**" degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science after 5th year. Students need to gain total credits required in the range of 202-207.
7. "**Integrated B. Tech *(Honours)* and M. Tech.**" degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science after 5th year. Students need to gain total credits required in the range of 222-227.

Programmme Educational Objectives (PEOs)

- **PEO 1:** Developing capability for continuous learning and problem identification in the field of Computer Science and Engineering
- **PEO 2:** To equip with high quality education, knowledge, innovation and computational skills in the area of Computer Science and Engineering
- **PEO 3:** To be more explorative in finding state-of-art solutions and implementations for complex real-life problems
- **PEO 4:** Inculcating managerial aptitude for communication, complex problem solving and decision making
- **PEO 5:** To enhance interpersonal skill, professional ethics, communication skills, team spirit and employability
- **PEO 6:** To motivate graduates to take up carrier as an entrepreneurs.
- **PEO 7:** To develop a strong foundation for building an engineering career with societal and humanitarian responsibility.

Programme Specific Outcomes (PSOs)

- Quality professionals in Computer Science and Engineering who fulfill the educational objectives of the program and meet the missions of the University and the Department.
- Professionally empowering the student as technical manpower in the industry or as an entrepreneur for product development, research and innovations.
- Able to apply the engineering knowledge to suit the present-day requirements of industry and academia
- Motivated professionals who can become leaders, researchers, innovators and contribute to the society and nation.

Programme Outcomes (POs)

Computer Engineering graduates will be able to:

- **Engineering knowledge:** Apply the knowledge of basic sciences, engineering fundamentals, and a Computer Engineering specialization to resolve the complicated engineering problems.

- **Problem analysis:** Identify, formulate, review, and disintegrate complex engineering problems reaching substantiated conclusions using principles of mathematical sciences, natural sciences, and engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit		
1	1 Hr. Lecture (L) per week	1 Credit
2	1 Hr. Tutorial (T) per week	1 Credit
3	1 Hours Practical (P) per week	0.5 Credit
4	2 Hours Practical (P) per week	1 Credit

B. Course Code Definitions	
L	Lecture
T	Tutorial
P	Practical
C	Credit
TCH	Total contact hours per week/semester

HSC	Humanities & Social Science Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Courses
OEC	Open Elective Courses
AU	Audit Courses
EEC/Project	Employment Enhancement Courses (Project/ Summer Internship/ Seminar)
MSC	Minor Specialization Course

C. Structure of Integrated UG & PG Programme

S. No.	**Category**	Breakup of Credits	**Course Credits**	
1.	Humanities & Social Science Courses	12-15	6	
2.	Basic Science Courses	23-29	28	
3.	Engineering Sciences including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc.	17-27	26	
4.	Program Core Courses (Branch specific)	58-64	59	
5.	Program Elective Courses (Branch specific)	9-18	18 (B.Tech)	8 (M.Tech)
6.	Open Elective Courses (Cross Discipline Subjects) – Electives from other technical and /or emerging Subjects	9-15	9	
7.	Project work, Seminar and Internship in Industry or Elsewhere	16-20	16 (B.Tech)	32 (M.Tech)
8.	Mandatory Audit Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	0 (non-credit)	0 (non-credit)	
Minimum Total credit for acquiring B. Tech. degree		**160**	162	
9.	Minor Specialization Course/ Department Honors Degree	18-20	20	
Minimum credit for acquiring B. Tech. (Hons.) degree			182	
Minimum Total credit for acquiring Integrated M. Tech. degree			202	
Minimum Total credit for acquiring Integrated M. Tech. degree with B. Tech. (Hons.)			222	

D. Proposed NEP -2020 based course code for UGC & AICTE Programmes				
Category	**Proposed code in LETTER format**	**Proposed Code in NUMBER format**	**Credit requirement per paper**	**Minimum credit requirement (AICTE – Engg. & Tech)**
Pre-requisite course	PR	00	0	00
Programme Core Courses	**MJ**	**01**	**3-5**	**58-64**
Minor *	**MN**	**02**	**3-5**	**16-20**
Multidisciplinary/Basic Science Courses	**MD**	**03**	**3-5**	**23-29**
Ability Enhancement Courses/Humanities and Social Sciences including Management courses	**AE**	**04**	**1-3**	**12-15**
Skill enhancement Courses	**SE**	**05**	**3**	**16**
Summer Internship in industry			**2-3**	
Research Project/ Dissertation/Project work			**12**	
Value added course come for all UG	**VA**	**06**	**2**	**00**

Engineering Science courses including workshop, drawing, basics of electronics/ electrical/ mechanical/computer etc.	**ES**	**07**	**3-5**	**17-29**
Programme Elective courses relevant to chosen specialization/branch	**PE**	**08**	**3**	**12-18**
Open Electives from other technical and /or emerging subjects	**OE**	**09**	**3**	**9-12**
Audit Courses (Mandatory Courses)	**AU**	**10**	**00**	**00**

D1. Proposed Course Code Preparation Style				
Position from Left →	First, Second & Third	Fourth & Fifth	Sixth	Seventh & Eights
Code →	DDD	MJ/MN/	1	XX
Concerned →	Department code	Subjects Category (Major/Minor/AEC……	Programme year / Intensity level of Course	Programme Code (for odd semester: 01,03,05…… and for even semester: 02, 04, 06.....)

E. Multiple Entry – Multiple Exit and Degree Nomenclature as per NEP 2020		
Academic Level	Entry Qualifications at various levels	Exiting Qualifications at various levels
Final year Diploma/ 1st year UG Degree	• Class 12 • 12+ Industrial Training Certificate (Eng) • Class 12+ QPs & NOCs	UG Certificate (Eng.)
2nd year UG Degree	UG Certificate (Eng.)	UG Diploma (Eng.)
3rd year UG Degree	UG Diploma (Eng.)	B. Voc (Eng.)
Final year UG Degree	B. Voc (Eng.)	B.E./B. Tech.
PG (Eng)	B.E./B. Tech.	M.Tech(Eng.)

Bridge Courses (for students opting EXIT)

1. After First Year

In case of students opting to exit from the programme after securing **41 credits** in the First Year, the student should pass any two suitable skill-based courses of 6 credits of ITI Level during the summer vacation in addition to credits earned during first and second semesters to qualify for Undergraduate Certificate (Engineering).

*Any two courses of 6 credits from the SWAYAM/NPTEL courses bucket (*Exit courses for 1st Year*).***OR**

Internship/**Apprenticeship of 6 credits during the summer vacation** in addition to credits earned during first and second semesters.

2. After Second Year

In case of students opting to exit after securing **79 credits** in Second Year, the candidate should pass any two suitable **skill-based courses of 6 credits of Diploma Level** semester **during the summer vacation** in addition to credits earned during first to four semesters to qualify for **Undergraduate Diploma (Engineering)**.

*Any two courses of 6 credits from the SWAYAM/NPTEL courses bucket (*Exit courses for 2nd Year.*)* **OR**

Internship / Apprenticeship of 6 credits during the summer vacation in addition to credits earned during first to four semesters.

3. After Third Year

In case of students opting to exit after securing **126 credits in Third Year**, the candidate should pass any two suitable **skill-based courses of 6 credits of Degree Level during the summer vacation** in addition to credits earned during first to six semesters to qualify for **B. Voc. (Engineering)**.

*Any two courses of 6 credits from the SWAYAM/NPTEL courses bucket (*Exit courses for 3rd Year*).*

OR

Internship / Apprenticeship of 6 credits during the summer vacation in addition to credits earned during first to six semesters.

4. After Fourth Year

"***B. Tech***." degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science in case of opting exit after 4th year. Students need to gain total credits required in the range of 162-167.

OR

"***B.Tech. (Honours)***" degree will be awarded in Computer Science and Engineering with specialization in Machine Learning and Data Science in case of opting exit after 4th year, if the student gains additional 18 to 20 credits; these credits can be earned from list of MINOR SPECIALIZATION COURSE (MSC) BUCKET between third to eighth semesters. It is recommended that he/she may choose at least one paper per semester, although he/she may choose more than one paper per semester. Students need to gain total credits required in the range of 182-187.

Note: The Bridge Courses (for students opting EXIT) list is subject to modifications; and also selection of courses will depends on its availability on SWAYAM/NPTL.

MINOR SPECIALIZATION COURSE (MSC)

After successful completion of 162-167 credits, a student shall be eligible to get Under Graduate degree in Computer Science & Engineering. A student will be eligible to get Under Graduate degree with Honours; if he/she completes additional Department/ University recommended courses of 18-20 credits extra from NPTEL Courses of 4 Weeks, 8 Weeks and 12 Weeks either of 2, 3 or 4 Credits respectively from MOOCs. For registration to MOOCs Courses, the students shall follow NPTEL Site http://nptel.ac.in/ as per the NPTEL policy and norms. The same number of credits can be earned from the departmental offering of the MSC list of courses. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the Department) may be cleared during the B. Tech degree program (not necessary one course in each semester). After successful completion of these MOOCs courses the students, shall, provide their successful completion NPTEL status/certificates to the University Controller of Examination (CoE) through their department of study. The student shall be awarded Hons. Degree with specialization (on successful completion of additional 18-20 credit) only if he/she secures 7.50 or above CGPA.

Note: The MSC list is subject to modifications; and also selection of MSC will depends on the availability of courses on SWAYAM/NPTL.

SEMESTER WISE STRUCTURE

FIRST SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	BSC	Physics –I	3	1	0	4	PHY03101
2.	BSC	Physics-I Lab	0	0	2	1	PHY03103
3.	BSC	Mathematics-I	3	1	0	4	MAT03101
4.	ESC	Basics Electrical Engineering	3	1	0	4	EEN07101
5.	ESC	Basics Electrical Engineering Lab	0	0	2	1	EEN07105
6.	ESC	Engineering Graphics & Design	1	0	2	2	EEN07103
7.	HSS	Communicative English	2	0	2	3	ENG04101
8.	ESC	Design Thinking	0	0	2	1	HSS04101
			Total Credits			20	

SECOND SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	BSC	Chemistry – I	3	0	0	3	CHM03102
2.	BSC	Chemistry - I Lab	0	0	2	1	CHM03104
3.	BSC	Mathematics-II	3	1	0	4	MAT03102
4.	BSC	Biology for Engineers	3	0	0	3	MME07102
5.	ESC	Programming for Problem Solving	3	0	0	3	CSE07102
6.	ESC	Programming for Problem Solving Lab	0	0	2	1	CSE07104
7.	ESC	Workshop Manufacturing Practices	1	0	4	3	EEN07102
8.	HSS	Universal Human Values –II: Understanding Harmony and Ethical Human Conduct	2	1	0	3	HSS04102
9.	AU	NSS/NCC	2	0	0	0	NSS10102
			Total Credits			21	

TOTAL CREDIT AFTER 1st YEAR = 41

*The candidate needs to gain SIX additional credits from SWAYAM/NPTEL for seeking "**EXIT" after 1st Year** for 'undergraduate certificate' as suggested in the table below. Candidates may opt other courses from SWAYAM/NPTEL of similar domain.*

THIRD SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	ESC	Digital Electronics	3	0	0	3	CSE07209
2.	ESC	Engineering Mechanics	3	0	0	3	DCE07201
3.	ESC	Engineering Mechanics Lab	0	0	2	1	DCE07203
4.	ESC	Digital Electronics Lab	0	0	2	1	CSE07211
5.	BSC	Mathematics-III (Probability and Statistics)	3	1	0	4	MAT03201
6.	PCC	Data structure & Algorithms	3	0	0	3	CSE01201
7.	PCC	Data structure & Algorithms Lab	0	0	2	1	CSE01203
8.	PCC	Object Oriented Programming with C++	3	0	0	3	CSE01205
9.	PCC	Object Oriented Programming with C++ Lab	0	0	2	1	CSE01207
10.	AU	Disaster Management	2	0	0	0	DGI10201
					Total Credits	**20**	

***Note**: Induction of Minor Specialization courses (MSC) to get 20 extra credits for Honors degree. These courses need to be done starting from 3rd semester until the end of 8th semester suggestive offering from SWAYAM/NPTEL. The students would have the flexibility of opting minor specialization courses in consultation with the department.*

FOURTH SEMESTER

Sl. No	Category		Course Title	Periods Per Week			Credit	Subject Code
				L	T	P		
1.	PCC		Design & Analysis of Algorithms	3	0	0	3	CSE01202
2.	PCC		Design & Analysis of Algorithms Lab	0	0	2	1	CSE01204
3.	PCC		Computer Organization & Architecture	3	0	0	3	CSE01206
4.	BSC		Discrete Mathematical Structure	3	1	0	4	MAT032020
5.	PCC		Operating Systems	3	0	0	3	CSE01208
6.	PCC		Operating Systems Lab	0	0	2	1	CSE01210
~~7.~~	~~AU~~		~~Environmental Sciences~~	~~2~~	~~0~~	~~0~~	~~0~~	
8.								
9.	MSC 1		Computer Graphics	3	1	0	4	CSE02212
10.	OEC	*OEC 1	Project Management Techniques**	3	0	0	3	DCE09212
		*OEC 2	Basic of Renewable Energy Resource**	3	0	0	3	EEN09202
		*OEC 3	Fundamentals of Materials Science and Engineering	3	0	0	3	MME09202
		**OEC 4	Introduction to Data Structure**	3	0	0	3	CSE09214
						Total Credits	**18**	

Note: During the summer after 4th & 6th semester students can do 45 days of 'Summer Internship' done at once or in two parts that will be evaluated through presentation/seminar.

TOTAL CREDIT AFTER 2ndYEAR = 79

Courses offered by other departments ****OEC*** *for CSE students*

Courses offered by DCSE *****OEC*** *for students of other departments*

(Introduction of Open elective courses (OEC) offered by Civil/Electrical/Energy engineering departments for CSE students and also offered by DCSE for Civil/Electrical/Energy from fourth semester onwards.)

*Note: The candidate needs to gain SIX additional credits from SWAYAM/NPTEL for "**EXIT**" after 2nd Year for 'undergraduate diploma' as suggested in the table. Candidate may opt other courses from SWAYAM/NPTEL of similar domain.*

FIFTH SEMESTER

Sl. No	Category		Course Title	Periods Per Week			Credit	Subject Code
				L	T	P		
1.	PCC		Introduction to Database Management Systems	3	0	0	3	CSE01301
2.	PCC		Introduction to Database Management Systems Lab	0	0	2	1	CSE01303
3.	PCC		Programming with Python	3	0	0	3	CSE01305
4.	PCC		Programming with Python Lab	0	0	2	1	CSE01307
5.	PCC		Theory of Computation	3	1		4	CSE01309
6.	PCC		Computer Networks	3	1	0	4	CSE01311
7.	ESC		Engineering Economics	3	0	0	3	DCE07301
8.	MSC 2		Introductory Cyber Security	3	1	0	4	CSE02313
9.	OEC	*OEC 1	Remote Sensing and GIS in Engineering	3	0	0	3	DCE09301
		*OEC 2	Basics of Solar Energy Engineering	3	0	0	3	EEN09301
		*OEC 3	Fundamental of Nanoscience and Technology	3	0	0	3	MME09301
		**OEC 4	AI Foundation and Applications	3	0	0	3	CSE09315
						Total Credits	**22**	

SIXTH SEMESTER

Sl. No	Category		Course Title	Periods Per Week			Credit	Subject Code
				L	T	P		
1.	PCC		Introduction to Artificial Intelligence	3	1	0	4	CSE01302
2.	PCC		Compiler Design	3	1	0	4	CSE01304
3.	PCC		Data Mining: Concepts and Techniques	3	1	0	4	CSE01306
4.	PEC		**Elective –I**	3	0	0	3	
			Software Engineering	-	-	-	-	CSE08308
			System Analysis and Design	-	-	-	-	CSE08310
			Software Project Management	-	-	-	-	CSE08312
5.	PEC		**Elective-II**	3	0	0	3	
			Mobile Computing	-	-	-	-	CSE08314
			Information Extraction and Retrieval	-	-	-	-	CSE08316
			Blockchain and Cryptocurrency Technologies	-	-	-	-	CSE08318
6.	PCC		Web Technology	3	0	0	3	CSE08320
7.	PCC		Web Technology Lab	0	0	2	1	CSE08322
8.	MSC 3		Network and System Security	3	1	0	4	CSE02324
9.	OEC	*OEC 1	Watershed Management	3	0	0	3	DCE09302
		*OEC 2	Basic of Fuel cell and Hydrogen Energy	3	0	0	3	EEN09302

		*OEC 3	Fundamentals of Materials Characterization Techniques	3	0	0	3	MME09302
		**OEC 4	Introduction to Machine Learning	3	0	0	3	CSE09326
						Total Credits	**25**	
Note: During the summer after 4th& 6th semester students can do 45 days of 'Summer Internship' done at once or in two parts that will be evaluated through presentation/seminar.								

TOTAL CREDIT AFTER 3rd YEAR = 126

*Note: The candidate needs to gain SIX additional credits from SWAYAM/NPTEL for "**EXIT**" after 1st Year for 'undergraduate certificate' as suggested in the table. Candidates may opt for other courses from SWAYAM/NPTEL of similar domain.*

SEVENTH SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	PCC	Machine Learning	3	1	0	4	CSE01401
2	PCC	Introduction to Data Analytics using Python	3	1	0	4	CSE01403
3.	PEC	**Elective – III**	**2**	**1**	**0**	**3**	
		Principles of Cloud Computing	-	-	-	-	CSE08405
		Next Generation Networks	-	-	-	-	CSE08407
		Introduction to Industry 4.0	-	-	-	-	CSE08409
4.	PEC	**Elective – IV**	**3**	**0**	**0**	**3**	
		Internet of Things	-	-	-	-	CSE08411
		Nature Inspired computing for Data Science	-	-	-	-	CSE08413
		Introduction to Cryptography	-	-	-	-	CSE08415
5.	MSC 4	Distributed Systems	3	1	0	4	CSE02417
6	PROJ	Engineering Project –I	0	0	10	5	CSE05419
7.	PROJ	Summer Internship	0	0	0	1	CSE05421
					Total Credits	**20**	

Note: The two engineering projects might incorporate specification and requirement analysis as well as design analysis, coding/implementation, testing and execution playing a major role. And the dissertations could have much broader outcomes relating research-based exploration where theoretical analysis, modeling and simulation, experimentation and analysis further augmented with prototype design, correlation and analysis of data, applied research and any other related activities plays a major role. The

outcomes of each project must be evaluated in the form of a technical report followed by presentation. And the dissertation might be considered where implementation, testing and execution would play a major role.

EIGHTH SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	PEC	**Elective – V**	**3**	**0**	**0**	**3**	
		Knowledge Representation and Reasoning	-	-	-	-	CSE08402
		Parallel Algorithms	-	-	-	-	CSE08404
2.	PEC	**Elective – VI**	**3**	**0**	**0**	**3**	
		Soft Computing	-	-	-	-	CSE08406
		Quantum Computing	-	-	-	-	CSE08408
3	MSC 5	Virtual and Augmented Reality	3	1		4	CSE02410
5.	PROJ	Engineering Project – II				10	CSE05412
					Total Credits	**16**	

TOTAL CREDIT AFTER 4th YEAR = 162

NINTH SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	PEC	**Elective – VII**	**3**	**0**	**0**	**3**	
		Big Data Analytics	-	-	-	-	CSE08501
		Artificial Neural Network	-	-	-	-	CSE08503
2.	PEC	**Elective – VIII**	**3**	**0**	**0**	**3**	
		Deep Learning	-	-	-	-	CSE08505
		Natural Language Processing	-	-	-	-	CSE08507
3.	PEC	Research Methodology and Intellectual Property Rights	2	0	0	2	CSE08509
3.	PROJ	Dissertation I				12	CSE05511
					Total Credits	**20**	

TENTH SEMESTER

Sl. No	Category	Course Title	Periods Per Week			Credit	Subject Code
			L	T	P		
1.	PROJ	Dissertation II				20	CSE05502
					Total Credits	**20**	

TOTAL CREDIT AFTER 5th YEAR = 202

Bridge/Exit Courses for 1st Year: NPTEL/SWAYAM Course

SN	**NPTEL Course Name & Institute**	**Credit**	**Link**
1.	Programming In Modern C++ **BY :**By Prof. Partha Pratim Das	3	https://onlinecourses.nptel.ac.in/noc23_cs78/preview
2.	Introduction To Algorithms and Analysis **By:** Prof. Sourav Mukhopadhyay	3	https://onlinecourses.nptel.ac.in/noc23_cs88/preview
`3	Introduction to Operating Systems **By**: Prof. Chester Rebeiro	2	https://onlinecourses.nptel.ac.in/noc20_cs75/preview
4	Data Base Management System **By**: Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay	2	https://onlinecourses.nptel.ac.in/noc23_cs79/preview
5	Soft Skill Development **BY:** Prof. Priyadarshi Patnaik, Prof. V.N. Giri, Prof. D. Suar	2	https://onlinecourses.nptel.ac.in/noc23_hs10/preview
6	ICT in Libraries **By:** Professor Uma Kanjilal	4	https://onlinecourses.swayam2.ac.in/nou20_lb10/preview

Bridge/ Exit courses for 2nd Year: NPTEL/SWAYAM Course

SN	**NPTEL Course Name & Institute**	**Credit**	**Link**
1.	The Joy Of Computing Using Python **By:** Prof. Sudarshan Iyengar	3	https://onlinecourses.nptel.ac.in/noc23_cs108/preview

2.	An Introduction to Artificial Intelligence, IIT Delhi. **BY:** Prof. Mausam	3	https://archive.nptel.ac.in/courses/106/102/106102220/
3	Ethical Hacking **By:** Prof. Indranil Sengupta	3	https://onlinecourses.nptel.ac.in/noc23_cs75/preview
4	Software Testing **BY:** Prof. Meenakshi D'souza	3	https://onlinecourses.nptel.ac.in/noc22_cs61/preview
5	Introduction to Virtual Reality **BY:**Ramesh C Sharma	4	https://onlinecourses.swayam2.ac.in/nou23_ge34/preview
6	Entrepreneurship **BY:** Prof. C Bhaktavatsala Rao	3	https://onlinecourses.nptel.ac.in/noc23_mg74/preview
7	Graphics and Animation Development **BY:** Er. Shano Solanki	2	https://onlinecourses.swayam2.ac.in/ntr20_ed15/preview

Bridge/ Exit courses for 3rd Year: NPTEL/SWAYAM Course

SN	**NPTEL Course Name & Institute**	**Credit**	**Link**
1.	Cyber Security and Privacy, IIT Madras. **BY :** Prof. Saji K Mathew	3	https://nptel.ac.in/courses/106106248
2.	Introduction To Machine Learning **By:** Prof. Balaraman Ravindran	3	https://onlinecourses.nptel.ac.in/noc23_cs98/preview
3	ANIMATIONs **By:**Dr. Abhishek Kumar	4	https://onlinecourses.swayam2.ac.in/ugc19_cs09/preview
4	Android Mobile Application Development **By:** Dr. Himanshu N. Patel	4	https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

5	Business Analytics and Data Mining Modeling using R **BY:** Prof. Gaurav Dixit	3	https://onlinecourses.nptel.ac.in/noc20_mg24/preview
6	Business Analytics & Text Mining Modeling Using Python **BY:**Dr. Gaurav Dixit	2	https://onlinecourses.nptel.ac.in/noc19_mg47/preview

MINOR SPECIALIZATION COURSE (MSC) LIST

SN	**NPTEL Course Name & Institute**	**Credit**	**Link**
1	Computer Graphics	4	Offered by the Department
2	Introductory Cyber Security	4	Offered by the Department
3	Network and System Security	4	Offered by the Department
4	Distributed System	4	Offered by the Department
5	Virtual and Augmented Reality	4	Offered by the Department
6.	Cloud Computing **By:** Prof. Soumya Kanti Ghosh	3	https://onlinecourses.nptel.ac.in/noc23_cs89/preview
7.	Advanced Distributed Systems **By:** Prof. Smruti Ranjan Sarangi	3	https://onlinecourses.nptel.ac.in/noc23_cs68/preview
8	Artificial Intelligence : Search Methods For Problem Solving **By:** Prof. Deepak Khemani	3	https://onlinecourses.nptel.ac.in/noc23_cs92/preview
9	Big Data Computing **By:** Prof. Rajiv Misra	2	https://onlinecourses.nptel.ac.in/noc23_cs112/preview
10	Data Science For Engineers **By:** Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan	2	https://onlinecourses.nptel.ac.in/noc23_cs97/preview
11	Deep Learning - IIT Ropar **By**: Prof. Sudarshan Iyengar, Prof. Padmavati	3	https://onlinecourses.nptel.ac.in/noc23_cs110/preview
13	Deep Learning for Computer Vision **By** Prof. Vineeth N Balasubramanian	3	https://onlinecourses.nptel.ac.in/noc23_cs126/preview

14	Ethical Hacking **By:** Prof. Indranil Sengupta	3	https://onlinecourses.nptel.ac.in/noc23_cs75/preview
15	Google Cloud Computing Foundations **By**: Prof. Soumya Kanti Ghosh	2	https://onlinecourses.nptel.ac.in/noc23_cs90/preview
16	Introduction To Internet Of Things **By**: Prof. Sudip Misra	3	https://onlinecourses.nptel.ac.in/noc23_cs83/preview
17	Machine Learning and Deep Learning - Fundamentals And Applications **By**: Prof. M. K. Bhuyan	3	https://onlinecourses.nptel.ac.in/noc23_ee87/preview
18	Social Network Analysis **By:** Prof. Tanmoy Chakraborty	3	https://onlinecourses.nptel.ac.in/noc23_cs106/preview
19	Software Testing (IIITB) **By**: Prof. Meenakshi D'souza	3	https://onlinecourses.nptel.ac.in/noc23_cs91/preview
20	Cyber Security and Privacy **By**: Prof. Saji K Mathew	3	https://onlinecourses.nptel.ac.in/noc23_cs127/preview
21	Privacy And Security In Online Social Media **By**: Prof. Ponnurangam Kumaraguru	3	https://onlinecourses.nptel.ac.in/noc23_cs69/preview
22	Reinforcement Learning **By**: Prof. Balaraman Ravindran	3	https://onlinecourses.nptel.ac.in/noc23_cs100/preview

Detailed Syllabus

5 Years Integrated
Integrated B. Tech.(CSE)and M. Tech.(CSE) with
Specialization in Machine Learning and Data Science

FIRST SEMESTER

COURSE CODE	PHY03101	
COURSE TITLE	**PHYSICS - I**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**Electrostatics in vacuum:**Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.	
UNIT **II**	**Electrostatics in a linear dielectric medium:** Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.	

UNIT **III**	**Magnetostatics:** Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.	
UNIT **IV**	**Magnetostatics in a linear magnetic medium:** Magnetization and associated bound currents; auxiliary magnetic field H; Boundary conditions on B and H. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.	
UNIT **V**	**Faraday's law:** Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.	
UNIT **VI**	**Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations:** Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Pointing vector with examples. Qualitative discussion of momentum in electromagnetic fields.	
UNIT **VII**	**Electromagnetic waves:** The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from anon-conducting medium-vacuum interface for normal incidence.	

TEXTBOOKs/REFERENCES

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. E. Hecht, Optics
4. A. Ghatak, Optics
5. O. Svelto, Principles of Lasers

COURSE OUTCOME	● Students will learn strong physics and practical implementation of its fundamentals. ● Students will learn different applications of commonly used laboratory machines.

COURSE CODE	**PHY03103**	
COURSE TITLE	**PHYSICS-I LAB**	
NUMBER OF CREDITS	1	**(L:0 , T: 1, P:2)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	To enhance the experimental knowledge in Physics and its practical applications relevant to various streams of Engineering and Technology.	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Experiments on electromagnetic induction and electromagnetic breaking
2. LC circuit and LCR circuit
3. Resonance phenomena in LCR circuits
4. Magnetic field from Helmholtz coil
5. Measurement of Lorentz force in a vacuum tube.

COURSE OUTCOME	The students will be able to use the different components and equipment in physics practical.

COURSE CODE	MAT03101	
COURSE TITLE	**MATHEMATICS-I**	
NUMBER OF CREDITS	4	**(L: 3, T:** 1**, P:** 0**)**
COURSE CATEGORY	**Basic Science Course**	

COURSE OBJECTIVE	The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Calculus:**Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.	
UNIT **II**	**Sequences and Series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	
UNIT **III**	**Multivariable Calculus (Differentiation):** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	
UNIT **IV**	**Matrices:** Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	

TEXTBOOKs/REFERENCES

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company,2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. W. E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
6. N. P. Bali and Manish Goyal, Atext book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

COURSE OUTCOME	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. The students will learn: ● To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions. ● To explain the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems. ● To discuss the tool of power series and Fourier series for learning advanced Engineering Mathematics. ● To deal with functions of several variables that is essential in most branches of engineering. ● To use the essential tool of matrices and linear algebra in a comprehensive manner.

COURSE CODE	**EEN07101**	
COURSE TITLE	**BASICS OF ELECTRICAL ENGINEERING**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	**To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.**	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT I	**Elementary Concepts:** **Prerequisite: Concept of Potential difference. Current and resistance. Ohm's law, effect of temperature on resistance, resistance temperature coefficient, insulation resistance. SI units of work Power and Energy. Conversion of energy from one form to another in electrical and thermal systems.**	
UNIT II	**D. C. Circuits (Only Independent sources)** **Kirchhoff's law, ideal and practical voltage and current sources. Mesh and Nodal analysis (Super node and super Mesh excluded). Source transformation. Star delta transformation. Superposition theorem, Thevevnins's theorem Norton's theorem, maximum power transfer theorem (Source transformation not allowed for superposition theorem, Mesh and Nodal analysis.**	

UNIT III	**A.C. Fundamentals: Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor, and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.** **Study of A.C circuits of pure resistance, inductance and capacitance and corresponding voltage- current phasor diagrams, voltage – current and power waveforms.**	
UNIT IV	**Single phase and poly phase A. C. circuits:** **A) Single phase AC Circuits: Study of series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active, reactive, apparent, complex power and power factor, resonance in series and parallel RLC circuit. Q- factor and bandwith** **B) Polyphase AC circuits: Concept of three phase supply and phase sequence. Balanced and unbalanced loads voltage current and power relations in three phase balance star and delta loads and their phasor diagrams.**	
UNIT V	**Electromagnetism:** **A) Magnetic effect of electrical current cross and dot convention, right hand thumb rule and cork screw rule, nature of magnetic field of long straight conductor, concepts of solenoid and torrid. Concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, their units and relationship. Simple series and parallel magnetic circuits. , comparison between electrical and magnetic circuits , force on current carrying conductor placed in magnetic field, Fleming's left hand rule.** **B) Faraday's law of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced EMF's self and mutual inductance coefficient of coupling, energy stored in magnetic field** **C) Introduction to electrical AC DC Machines: Principles of operation and applications.**	

UNIT VI	**Single phase transformer and electrostatics:** **A. Single phase transformers: Construction, principle of working, e.m.f equations, voltage and current ratios, losses, definition of regulation and efficiency, determination of these by direct loading method. Descriptive treatment of autotransformer.** **B. Electrostatics: electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and concept of time constant.**	

TEXTBOOKs/REFERENCES

1.V. N. Mittal and Arvind Mittal;, " Basic Electrical Engineering" McGraw Hill

2.Vincent DelToro, " Electrical engineering Fundamentals", PHI second edition 2011

3.Bolestaad, :"Electronics Devices and Circuits Theory", Pearson Education India

4.Edward Hughes, " Electrical Technology,", Pearson Education

5.D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition 2011

COURSE OUTCOME	**·To understand the basic concepts of magnetic circuits, electro magnetism and electrostatics.** **·To understand and analyses AC & DC circuits.** **·To understand the working principle, and applications of DC & AC machines.**

COURSE CODE	EEN07105	
COURSE TITLE	**BASICS OF ELECTRICAL ENGINEERING LAB**	
NUMBER OF CREDITS	1	**(L:0 , T: 1, P:2)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Mesh and nodal analysis
2. Verification of super position theorem
3. Verification of Thevevnins's theorem
4. Study of R-L series and R-C series circuit
5. R-L=C series resonance circuit
6. R-L- -C parallel resonance circuit
7. Relationship between phase and line currents and voltages in 3- phase system (Star-Deltas)
8. Power and phase measurements in three phase system by two wattmeter method
9. OC and SC test on single phase transformer

COURSE OUTCOME	To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.

COURSE CODE	EEN07103
COURSE TITLE	**ENGINEERING GRAPHICS & DESIGN**

NUMBER OF CREDITS	**1**	**(L: 1, T:** 0**, P:** 2**)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	The objective of this Course is to provide the basic knowledge about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning and specifications, so useful for a student in preparing for an engineering career.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales	
UNIT **II**	**Orthographic Projections:** Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;	
UNIT **III**	**Projections of Regular Solids:** Covering those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	
UNIT **IV**	**Sections and Sectional Views of Right Angular Solids:** Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).	
UNIT **V**	**Isometric Projections:** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	

UNIT **VI**	**Overview of Computer Graphics:** Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]	
UNIT **VII**	**Customisation& CAD Drawing:** Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	
UNIT **VIII**	**Annotations, layering & other functions:** Covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling	

UNIT **IX**	**Demonstration of a simple team design project that illustrates:** 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; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	

TEXTBOOKs/REFERENCES

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2. Jain Pradeep, (2019) Engineering Graphics and Design, Khanna Book Publishing Company
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
6. (Corresponding set of) CAD Software Theory and User Manuals.

COURSE OUTCOME	**Course Outcomes:** All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address: • to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability • to prepare you to communicate effectively • to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice The students will learn: ● Introduction to engineering design and its place in society. ● Exposure to the visual aspects of engineering design. ● Exposure to engineering graphics standards. ● Exposure to solid modelling. ● Exposure to computer-aided geometric design. ● Exposure to creating working drawings. ● Exposure to engineering communication.

COURSE CODE	ENG04101	
COURSE TITLE	**COMMUNICATIVE ENGLISH**	
NUMBER OF CREDITS	3	**(L: 2, T:** 0**, P:** 2**)**
COURSE CATEGORY	**Humanities and Social Sciences**	

COURSE OBJECTIVE	1. To provide learning environment to practice listening, speaking, reading and writing skills. 2. To assist the students to carry on the tasks and activities through guided instructions and materials. 3. To effectively integrate English language learning with employability skills and training. 4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Vocabulary Building 1.1. The concept of Word Formation 1.2. Root words from foreign languages and their use in English 1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. 1.4. Synonyms, antonyms, and standard abbreviations.	
UNIT **II**	Basic Writing Skills 1.1. Sentence Structures 1.2. Use of phrases and clauses in sentences 1.3. Importance of proper punctuation 1.4. Creating coherence 1.5. Organizing principles of paragraphs in documents 1.6. Techniques for writing precisely	
UNIT **III**	Identifying Common Errors in Writing 1.1. Subject-verb agreement 1.2. Noun-pronoun agreement 1.3. Misplaced modifiers 1.4. Articles 1.5. Prepositions 1.6. Redundancies 1.7. Clichés	
UNIT **IV**	Nature and Style of sensible Writing 1.1. Describing 1.2. Defining 1.3. Classifying 1.4. Providing examples or evidence 1.5. Writing introduction and conclusion	
UNIT **V**	Writing Practices 1.1. Comprehension 1.2. Précis Writing 1.3. Essay Writing	

UNIT **VI**	Oral Communication (This Module involves interactive practice sessions in Language Lab) 1.1 Listening Comprehension 1.2 Pronunciation, Intonation, Stress and Rhythm 1.3 Common Everyday Situations: Conversations and Dialogues 1.4 Communication at Workplace 1.5 Interviews 1.6 Formal Presentations	

TEXTBOOKs/REFERENCES

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
7. Effective Communication Skills. Kulbhushan Kumar. Khanna Publishing House.

COURSE OUTCOME	1. Produce words with right pronunciation. 2. Develop vocabulary and improve the accuracy in grammar. 3. Develop the confidence to speak in public. 4. Demonstrate positive group communication exchanges. Ability to speak and write clearly in standard, academic English.

COURSE CODE	HSS04101	
COURSE TITLE	**DESIGN THINKING**	
NUMBER OF CREDITS	**1**	**(L: 0, T:** 0**, P:** 2**)**
COURSE CATEGORY	**Humanities and Social Sciences**	
COURSE OBJECTIVE	The objective of this Course is to provide the new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	An Insight to Learning; Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting	
UNIT **II**	Remembering Memory; Understanding the Memory process, Problems in retention, Memory enhancement techniques	
UNIT **III**	Emotions: Experience & Expression: Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers	
UNIT **IV**	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	
UNIT **V**	Being Ingenious & Fixing Problem: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving	
UNIT **VI**	Process of Product Design: Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design	
UNIT **VII**	Prototyping & Testing; What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing	
UNIT **VIII**	Celebrating the Difference: Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences	

UNIT **IX**	Design Thinking & Customer Centricity: Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design of Tournament – Knock-Out, League/Round Robin & Combination.	
UNIT **X**	Feedback, Re-Design & Re-Create: Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".	
TEXTBOOKs/REFERENCES		
COURSE OUTCOME	● Compare and classify the various learning styles and memory techniques and Apply them in their engineering education ● Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products ● Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products ● Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development ● Perceive individual differences and its impact on everyday decisions and further Create a better customer experience	

SECOND SEMESTER

COURSE CODE	**CHM03102**	
COURSE TITLE	**CHEMISTRY-I**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	**1.** The objective of the Chemistry I is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field. **2.** The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. **3.** The student will able to understand the new developments and breakthroughs efficiently in engineering and technology. **4.** The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with the new technologies**.**	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT I	Atomic and Molecular Structure: Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	

UNIT II	Spectroscopic techniques and applications: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.	
UNIT III	Intermolecular forces and potential energy surfaces: Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.	
UNIT IV	Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.	
UNIT V	Periodic properties: Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, Ionization energies, electron affinity and electro-negativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	
UNIT VI	Stereochemistry: Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.	
UNIT VII	Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	

TEXTBOOKs/REFERENCES

1.AICTE'sPrescribedTextbook:Chemistry–IwithLabManual,KhannaBookPublishing.

2.EngineeringChemistry, byManisha Agrawal.

3.University chemistry, byB.H. Mahan

4.Chemistry:Principles an dApplications, by M.J.SienkoandR.A. Plane

5.Fundamentals of Molecular Spectroscopy, byC.N. Banwell

6.Engineering Chemistry(NPTELWeb-book), byB.L.Tembe, KamaluddinandM.S. Krishnan

7.PhysicalChemistry, byP. W. Atkins

8.OrganicChemistry:StructureandFunctionbyK.P.C.VolhardtandN.E.Schore,5thEdition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

COURSE OUTCOME	The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than100 years old and to understand phenomena at nano-metre levels, one has to base the description of all chemical processes at molecular levels. The course will enable the students: ● To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. ● To rationalise bulk properties and processes using thermodynamic considerations. ● To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques ● To rationalise periodic properties such as ionization potential,electronegativity,oxidationstatesand electronegativity. ● To list major chemical reactions that are used in the synthesis of molecules.

COURSE CODE	**CHM03104**	
COURSE TITLE	**CHEMISTRY-I LAB**	
NUMBER OF CREDITS	**1**	**(L:0, T:0, P:2)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	The objective of the Chemistry I is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with the new technologies.	
LIST OF SUGGESTED LABORATORY EXERCISES		

Choiceof10-12 experimentsfromthefollowing:

1. Determination of surface tension and viscosity.
2. Thinlayer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Colligativepropertiesusingfreezingpointdepression.
6. Determinationoftherateconstantofa reaction.
7. Determinationofcellconstantandconductanceofsolutions.
8. Potentiometry-determinationofredoxpotentialsandemfs.
9. Synthesisofa polymer/drug.
10. Saponification/acidvalueofanoil.
11. Chemicalanalysisofa salt.
12. Latticestructuresandpackingof spheres.
13. Modelsofpotentialenergysurfaces.
14. Chemicaloscillations-Iodineclock reaction.
15. Determinationofthepartitioncoefficientofasubstancebetweentwoimmiscible liquids.
16. Adsorptionofaceticacidbycharcoal.
17. Use of the capillaryviscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	ExperimentName	ExperimentLink(s)
1	**Determinationofsurfacetensionand viscosity.**	**http://pcv-au.vlabs.ac.in/physical-chemistry/Determination_of_Viscosity_of_Organic_Solvents/**
2	**Ionexchangecolumnforremovalof hardness of water.**	**http://icy-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Chemical_Parameters/**
3	**Determinationofchloridecontentof water.**	**http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experiments/determination-of-chloride-nitk/simulation.html**

4	**Colligativepropertiesusingfreezing point depression.**	**http://pcv-au.vlabs.ac.in/physical-chemistry/Cryoscopy/**
5	**Determination of the rate constant of a reaction.**	**http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/**
6	**Determinationof cellconstant and conductance of solutions.**	**http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Physical_Parameters/**
7	**Potentiometry - determination of redox potentials and emfs.**	**http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/**
8	**Saponification/acidvalueofanoil.**	**http://biotech01.vlabs.ac.in/bio-chemistry/Estimation_of_Saponification_Value_of_Fats_or_Oils/**
9	**Lattice structures and packing of spheres.**	**https://vlab.amrita.edu/?sub=1&brch=282&sim=370&cnt=1**

COURSE OUTCOME	**Laboratory Outcomes: The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn:** • **Products as a function of time.** • **To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.** • **To synthesize a small drug molecule and analyze a salt sample.**

COURSE CODE	**MAT03102**	
COURSE TITLE	**MATHEMATICS-II**	
NUMBER OF CREDITS	**4**	**(L: 03, T: 1, P: 0)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	**Mathematics fundamental necessary to formulate, solve and analyze engineering problems.**	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT I	Matrices: Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.	
UNIT II	First order ordinary differential equations: Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	
UNIT III	Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.	
UNIT IV	ComplexVariable–Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	

UNIT V	Complex Variable–Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (withoutproof); Taylor's series, zerosofanalytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (withoutproof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.	

TEXTBOOKs/REFERENCES:

1. AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.
2. ReenaGarg, Engineering Mathematics, Khanna Book Publishing Company,2022.
3. Reena Garg, A dvanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
4. ErwinKreyszig, Advanced Engineering Mathematics,10thEdition, JohnWiley&Sons,2006.
5. VeerarajanT., Engineering Mathematics for first year,Tata McGraw-Hill,NewDelhi,2008.
6. W.E.BoyceandR.C.DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
7. D.Poole, Linear Algebra: A Modern Introduction, 2ndEdition,Brooks/Cole, 2005.
8. S.L.Ross, Differential Equations ,3rdEd.,WileyIndia,1984.
9. E.A.Coddington,An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.
10. E.L. Ince, Ordinary Differential Equations, DoverPublications, 1958.
11. J.W. Brown and R. V. Churchill, Complex Variables and Applications, 7thEd.,Mc-Graw Hill, 2004.
12. N.P.Bali and Manish Goyal, A textbook of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
13. B.S.Grewal, Higher Engineering Mathematics ,Khanna Publishers,36th Edition, 2010.

COURSE OUTCOME	The objective of this course is to familiarize the prospective engineers with techniques in matrices, ordinary differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. The students will learn: • The essential tool of matrices and linear algebra in a comprehensive manner. • The effective mathematical tools for the solutions of differential equations that model physical processes. • The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

COURSE CODE	**MME07102**	
COURSE TITLE	**BIOLOGY FOR ENGINEERS**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	The course objective is to establish a bridge to understanding the basics of biological science and various fields of engineering for students in their undergraduate courses.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT I	Cell Biology: Cell as a unit of life. Prokaryotes and Eukaryotes cells- Structure and functions. Ultra structure of plant, animal and microbial cells. Cell membranes & structures. Cell Organelles, Types of Cell division: Mitosis and Meiosis. Cell cycle and its regulation, Cancer.	

UNIT II	Molecular Biochemistry: Water, Carbohydrates - Sugars-disaccharides, Oligosaccharides, polysaccharides-homo and hetero, amylose, amylopectin, dextran, starch – glycogen, cell wall polysaccharides – cellulose, chitin. Lipids: Fats, Oils, Waxes - Fatty acids. Proteins: Amino acids, - essential and non-essential - dipeptides, fibrous and globulins - primary, secondary, tertiary, quaternary structures, alpha helix and beta pleats – triple helix - Ramachandran plots. Mechanism of enzyme action: enzyme kinetics, regulation of enzyme activity, Cofactor and Coenzyme, Technological application of enzyme. Bioenergetic and Metabolism – Laws of Thermodynamics applied to biological systems, Carbohydrate Metabolism, Lipid Metabolism, Lipid Metabolism, Amino Acid Metabolism, and Nucleic Acid Metabolism.	
UNIT III	Human Physiology: Integumentary System, Digestive System, Respiratory System, Circulatory System, Musculoskeletal System, Excretory System, Endocrine System, Nervous Engineering, and Reproductive System. Human Immune System.	
UNIT IV	Molecular Biology: Nucleic acids: Nitrogen bases-purines, pyrimidines, nucleosides and nucleotides – oligonucleotides - base paring – DNA, RNA – tRNA, mRNA, rRNA, antisense RNA –single and double-stranded – hypo and hyperchromicity, DNA varieties – A, B, and Z – Okazaki fragment –palindrome concatenation- polymorphism –DNA Replication, Central Dogma, Genetic code, Gene expression, Translation, Mutation, Immune system.	
UNIT V	Application of Biology in Engineering: Biological Engineering Solutions – Biosensor, Bioremediation, Genetic Engineering, Biology vs Technology, Biomimetic Engineering, Alliance between Engineering and Biology – (Mechanical Eng. & Biology, Electronic Eng. & Biology, Electrical Eng. & Biology, Computer Eng. & Biology, Civil Eng. & Biology, Materials Eng. & Biology, Ceramic Eng. & Biology, Mining Eng. & Biology).	

TEXTBOOKs/REFERENCES

1. Robert K. Murray, Daryl K. Garner, Peter A. Mayes, Victor W. Rodwell, Harper's Biochemistry, 28th edition, Lange Medical Books/ McGraw Hill, New York.

2. David L. Nelson, Michael M. Cox, W. H. Lehninger, Principles of Biochemistry, 5th edition, Freeman Publishers, New York.

3. E.D.P.DeRobertis, Cell & Molecular Biology, 8th edition, Lippincott publishers.

4. Alberts, Molecular biology of the cell, 6th edition, Garland Publishing.

5. David Freifelder, Essentials of Molecular biology, Jones & Bartlett Publishers.

6. Lewin Benjamin, Genes, 9th edition,. CBS Publishers and Distributors.

7. J. Cooper and C. Tass, Biosensors: A Practical Approach, Oxford University Press, 2004.

8. C.S. Kumar, Nanomaterials for Biosensors, Wiley – VCH, 2007.

9. Harvey Lodish, David Baltimore, Arnold Berk, Molecular Cell Biology, WH Freeman and Co.

10. Brian, R. Eggins, Chemical Sensors and Biosensors,Wiley New York, Chichester, 2002.

11.G.K. Knoff and A.S. Bassi, Smart Biosensor Technology, CRC Press, 2006.

COURSE OUTCOME	After studying the course, the student will be able to: ·Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine ·Classify enzymes and distinguish between different mechanisms of enzyme action. ·Identify DNA as a genetic material in the molecular basis of information transfer. ·Analyse biological processes at the reductionistic level ·Apply thermodynamic principles to biological systems.

COURSE CODE	**CSE07102**	
COURSE TITLE	**PROGRAMMING FOR PROBLEM SOLVING**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	The course objective is to demonstrate and disseminate the knowledge of computer fundamentals involving the basics of C-program development methods and techniques.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**

UNIT I	Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Algorithms, flowcharts. Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements	
UNIT II	Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions. Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.	
UNIT III	Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays, Basic Algorithms: Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, as a different way of solving problems.	
UNIT IV	Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation.	
UNIT V	Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self referential structures, unions, type def, enumerations. File handling: command line arguments, File modes, basic file operations read, write and append	

TEXTBOOKs/REFERENCES

1.Byron S Gottfried “Programming with C” Second edition, Tata McGrawhill, 2007 (Paper back)

2.R.G. Dromey, “How to solve it by Computer”, Pearson Education, 2008.

3.Kanetkar Y, “Let us C”, BPB Publications, 2007.

4.Hanly J R & Koffman E.B, “Problem Solving and Programm design in C”, Pearson Education, 2009.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Identify and describe basic c-programming structure, algorithms and draw flowcharts for problem definition involving C-Toekns, Keywords, Identifiers, data types and i/o statements. 2. To integrate operators, expressions and statements from algorithms/flowcharts into C programs 3. To generalize the concepts of arrays and functions during coding a C-program and test a given logic in the C-programming language. 4. To decompose a problem into modular reusable code for searching and sorting problems

COURSE CODE	**CSE07104**	
COURSE TITLE	**PROGRAMMING FOR PROBLEM SOLVING LAB**	
NUMBER OF CREDITS	**1**	**(L:0, T:0, P:2)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	The objective of the course is to interpret the understanding of the various steps in C-program development.	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1DArraymanipulation
6. Matrix problems, String operations
7. Simple functions
8. Programming for solving Numerical methods problems
9. Recursive functions
10. Pointers and structures
11. File operations

COURSE OUTCOME	At the end of the course the students will be able to: 1. To demonstrate the formulation of the algorithms for simple problems. 2. To translate given algorithms to a working and correct program and be able to use correct syntax, identify errors as reported by the compilers. 3. To write iterative as well as recursive programs and be able to identify and correct logical errors encountered at run time. 4. To represent data using arrays, strings, structures and pointers and be able to manipulate them through a C-program.

COURSE CODE	**EEN07102**	
COURSE TITLE	**WORKSHOP MANUFACTURING PRACTICES**	
NUMBER OF CREDITS	**3**	**(L: 1, T: 0, P: 4)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	**1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.** **2. To have a study and hands-on-exercise on plumbing and carpentry components.** **3. To have a practice on gas welding, foundry operations and fitting** **4. To have a study on measurement of electrical quantities, energy and resistance to earth.** **5. To have a practice on soldering.**	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT I	**Manufacturing Methods-casting, forming, machining, joining, and advanced manufacturing methods.**	
UNIT II	**CNC machining, Additive manufacturing.**	
UNIT III	**Fitting operations & power tools.**	
UNIT IV	**Electrical & Electronics.**	
UNIT V	**Carpentry**	
UNIT VI	**Plastic moulding, glass cutting**	
UNIT VII	**Metal casting**	

UNIT VIII	**Welding(arc welding & gas welding),brazing**	

PRACTICALS

1. **Machine shop**
2. **Fitting shop**
3. **Carpentry**
4. **Electrical & Electronics**
5. **Welding shop (Arc welding+Gas welding)**
6. **Casting**
7. **Smithy**
8. **Plastic moulding& Glass Cutting**

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

Experiments that may be performed through virtual labs:

S. No.	Experiment Name	Experiment Link(s)
1	Welding shop(Arc welding+Gas welding).	http://mm-coep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory
2	Casting	http://fab-coep.vlabs.ac.in/exp7/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20FAB%20laboratory

TEXTBOOKs/REFERENCES

1. **Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.**
2. **Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.**
3. **Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.**
4. **Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.**
5. **RaoP.N.,"ManufacturingTechnology",Vol. IandVol.II,TataMcGrawHillHouse,2017.**

COURSE OUTCOME	Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials. Laboratory Outcomes: 1.Upon completion of this laboratory course, students will be able: 2.To fabricate components with their own hands. 3.To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. 4.Todesignsmalldevicesoftheirinterestbyassemblingdifferentcomponents

COURSE CODE	**HSS04102**	
COURSE TITLE	**UNIVERSAL HUMAN VALUES-II: Understanding Harmony and Ethical Human Conduct**	
NUMBER OF CREDITS	**3**	**(L: 1, T: 0, P: 4)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	This introductory course input is intended: 1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. 2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. 3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. 4. Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.	

COURSE CONTENT		
UNIT	**CONTENT**	**HRS**

UNIT I	Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education); Understanding Value Education; Self-exploration as the Process for Value Education; Continuous Happiness and Prosperity – the Basic Human Aspirations; Happiness and Prosperity – Current Scenario; Method to Fulfill the Basic Human Aspirations Tutorial: Sharing about Oneself; Exploring Human Consciousness; Exploring Natural Acceptance	**L6, 3T**
UNIT II	Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body; Distinguishing between the Needs of the Self and the Body; The Body as an Instrument of the Self; Understanding Harmony in the Self; Harmony of the Self with the Body; Programme to ensure self-regulation and Health Tutorial: Exploring the difference of Needs of Self and Body; Exploring Sources of Imagination in the Self; Exploring Harmony of Self with the Body	**L6, 3T**
UNIT III	Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction; 'Trust' – the Foundational Value in Relationship; : 'Respect' – as the Right Evaluation; : Other Feelings, Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order. Tutorial: Exploring the Feeling of Trust; Exploring the Feeling of Respect; Exploring Systems to fulfil Human Goal	**L6, 3T**
UNIT IV	Harmony in the Nature/Existence: Understanding Harmony in the Nature; Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature; Realizing Existence as Co-existence at All Levels; The Holistic Perception of Harmony in Existence Tutorial: Exploring the Four Orders of Nature; Exploring Co-existence in Existence	**L4, 2T**

UNIT V	Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values; Definitiveness of (Ethical) Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order; Holistic Technologies, Production Systems and Management Models- Typical Case Studies; Strategies for Transition towards Value-based Life and Profession; Competence in Professional Ethics; Tutorial: Exploring Ethical Human Conduct; Exploring Humanistic Models in Education; Exploring Steps of Transition towards Universal Human Order	**L6, 3T**

TEXTBOOKs/REFERENCES

1. The Textbook - AFoundation Course in Human Values and Professional Ethics, R R Gaur,RAsthana,GPBagaria,2nd RevisedEdition,ExcelBooks,NewDelhi,2019. ISBN978-93-87034-47-1
2. TheTeacher'sManual-Teachers'ManualforAFoundationCourseinHumanValues and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53
3. JeevanVidya:EkParichaya,ANagaraj,JeevanVidyaPrakashan,Amarkantak,1999.
4. HumanValues, A.N. Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.
5. The Story of Stuff (Book).
6. The Story of My Experiments with Truth -byMohandasKaramchandGandhi
7. Small is Beautiful-E.FSchumacher.
8. Slow is Beautiful-Cecile Andrews
9. Economy of Permanence-JC Kumarappa
10. Bharat Mein Angreji Raj–PanditSunderlal
11. Rediscovering India- by Dharampal
12. Hind Swaraj or Indian Home Rule-by Mohandas K. Gandhi
13. IndiaWins Freedom –Maulana Abdul Kalam Azad
14. Vivekananda-Romain Rolland (English)
15. Gandhi-Romain Rolland(English)

COURSE OUTCOME	By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Therefore, the course and further follow up is expected to positively impact common graduate attributes like: ·Holistic vision of life ·Socially responsible behaviour ·Environmentally responsible work ·Ethical human conduct ·Having Competence and Capabilities for Maintaining Health and Hygiene ·Appreciation and aspiration for excellence (merit) and gratitude for all This is only an introductory foundational input. It would be desirable to follow it up by ·Faculty-student or mentor-mentee programs throughout their time with the institution ·Higher level courses on human values in every aspect of living.

THIRD SEMESTER

COURSE CODE	**EEN**	
COURSE TITLE	**Digital Electronics**	
NUMBER OF CREDITS	**3**	**(L: 03, T:** 0**, P:** 0**)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	1. To acquaint students with the basic concepts of digital and binary systems. 2. To analyze and design combinational and sequential logic circuits for real world applications. 3. To apply the theoretical concepts in designing the circuits using appropriate tools and hardware.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Review of number systems and Number base conversion (binary, octal, decimal, hexadecimal), Binary codes (weighted, unweighted, self complementary), Signed and unsigned binary numbers, complements (1's, 2's, 9's, 10's), Binary arithmetic (addition, subtraction, multiplication, division)	**10**
UNIT **II**	Boolean algebra, Boolean functions, Logic gates (AND, OR, NOT, XOR, XNOR, NAND, NOR). Combinational logic circuits, Simplification of Boolean functions, Karnaugh map methods, SOP-POS simplification, NAND-NOR implementation. Combinational Logic- Half adder, Half subtractor, Full adder, Full subtractor, look- ahead carry generator,BCD adder, Series and parallel addition, Multiplexer – demultiplexer, encoder- decoder, arithmetic circuits, ALU	15
UNIT **III**	Sequential Logic- Level and edge-triggered flip-flops (RS flip-flop, D flip-flop, JK flip-flop, T flip-flop, timing specifications of flip-flops, characteristic table and equation of flip-flops, excitation table of flip-flops).	10
UNIT **IV**	Register and Counter- Registers, Shift Registers, Bi-directional shift registers, Counters, Ripple and Synchronous Counters, Ring and Johnson counters.	10

TEXTBOOKs/REFERENCES

1. M. Morris Mano, Michael D. Ciletti, "Digital Design", Prentice Hall, 4th Edition
2. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition
3. Albert Paul Malvino, Donald P. Leach, "Digital Principles and Applications", Tata McGraw Hill, 6th Edition
4. John F. Wakerly, "Digital Design: Principles and Practices", Pearson Education, 4th Edition

COURSE OUTCOME	1. Differentiate and represent the different types of number system. 2. Express and reduce the logic functions using Boolean Algebra and K-map. 3. Design minimal combinational logic circuits. 4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, de-multiplexer. 5. Analyze and Design the Basic Sequential Logic Circuits 6. Outline the construction of Basic Arithmetic and Logic Circuits 7. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

COURSE CODE	**EEN**	
COURSE TITLE	**Digital Electronics Lab**	
NUMBER OF CREDITS	**02**	**(L: , P: 02)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	To design the logic building blocks (combinational and sequential circuits) using bread boards, Use of Verilog language to design and synthesize the combinational and sequential circuits. Implement a project.	

LIST OF SUGGESTED LABORATORY EXERCISES	
1. HALF ADDER, FULL ADDER using basic logic gates **2.** Binary -to -Gray, Gray -to -Binary code conversions **3.** 3-8 line DECODER **4.** 4x1 and 8x1 MULTIPLEXERS **5.** Verify the excitation tables of various FLIP-FLOPS **6.** 8-bit Input/ Output system with four 8-bit Internal Registers **7.** 8-bit ARITHMETIC LOGIC UNIT etc.	
COURSE OUTCOME	1. To provide a comprehensive introduction to digital logic design leading to the ability to understand binary codes, binary arithmetic and Boolean algebra and its relevance to digital logic design. 2. To design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder etc. 3. To design & analyze synchronous sequential logic circuits. 4. To familiarize students with the basics of digital logic families. 5. To Analyze and design simple systems composed of PLDs.

COURSE CODE	**DCE07201**	
COURSE TITLE	**Engineering Mechanics**	
NUMBER OF CREDITS	**3**	**(L: 03, T:** 0**, P:** 0**)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	Course Objective: Engineering Mechanics provides the basic concepts and skills that form the foundation for structural and mechanical design. The class is a problem-focused engineering science class that helps engineering students develop the ability to	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**

UNIT **I**	Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space, Resultant Moment of Forces and its Applications; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems	**10**
UNIT **II**	Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of the moment of inertia, Moment of inertia of standard sections and composite sections;	15
UNIT **III**	Basic Structural Analysis, Equilibrium in three dimensions; Analysis of simple trusses by method of sections & method of joints, Zero force members, Simple beams and support reactions.	10
UNIT **IV**	Shear forces and bending moment diagrams for statically determinate beams	10
UNIT V	Friction: Types of friction, Limiting friction, Laws of Friction, Static & Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.	

TEXTBOOKs/REFERENCES

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I - Statics, Vol II Dynamics, 6th Ed., John Wiley, 2008
2. I. H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Ed., PHI, 2002.
3. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II - Dynamics, 9th Ed., Tata McGraw Hill, 2011
4. R. C. Hibbler, Engineering Mechanics, Vols. I and II, Pearson Press, 2006
5. KL Kumar and Veenu Kumar- Engineering Mechanics, McGraw-Hill, New York,2017
6. J.J. Hughes, K.F. Martin, Basic Engineering Mechanics ISBN: 0333177215, 9780333177211, Macmillan, 1977.
7. Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, Oxford University Press, 2011

COURSE OUTCOME	1. To develop the ability to model and analysis of mechanical engineering systems using a vectorial representation of forces and moments. 2. To be able to draw the free body diagrams of mechanical components and systems. 3. Ability to draw shear force diagram and banding moment for different types of beams taking 4. To understand the phenomenon of friction and the ability to solve problems related to the same. 5. After completing this course, the students should be able to understand the various effects of force and motion on engineering design structures.

COURSE CODE	**DCE01209**	
COURSE TITLE	**Engineering Mechanics Lab**	
NUMBER OF CREDITS	**1**	**(L: ,T: P: 02)**
COURSE CATEGORY	**Engineering Science Course**	
COURSE OBJECTIVE	The objectives of the Engineering Mechanics Laboratory course are to make students learn the effect of force, moment and coupling on rigid body. Also to compute forces in member of trusses and study the friction effect between two rigid body.	
LIST OF SUGGESTED LABORATORY EXERCISES		

1. Efficiency of a Simple Screw Jack Apparatu
2. Deflection of a Simply Supported Beam
3. Deflection of a Cantilever Beam
4. Momemt of Inertia of a Fly Wheel
5. Funicular Polygon of Forces
6. Forces in the members of a member Truss Apparatus
7. Determination of Friction coefficient of Flat Belt
8. Forces in Jib and Tie using Jib Crane Apparatus

TEXTBOOK/REFERENCES

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I - Statics, Vol II - Dynamics, 6th Ed., John Wiley, 2008.
2. I.H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Ed., PHI, 2002.
3. 3. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II - Dynamics, 9th Ed., Tata McGraw Hill, 2011
4. 4. R. C. Hibbler, Engineering Mechanics, Vols. I and II, Pearson Press, 2006
5. 5. KL Kumar and Veenu Kumar- Engineering Mechanics, McGraw-Hill, New York,2017 6. J.J. Hughes, K.F. Martin, Basic Engineering Mechanics ISBN: 0333177215, 9780333177211, Macmillan, 1977.

COURSE OUTCOME	.At the end of the course the students will be able to: 1. Illustrate the concept of efficiency of a simple screw jack. 2. Explain the method of determining deflection of Simply Supported and Cantilever beams. 3. Demonstrate the method to determine the Momet of Inertia of a Fly Wheel.

COURSE CODE	**MAT**	
COURSE TITLE	**MATHEMATICS III**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	The main objective of this course is to provide students with the foundations of probabilistic and statistical methods and analysis techniques mostly used in various applications in engineering and science like modelling of processes and predictions based on processes.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	Probability spaces, conditional probability, Bayes' theorem	
UNIT **II**	Random variables, probability distribution functions, joint distributions, independence, mathematical expectations, Chebyshev's inequality	
UNIT **III**	Special distributions: binomial, hypereometric, Poisson, exponential, uniform, normal distributions	
UNIT **IV**	Random sampling, sample mean, sample variance, weak law of large numbers and central limit theorems	
UNIT **V**	Estimation of parameters, the method of maximum likelihood estimation, confidence intervals, testing of hypotheses, goodness of fit, nonparametric tests, correlation analysis.	

TEXTBOOKs/REFERENCES

1. Papoulis and S.U. Pillai, Probability Random Variables and Stochastic Processes, 4th Ed., McGraw-Hill, 2002.
2. L. Garcia, Probability and Random Processes for Electrical Engineering, 2nd Ed., Addison-Wesley, 1993.
3. Reena Garg and Chandrika Prasad, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2020.
4. P.Z. Peebles, Probability, Random Variables and Random Signal Principles, 4th Ed., Mc-Graw Hill, 2000.
5. H. Stark and J.W. Woods, Probability and Random Processes with Applications to Signal Processing, Prentice Hall, 2002.
6. K. L. Chung and F. AitSahlia, Elementary Probability Theory with Stochastic Processes
7. Introduction to Mathematical Finance, 4th Ed., Springer-Verlag, 2003.
8. Amit Gupta, Manish Sharma, The Practice of Business Statistics, Khanna Book Publishing, 2010.

COURSE OUTCOME	1. Students will be able to use appropriate statistical terms to describe data and understand probability space and conditional probability applications. 2. Identify the types of data (qualitative, quantitative, discrete, and continuous). 3. Identify the types of sampling (random, stratified, systematic, cluster). 4. Identify the misuses of statistics. 5. Student will use appropriate statistical methods to collect, organize, display, and analyse relevant data. 6. Apply graphical methods of displaying data. 7. Construct frequency distributions, histograms, frequency polygons, pareto charts, ogives, pie charts, and box-and-whisker plots. 8. Read and analyze frequency distributions, histograms, frequency polygons, pie charts, and box-and-whisker plots. 9. Students will apply basic concepts of probability. 10. Calculate combinations and permutations. 11. Apply the rules of probability (addition, conditional, multiplication). 12. Apply the terms of probability (mutually exclusive, independent, and dependent)

COURSE CODE	CSE01201	
COURSE TITLE	**Data Structures & Algorithm**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to demonstrate the understanding of the basic terminologies of algorithm and data organization through ADTs, learn linear and dynamic data structures as well as sorting, searching and hashing algorithms.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introduction to Data Structure**, Importance of Data Structure, Types of Data Structures, Arrays, Pointers, Structures, Storage Allocation: Static and Dynamic Allocation. Time and Space Complexity. Asymptotic Notations. Growth of functions (Graph representation), Abstract Data Type (ADT).	
UNIT **II**	**Sorting and Searching**: Insertion Sort, Bubble Sort, Selection Sort, Shell Sort, Merge Sort, Quick Sort, Radix Sort, Linear search, binary search	
UNIT **III**	**List:** Definition, Operations–Implementation, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists, **Stack:** Definition, Operations, Implementations, Applications: Recursion, Infix to Postfix and Evaluation of Postfix, **Queue:** Definition, Operations, Implementations, Applications: Circular Queue and Priority Queue.	
UNIT **IV**	**Trees**: Basic terminology, binary trees, binary tree traversal, representations of binary tree, application of trees, Threaded Trees, Binary Search Tree, AVL tree, B-tree, B+ tree.	
UNIT **V**	**Graph**: Types of Graphs, Graph Representations, basic algorithms on graphs: depth first and breadth first search, Minimum Spanning Tree, Dijkstra‘s algorithm **Hashing**: Review of Hashing, Hash Function, Hash Table, Collision Resolution Techniques in Hashing	

TEXTBOOKs/REFERENCES

1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019.
2. Data Structures and Program Design in C By Robert L. Kruse,C.L. Tondo, Bruce Leung, Pearson Education, 2007.
3. Expert Data Structures with C/ 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020.
4. Expert Data Structures with C++/ 2nd Edition, R.B. Patel, Khanna Book Publishing, 2020.
5. Data Structures Using C & C++, By Langsam, Augenstein, Tanenbaum, Pearson Education, 1989.
6. Fundamentals of Data Structures, By Ellis Horowitz and SartajSahni, Computer Science Press, 2011.
7. An introduction to data structures with applications, By J.P. Trembley& P.G. Sorensen, TMH, 2004.

COURSE OUTCOME

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

1. Implement different data structures to solve real life computing problems through the choice of appropriate data structures for storage and management of different types of data.

2. Analyze algorithms asymptotically and compute the performance analysis of algorithms with the same functionality.

3. Use a variety of data structures for the design, implementation, testing, and debugging programs including stacks, queues, hash tables, binary and general tree structures, search trees, and graphs.

4. Solve a particular problem through the application of efficient data structure (linked lists, stacks and queues)

COURSE CODE	CSE01205	
COURSE TITLE	**Data Structures & Algorithms lab**	
NUMBER OF CREDITS	1	**(L: , P: 2)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to analyze design and implement linear and non-linear data structures, develop & implement binary search trees with all operations, write functions to implement graph traversal algorithms as well as get familiar with sorting and searching algorithm	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Computations on arrays - binary search, bubble sort, insertion sort, quicksort, external merge sort, heaps and heapsort, priority queues using heaps.
2. Linked lists - single and doubly linked lists.
3. Queue and Stack data structures - array based and linked list based implementations. Infix to postfix conversion and expression evaluation.
4. Graphs - Adjacency matrix and adjacency list representations, DFS, BFS.
5. Binary Trees, Tree traversals, Binary search trees, B-Trees

COURSE OUTCOME	At the end of the course the students will be able to: 1. Analyze and implement linear and non-linear data structure operations as well as binary search trees and graph traversal algorithms. 2. Identify and critique list representation and sorting algorithms 3. Recognize and list searching algorithm for different data structures 4. Appropriately use the linear / non-linear data structure operations for a given problem

COURSE CODE	CSE01203	
COURSE TITLE	**OBJECT ORIENTED PROGRAMMING WITH C++**	
NUMBER OF CREDITS	**03**	**(L:**03 **,T:**…**, P:**…**)**
COURSE CATEGORY	PCC	
COURSE OBJECTIVE	The objective of the course is to designate and generalize the demonstration of object oriented programming and C++ concepts.to better the students problem solving skills to justify the understanding of algorithms in response to problem scenarios which leads to well-organized block-structured easily readable programs.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Object oriented thinking:** Need for OOP Paradigm, Procedural programming vs object oriented programming, Elements of object oriented programming	
UNIT **II**	**Classes:** Classes and Objects, accessing class members, defining member functions, inline functions, data hiding, class member accessibility, constructors, parameterized constructors, constructor overloading, copy constructor, "this" pointer, friend classes and friend functions.	
UNIT **III**	**Inheritance** - Base class and derived class relationship, derived class declaration, Types of inheritance, constructors in derived class, and destructors in derived class	
UNIT **IV**	**Polymorphism**: Overloading- Function overloading, operator overloading-arithmetic operators, concatenation of strings, comparison operators, Generic programming with templates-Function templates, class templates, abstract classes, virtual base classes and virtual functions.	
UNIT **V**	**Files and Exception**: Classes for file stream operations, opening and closing files, File opening modes, file Pointers, Error handling during file operations, Exception handling- try, catch and throw.	

TEXTBOOKs/REFERENCES

1. The Complete Reference-C++,4th Edition. Herbert Schildt,TataMcGrawHill
2. The C++ Programming Language, 4th Edition, Bjarne Stroustrup, AddisonWesly
3. Absolute C++,4th Edition, Walter Savitch,Pearson Education
4. James Rumbaugh et. al, "Object Oriented Modeling and Design", PHI
5. 2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education
6. 3. Object Oriented Programming with C++, E Balagurusamy, TMH

COURSE OUTCOME	At the end of the course the students will be able to: 1. Design a standard algorithm to solve a given real time problem and program the structured and object-oriented paradigm with concepts of streams, classes, functions, data and objects. 2. Analyze the features of C++ supporting object oriented programmingto apply the major object-oriented concepts for the implementation of object-oriented programs in C++, encapsulation, inheritance, polymorphism, describe the concept of function overloading, operator overloading, and virtual functions. 3. Classify and perform the inheritance with the understanding of early and late binding, usage of exception handling. 4. Use of various OOPs concepts with the help of programs.andadvanced features of C++ specifically stream I/O, and templates.

COURSE CODE	CSE01207	
COURSE TITLE	**OBJECT ORIENTED PROGRAMMING WITH C++ LAB**	
NUMBER OF CREDITS	**01**	**(L:, P:02)**
COURSE CATEGORY	PCC	
COURSE OBJECTIVE	The objective of the course is to demonstrate the object-oriented principles in construction of robust and maintainable programs with the competence to design, write, compile, test and execute programs using high level language.	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Programs to demonstrate the use of basic C++ syntaxes and functions.
2. Programs to demonstrate the use of class and object concepts.
3. Programs to demonstrate the concept of Default constructor, Parameterized constructor, Copy constructor, Constructor overloading, destructor.
4. Programs to demonstrate the concepts of inheritance: multiple inheritance, multilevel inheritance, hybrid inheritance, containership.
5. Programs to demonstration of the concepts of operator overloading: overload unary operator, overload binary operator
6. Programs to demonstrate the concept of polymorphism (static and run-time) and virtual functions.
7. Programs to demonstrate the use of templates in object-oriented programming.
8. Program to demonstration of read and print Employee details using Files
9. Programs to demonstration of the use of exception handling concepts in **C++**

COURSE OUTCOME	At the end of the course the students will be able to: 1. Distinguish and formulate OOPs functions and pointers in their C++ program through the use of tokens, expressions, and control structures 2. Explain arrays and strings and create programs using them 3. Identify and infer the use constructors and destructors 4. Plan and employ file management and demonstrate how to control errors with exception handling

COURSE CODE		DGI
COURSE TITLE		**DISASTER MANAGEMENT**
NUMBER OF CREDITS	0	(L: 2, T: 0, P: 0)
COURSE CATEGORY	**Audit Course**	
COURSE OBJECTIVE	To provide basic conceptual understanding of Natural and manmade disasters and its remedial measures with planning of disaster preparedness.	

COURSE CONTENT

UNIT	CONTENT	
UNIT I	Introduction to Disasters and Natural Hazards: Types of Hazards, Earth as a system, Seismic zonation of India, Case Study of Cyclone, Earthquakes, Landslides, Floods and Tsunami, Disaster prediction and warning, Surviving Natural Disaster, Myths and perception about Natural Disaster, Natural Disaster preparedness, mitigation and Emergency response.	6
UNIT II	Plate Tectonics and related Hazards: Earthquake and their causes, mitigation, Active faults and related hazards in India, Ground effects and evaluation of earthquake hazards, Liquefaction and related geological features.	6
UNIT III	Volcanic Eruption and related Hazards: Types of volcanoes, causes and mitigation plans.	6
UNIT IV	Landslides, Hurricanes, Cyclones, Typhoons and Storms: Causes of landslides and mudslides, Classification, zonation, Protection, Land subsidence, Control and stabilization of landslides. Classification of Hurricanes, Cyclones, Typhoons and Storms, Mitigation, preparedness, storm surge, case study of the recent tropical cyclones, Hailstorms, Tornadoes, dust and sand storms, case study.	6

UNIT V	Floods, Droughts and Diseases: Streams and river hydrology, types of floods, Nature and extent of floods Hazard, flood hazard zoning, flood control and protection. Types of Droughts Effect and measurement of drought, predicting drought depending on weather patterns, case study depending on widespread famine and decimation of crops. Causes of diseases, Epidemic, Pandemic, case study of historic plagues, Case study of twentieth century virus outbreak, twenty first century virus outbreak, Mitigation and preparedness	6

TEXTBOOKs/REFERENCES

1. 1. D.P. Coppola, Introduction to International Disaster Management, Elsevier Science (B/H), London, 2007
2. 2. M. C. Gupta, Manual on natural disaster management in India, NIDM, New Delhi
3. 3. World Disasters Report, International Federation of Red Cross and Red Crescent, Switzerland, 2009
4. 4. S.L. Goyal, Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, Deep & Deep, New Delhi, 2006
5. 5. ational Disaster Management Policy, 2009, GoI

COURSE OUTCOME	After learning the course, the student will be able to understand the natural and manmade disasters, disaster preparedness and measures taken to mitigate them.

FOURTH SEMESTER

COURSE CODE	**CSE01202**	
COURSE TITLE	**DESIGN AND ANALYSIS OF ALGORITHM**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Professional Core Course**	
COURSE OBJECTIVE	The objective of the course is to designate the understanding of time and space complexity for various algorithms and analyze them for solving computational problems by developing and applying various algorithms and design strategies. Also to demonstrate the complexity of algorithms through the effective choice of data structures, classes P, NP and NP-Complete	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Analysis Techniques:** Introduction to algorithms and its importance, Asymptotic analysis: Worst, average and best cases; Asymptotic notation, complexity analysis of non-recursive and recursive algorithms, Solution of recurrence relations using substitution method.	
UNIT **II**	**Divide and conquer:** Structure of divide-and-conquer algorithms, Binary search, Quick sort, Finding maximum and minimum element, Merge sort, Recurrence equation for divide-and-conquer, Graph Algorithms, Depth first search, Breadth first search.	
UNIT **III**	**Greedy Techniques:** Basics of greedy approach, Job sequencing with deadlines, Fractional Knapsack problem, Huffman Coding, Minimum Cost Spanning Tree, Single Source Shortest Path, etc. Dynamic programming, Overview, difference between dynamic programming and divide and conquer, Matrix Chain Multiplications,, 0/1 Knapsack Problem	
UNIT **IV**	**Backtracking and Branch and Bound:** General method backtracking**,** N-Queen problem, 0/1 Knapsack problem, General method of branch & bound, Traveling salesperson problem	

UNIT **V**	**NP-Completeness:** Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems. Introduction to Approximation Algorithms. **Complexity classes:** Tractable and Intractable Problems, Decidable and Undecidable problems, Reduction, P, NP and NP Complete, Cook's Theorem.	

TEXTBOOKs/REFERENCES

1. Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest. *Introduction to Algorithms*, Prentice Hall of India Publications, 3rd Edition 2015.
2. J. Kleinberg and E. Tardos. *Algorithm Design*, Pearson 2006.
3. Sara Baase and Allen Van Gelder. *Computer Algorithms: Introduction to Design and Analysis*, Pearson education (Singapore) Pvt. Ltd, New Delhi 2007.
4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman. *The Design and Analysis of Computer Algorithms*, Pearson Education (Singapore) 2006.
5. *Algorithmics: Theory and Practice* by Brassard and Bratley, Prentice Hall

COURSE OUTCOME	At the end of the course the students will be able to: 1. Apply the best data structure for designing an algorithm to solve a given problem and evaluate different algorithms with respect to time and space complexity. 2. Create algorithms to solve various computational problems. 3. Demonstrate theunderstanding of classes P, NP and NP-Complete and be able to prove that a certain problem is NP Complete. 4. Analyze the trade-offs between. memory and time during the design of computer based systems through the proper choice of modeling foundations.

COURSE CODE	CSE01204
COURSE TITLE	**DESIGN AND ANALYSIS OF ALGORITHM LAB**

NUMBER OF CREDITS	**1**	**(L:0 ,T:0 P: 2)**
COURSE CATEGORY	**Professional Core Course**	
COURSE OBJECTIVE	The objective of the course is to impart among the students the ability to develop programs for computing and real-life applications using basic elements like control statements, arrays, functions, pointers and strings, and data structures like stacks, queues and linked lists. Also to imbibe the critique toimplement searching and sorting algorithms/	

LIST OF SUGGESTED LABORATORY EXERCISES

1. Searching Algorithms (Binary, Min & Max etc.)
2. Sorting Algorithms (Quick Sort, Merge Sort, etc.)
3. Operation on Graph & Tree
4. Minimum Cost Spanning Tree
5. Greedy algorithms
6. Dynamic programming
7. Backtracking
8. Graph Coloring

COURSE OUTCOME	At the end of the course the students will be able to: 1. Argue the correctness of algorithms using inductive proofs and invariants and design algorithms using divide and conquer, greedy and dynamic programming 2. Analyze worst-case running times of algorithms using asymptotic analysis and execute sorting algorithms such as sorting, graph related and combinatorial algorithms in a high level language. 3. Analyze the performance of merge sort and quick sort algorithms using divide and conquer technique. 4. Apply the dynamic programming technique to solve real world problems such as knapsack and TSP.

COURSE CODE	CSE01206	
COURSE TITLE	Computer Organization & Architecture	
NUMBER OF CREDITS	**3**	**(L: 03,T:…, P:…)**
COURSE CATEGORY	PCC	
COURSE OBJECTIVE	The objective of the course is to get the students acquainted with the fundamental components, architecture, register organization and performance metrics of a computer to better their understanding of analyzing the effects of each instruction execution and the data path in those instruction executions. Also to disseminate the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer.to with the understanding of the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Overview of Computer Architecture:** CPU, memory, input-output subsystems, Control unit, Introduction to Instruction Set Architecture: Instruction formats - Instruction types - Addressing modes - Instruction cycle	5
UNIT **II**	**Data representation:** Introduction to Fixed point representation of numbers - Floating point representation of numbers (IEEE standard representation) - Algorithms for fixed point arithmetic operations: Addition, Subtraction	9
UNIT **III**	**Processor Design**: Logic Design, Conventions, Hardwired Control versus microprogrammed control, Single cycle implementation, Multi-cycle implementation, Pipelining, Performance enhancement using pipelining	12

UNIT **IV**	**Memory System Organization:** Memory systems hierarchy, Main memory organization,Byte ordering,Interleaving, characteristics,Cache memories, Parameters, Address mapping, Read and write policies,Cache Coherence, Virtual memory systems.	10
UNIT **V**	**Interconnects:** I/O fundamentals: Modules, mapped.I/O techniques: Programmed I/O, Interrupt-driven I/O, DMA - Interrupt structures: Interrupt cycle, Subroutine call and return mechanisms, Bus System: Synchronous and asynchronous buses	9

TEXTBOOKs/REFERENCES

1. D.A. Patterson, J.L. Hennessy, "Computer Organization and Design", Elsevier, 5th Edition

2. John P. Hayes, "Computer Architecture and Organization", McGraw Hill, 5th Edition

3. William Stalling, "Computer Organization and Architecture", Prentice Hall India
4. C. Hamacher, Z.Vranesic, S. Zaky, "Computer Organization", McGraw Hill, 5th Edition

COURSE OUTCOME	At the end of the course the students will be able to; 1. Demonstrate the understanding ofthe general computer architecture and data representation for fixed and floating point data with the validation of efficient algorithms for arithmetic operations. 2. Explain the importance of processor design and suggest efficient cache mapping technique and replacement algorithms for given design requirements as well as get the idea about different external storage devices. 3. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. 4. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.

COURSE CODE	**MAT**	
COURSE TITLE	**DISCRETE MATHEMATICAL STRUCTURE**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	**Basic Science Course**	
COURSE OBJECTIVE	1. To understand Discrete Mathematical Structures (DMS) for the development of theoretical computer science, problem solving in programming language using Discrete Structure. 2. To understand the importance of discrete structures towards simulation of a problem in computer science and engineering.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Mathematical Reasoning, Mathematical reasoning, Propositions, Negation, disjunction and conjunction, Implication and Equivalence, Truth tables, Predicates, Quantifiers, Natural deduction, Rules of Inference, Methods of proofs, Resolution principle, Application to PROLOG.	10
UNIT **II**	Set Theory, Paradoxes in set theory, Inductive definition of sets and proof by induction, Peano postulates, Relations, Properties of relations, Equivalence Relations and partitions, Partial orderings, Posets, Linear and well-ordered sets.	14
UNIT **III**	Combinatorics and Functions, Elementary Combinatorics, counting techniques, Recurrence relation, Generating functions, Functions; mappings, Injection and Surjections, Composition of functions, Inverse functions, Special functions, Pigeonhole principle, Recursive function theory.	12
UNIT **IV**	Graph Theory, Elements of graph theory, Euler graph, Hamiltonian path, trees, Tree traversals, Spanning trees, Representation of relations by graphs.	12

UNIT **V**	Groups, Rings, Fields, Discrete Probability, Definition and elementary properties of groups, Semigroups, Monoids, Rings, Fields, Vector spaces and lattices, Introduction, Discrete random variables, Applications to Binary Search Tree	12

TEXTBOOKs/REFERENCES

1. K. H. Rosen, Discrete Mathematics and applications, 6th Edition, Tata McGraw Hill 2007.
2. S.B. Singh, Discrete Structures/ 3rd Edition, Khanna Book Publishing, 2019.
3. S.B. Singh, Combinatorics and Graph Theory/ 3rd Edition, Khanna Book Publishing, 2018.
4. C. L. Liu, Elements of Discrete Mathematics, 2nd Edn., Tata McGraw-Hill 2000.
5. J .L. Mott, A. Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Second edition, Prentice Hall of India 1986.
6. W. K. Grassmann and J. P. Tremblay, Logic and Discrete Mathematics, A Computer Science Perspective, Prentice Hall Inc 1996

COURSE OUTCOME	1. Understand the basics of various discrete structures. 2. Apply applications of discrete structures in Computer Science and Engineering.

COURSE CODE	CSE01208	
COURSE TITLE	**OPERATING SYSTEMS**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce Operating system concepts, designs different views along with system processes, state control and threads communication. The students would able be made aware of the CPU scheduling basic concepts, process synchronization, memory management, file system and storage.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introduction**: Types of operating systems, Different views of the operating system, System Programmer's view, User's view, Operating system concepts and structure, Layered Operating Systems, Monolithic Systems.	5
UNIT **II**	**Processes**: Process states, process state transitions, context switching, process control block, operations on processes, Inter-process Communication, Threads – Overview.	10
UNIT **III**	**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling algorithms (First come first serve, Round Robin, Shortest run time next, Multilevel Feedback Queues),**Deadlocks-**Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	10

UNIT **IV**	**Process Synchronization:**The Critical-Section Problem, Peterson‟s Solution, Synchronization Hardware, MutexLocks, Semaphores, Monitors, **Memory Management:** Logical and physical address space, storage allocation and management techniques, swapping concepts of multi programming, paging, segmentation, virtual storage management strategies, demand paging , page replacement algorithm (Optimal, MRU, FIFO, LRU), Belady's anomaly, thrashing.	11
UNIT **V**	**File System and Storage:** File System, File organization and access (Sequential, Direct, Index and Sequential) methods. Memory mapped files, directory structures, file sharing. Disk scheduling algorithm (FCFS, SSTF, Scan scheduling, C-scan schedule,Look and C-Look schedule), Security and Protection Mechanisms; System Threat.	9

TEXTBOOKs/REFERENCES

1. Operating system, Galvin & Silberschatz, 7th Edition, John Willey 2004
2. Operating Systems-A Concept Based Approach, Dhamdhare, TMH 2006
3. Operating System Concepts, EktaWalia, Khanna Book Publishing 2020.
4. Operating systems Internals and design principles By William Stallings, Pearson Education, 2012
5. Operating Systems –A Design Oriented Approach, Crowley, TMH, 2001
6. Operating systems Design and Implementation, Andrew S. Tanenbaum, Pearson Education 2009

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand the structure and functions of OS in order to describe the general architecture of computers. 2. Analyze and describe the basics of an operating system and its major components. 3. Demonstrate the implementation of processes, resource control (concurrency etc.) and report about creation and/or modification of concurrent programs. 4. Understand the concepts of physical and virtual memory, scheduling, memory management, I/O and files

COURSE CODE	CSE01210	
COURSE TITLE	**Operating Systems lab**	
NUMBER OF CREDITS	**1**	**(L: , P: 2)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective o f the course is to understand the functionalities of various layers of OSI model and discuss the difference between hardware, software; operating systems, programs and files as well as identify the purpose of different software applications.	

LIST OF SUGGESTED LABORATORY EXERCISES

1. CPU Scheduling Algorithms (FCFS, SJF, RR, Priority)
2. Deadlock Avoidance Algorithm (Bankers algorithm)
3. IPC (Threads)
4. Process synchronization (Producer Consumer / Reader Writer/Dining Philosopher using semaphores)
5. Dynamic Memory Allocation Algorithms (First fit, Best fit, Worst fit)
6. Page Replacement Algorithms. (FIFO, LRU, Optimal)
7. Disk Scheduling Algorithms

COURSE OUTCOME	At the end of the course the students will be able to: 1. Encompass the ability to implement inter process communication between two processes. 2. Design and solve process synchronization problems and memory allocation. 3. Simulate and implement operating system concepts such as scheduling, deadlock management, file management, and memory management 4. Analyse disk scheduling algorithms

COURSE CODE	**ENV**	
COURSE TITLE	**ENVIRONMENTAL SCIENCE**	
NUMBER OF CREDITS	**0**	**(L: 2, T: 0, P: 0)**
COURSE CATEGORY	**Audit Course**	
COURSE OBJECTIVE	1. Understanding the importance of ecological balance for sustainable development. 2. Understanding the impacts of developmental activities and mitigation measures 3. Understanding the environmental policies and regulations	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.	
UNIT **II**	Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.	
UNIT **III**	Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.	

UNIT **IV**	Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.	
UNIT **V**	Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.	

TEXTBOOKs/REFERENCES

1. Benny Joseph (2005)., Environmental Studies, New Delhi, Tata McGraw Hill Publishing co. Ltd
2. Erach Bharucha (2005)., Textbook of Environmental Studies for Undergraduate Courses, Hyderabad, Universities Press
3. Anji Reddy .M (2007), Textbook of Environmental Sciences and Technology, Hyderabad, BS Publications.
4. Y Anjaneyulu.(2004), Introduction to Environmental Sciences, BS Publications.

COURSE OUTCOME	Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

COURSE CODE	CSE09214	
COURSE TITLE	**INTRODUCTION TO DATA STRUCTURES**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	OEC (Open Elective Course)	
COURSE OBJECTIVE	1. The knowledge about linear and non-linear data structures, 2. The students should be able to describe and implement various data structures including lists, arrays, stacks, queues, binary search trees, graphs, hash tables, and matrices. 3. The student will be able to analyse and apply various algorithms for shortest path calculation, sorting and searching applications etc.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**

UNIT **I**	**Introduction to Data Structure**, Types of Data Structures, Static and Dynamic Allocation. Time and Space Complexity.	5
UNIT **II**	**Sorting and Searching**: Insertion Sort, Bubble Sort, Selection Sort, Radix Sort, Linear search, binary search	10
UNIT **III**	**List:** Definition, Operations–Implementation, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists, **Stack:** Definition, Operations, Implementations, Applications: Recursion, Infix to Postfix and Evaluation of Postfix, **Queue:** Definition, Operations, Implementations, Applications: Circular Queue.	10
UNIT **IV**	**Trees**: Basic terminology, binary trees, binary tree traversal, representations of binary tree, application of trees, Binary Search Tree	10
UNIT **V**	**Graph**: Types of Graphs, Graph Representations, depth first and breadth first search, Minimum Spanning Tree, Dijkstra's algorithm, Hash Function, Hash Table, Collision Resolution Techniques in Hashing	10

TEXTBOOKs/REFERENCES

1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019.
2. Data Structures and Program Design in C By Robert L. Kruse,C.L. Tondo, Bruce Leung, Pearson Education, 2007.
3. Expert Data Structures with C/ 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020.
4. Fundamentals of Data Structures, By Ellis Horowitz and SartajSahni, Computer Science Press, 2011.
5. Expert Data Structures with C by R.B. Patel; Khanna Publishers, New Delhi.
6. Algorithms + Data Structures = Programs by Niklaus Wirth; Prentice Hall, 1976.
7. Horowitz and Sahani: Fundamentals of Computer Algorithms.
8. T.H. Coremen, C.E. Leiserson, R.L. Rivest and C. Stein: Introduction to Algorithms, 20th edition, Prentice Hall India, 2010.
9. Shaum's Outline Series by Lipschutz; McGraw Hill Education P Ltd , New Delhi.

COURSE OUTCOME	1. To learn about the implementation of various data structures in order to address real-world computing challenges. 2. To choose the appropriate data structures for storage and management of different types of data. 3. To design, construct, test, and debug programmes using a range of data structures such as stacks, queues, hash tables, binary and general tree structures, search trees, and graphs. 4. To tackle a specific problem by utilising an efficient data structure (linked lists, stacks, and queues).

FIFTH SEMESTER

COURSE CODE	CSE01301	
COURSE TITLE	**INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce to the students database management system architecture, modeling schemes and relationships models. Also the students would be able to generalize structured query language, normalization techniques and understand the transaction processing in order to control the consequences of concurrent data access.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Introduction,Database Systems versus File Systems, Database system concept and architecture, data model schema and instances, data independence, DDL, DML. Entity-Relationship Model. Generalization, aggregation, ER diagrams to tables.	6
UNIT **II**	**Relational data Model and Language:** Relational data model concepts, integrity constraints, relational algebra, SQL ,SQL commands, operatorse, functions, Tables- views and indexes. Aggregate, Insert, update and delete operations, Joins, Unions, Intersection, Minus.	9
UNIT **III**	**Database Design & Normalization**: Functional dependencies,Transitive dependencies, Multivalued dependency, normal forms- 1NF, 2NF, 3NF, BCNF.	12
UNIT **IV**	**Transaction Processing Concept:** Transaction concept, transaction state, ACID properties Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures.	10
UNIT **V**	**Concurrency Control Techniques:** Concurrency control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multiversion schemes, Recovery with concurrent transaction.	8

TEXTBOOKs/REFERENCES

1. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Tata McGraw Hill, 2006
2. Fundamentals of Database Systems, Elmsari and Navathe, Pearson Education 2013
3. Database Management Systems, Ramakrishnan and Gehrke, McGrawHill 2003
4. "An Introduction to Database Systems", C.J.Date, A.Kannan, S.Swamynathan, Pearson Education, 2006
5. Database Management Systems, R.P. Mahapatra, Khanna Book Publishing 2016.
6. J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications
7. Learning Spark: Lightning-Fast Big Data Analysis / Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia / O'Reilly Media; 1st edition / ISBN-13: 978-1449358624 / ISBN-10: 1449358624

COURSE OUTCOME	At the end of the course the students will be able to: 1. Explain the basic concepts of database management systems. and design ER-models to represent simple databaseapplication scenarios 2. Demonstrate structured query languages for various database applications 3. Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data. 4. Improve the database design by normalization and explain transaction management, recovery management, and concurrency control for real application

COURSE CODE	CSE01303	
COURSE TITLE	**INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS LAB**	
NUMBER OF CREDITS	**1**	**(L:0 ,T:0 P: 2)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to understand the practical applicability of database management system concepts working along the existing database analysis and table design.	
LIST OF SUGGESTED LABORATORY EXERCISES		

1. Practice My SQL queries for Data Manipulation (Insert, Update, Delete, Select) and Data Definition (Create, Drop, Truncate, Rename, etc.) Language 2. Practice SQL queries using logical operations and operators (Arithmetic, Comparison, Logical, etc.) SQL queries using group by and order by functions 3. SQL queries for group functions(Avg, Count, Max, Min ,Sum) 4. Practice Subqueries / Nested Queries 5. SQL queries to implement joins 6. SQL Queries for extracting data from more than one table 7. Implement a mini database project with all the sql query concepts learnt above	
COURSE OUTCOME	At the course the students will be able to: 1. Understand relational database systems and various queries execution methods. 2. Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL. 3. Use of various softwares to design and build ER Diagrams, UML, Flow chart for related database systems. 4. Design and implement database applications on their own

COURSE CODE	CSE01305	
COURSE TITLE	**PROGRAMMING WITH PYTHON**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to learn advanced machine learning practical development through the use of python and the relevant tools that help create models for prediction and planning. Moreover with python the demonstration would systematically involve learning the syntax and semantics of Python Programming Language, functions in use with string setting, structuring lists, tuples and dictionaries and developing a fully functional python progam.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**

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

TEXTBOOKs/REFERENCES

1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
4. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
5. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.
6. ReemaThareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173
7. Charles R. Severance, “Python for Everybody: Exploring

COURSE OUTCOME	At the end of the course the students will be able to: 1. Identify core aspects of programming and features of the Python language 2. Understand and apply core programming concepts like data structures, conditionals, loops, variables, and functions 3. Use different tools for writing and running Python code 4. Design and write fully-functional Python programs using commonly used data structures, custom functions, and reading and writing to files

COURSE CODE	CSE01307	
COURSE TITLE	**PROGRAMMING WITH PYTHON LAB**	
NUMBER OF CREDITS	**1**	**(L: 0, T: 0, P: 2)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce the programming basics and program design with functionsusing Python programming language as well as have an understanding of a range of Object-Oriented Programming, and in-depth data andinformation processing techniques for growing towards the high-performance programs designed to strengthen the practicalexpertise	
LIST OF SUGGESTED LABORATORY EXERCISES		

1. Introduction: History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator
2. Conditional Statements: If, If-else, Nested if-else, Looping, For, While, Nested loops
3. Control Statements: Break, Continue, Pass
4. String Manipulation: Accessing Strings, Basic Operations, String slices, Function and Methods
5. Lists: Introduction, Accessing list, Operations, Working with lists, Function and Methods
6. Tuple: Introduction, Accessing tuples, Operations, Working, Functions and Methods
7. Dictionaries: Introduction, Accessing values in dictionaries, Working with dictionaries, Properties
8. Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables
9. Modules: Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions
10. Exception Handling: Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand the basic concepts of scripting and the contributions of scripting language 2. Demonstrate the ability to explore python especially the object oriented concepts, and the built inobjects of Python. 3. Create practical and contemporary applications such as TCP/IP network programming 4. Develop web applications, discrete event simulations

COURSE CODE	CSE01309	
COURSE TITLE	**THEORY OF COMPUTATION**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to provide an exposition first to the notion of computability, then to the notion of computational feasibility or tractability.	

COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**Regular Languages & Finite Automata**: Regular Languages and Regular Expressions, Deterministic and Non-deterministic Finite Automata, Kleene's Theorem, Pumping Lemma, Myhill-Nerode Theorem.	
UNIT **II**	**Introduction to Context-free Languages & Pushdown Automata**: Context-free Languages and Grammars, Ambiguity, Chomsky Normal Form, CYK Algorithm, Pumping Lemma, Introduction to Deterministic and Nondeterministic Pushdown Automata	
UNIT **III**	**Turing Machines**: Mathematical modelling of computation, Deterministic Turing Machines, Church-Turing Thesis, Chomsky Hierarchy, Universal Turing Machines.	
UNIT **IV**	**Recursive Languages**: Recursive and Recursively Enumerable Languages. Non-recursive Languages and Undecidable Problems, the Halting Problem. Reduction	
UNIT **V**	**Complexity**: Resource-bounded computation, Classes P and NP, Polynomial time reductions, NP-completeness	

TEXTBOOKs/REFERENCES

1. Introduction to Languages and The Theory of Computation (4th Edition) by John C. Martin, McGraw-Hill Publishers, 2011. ISBN: 9780073191461.
2. Automata and Computability by Dexter C. Kozen. Springer Publishers 2007. ISBN: 0387949070.
3. Elements of Computation Theory by Arindama Singh, Springer-Verlag London, 2009. ISBN: 978-1-4471-6142-4.
4. Introduction to Automata Theory, Languages and Computation by Hopcroft, Motwani, and Ullman. 3rd Edition, Pearson Publishers, 2006. ISBN:0321462254.
5. Elements of the Theory of Computation by H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers, 1981. ISBN-13: 978-0132624787.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand how to rigorously reason about computation through the use of abstract, formal models. 2. Give the mathematical definition of various computational models and state and prove their limitations. 3. Analyse and interpret models of computation including finite automata, context-free grammars, and Turing machines, and understand how they are used in other areas of computer science. 4. Explain important notions in computing like nondeterminism, reductions and resource boundedness.

COURSE CODE	CSE01311	
COURSE TITLE	**COMPUTER NETWORKS**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to help the students gain insight into the basic taxonomy and terminology of the computer networking area for a basic knowledge of the various network models, protocols, layers as well as respective topologies and their uses.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction & Physical Layer:** Classification of Computer network, Network Topology: Star, Bus, Ring, Mesh, Network Models: OSI, TCP/IP, Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways, Network Performance Metrics, Transmission Impairments, Transmission Medium, Data Encoding: Line Encoding, Types of Line Coding	
UNIT **II**	**Data Link Layer:** Error Detection and Correction- One and two dimensional parity checks, Hamming code, Cyclic redundancy check (CRC); Flow Control Protocols: Protocols for Noiseless Channels and Noisy Channels – Ethernet- Access Control Protocols: CSMA,CSMA/CA,CSMA/CD, Token Ring- Token Passing,TDMA,FDMA,CDMA	
UNIT **III**	**Network Layer:** IP Addressing Scheme, Subnet Addressing, Subnet Masks, IPV4 Addressing, IPV6 Addressing, Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Routing.	
UNIT **IV**	**Transport Layer:** Services of Transport Layer, Transport Layer Protocols: UDP, TCP- Sliding Window, sender and receiver window size, Transport Layer Security Protocols : SSL,TLS	
UNIT **V**	**Application Layer**- Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), TELNET, SNMP, DNS, Hypertext Transfer Protocol (HTTP), World Wide Web (WWW), Security in Internet, E-mail Security	

TEXTBOOKs/REFERENCES

1. James F. Kurose and Keith W. Ross, "Computer Networking: A top-down approach", Pearson Education, 6th edition. 2012
2. A.S. Tanenbaum, "Computer Networks", 5th Edition, PHI 2010
3. Bhavneet Sidhu, "An Integrated Approach to Computer Networks", Khanna Book Publishing House 2019.
4. G. Keiser, "Local Area Networks", 2nd Edition, TMH 2002
5. D. Bertesekas and R. Gallager, "Data Networks", 2nd Edition, PHI 2000
6. William Stallings, "Data & Computer Communication", PHI, 10th Edition 2013
7. B.A. Forouzan, "Data communications and networking", TMH, 5th Edition2012
8. B.A. Forouzan, "Local Area Networks", TMH. 2002
9. B.A. Forouzan, "TCP/IP Protocol Suite", TMH.2004
10. Peterson and Bruce S. Davie Larry L.,Computer Networks

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand basic computer network technology, devices, functions within a network and identify challenges in the architecture of a network. 2. Demonstrate the knowledge of multiple access to design a access technique for a particular application 3. Understand and build the skills of subnetting and routing mechanisms as well as services and features of various protocol layers in the data link layer 4. Manage protocols at different layers of a network hierarchy and recognize security issues in a network.

COURSE CODE	CSE09315	
COURSE TITLE	**AI FOUNDATION & APPLICATIONS**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Open Elective Course**	
COURSE OBJECTIVE	The objective of the course is to understand the foundations of AI in the context of Engineering and Science as well as their applications to equip the students with the requisite machine learning, AI engineering along with ethical and societal implications.	

COURSE CONTENT

UNIT	**CONTENT (Basics Only)**	**HRS**
UNIT **I**	**Introduction to Artificial Intelligence and Its Applications** Introduction to AI, its history, and importance in engineering disciplines Types of AI: Narrow AI, General AI, and their applications Machine Learning, Deep Learning, and their relevance to various engineering domains Ethical considerations and societal impacts of AI	
UNIT **II**	**Machine Learning Fundamentals for Engineering** Supervised, unsupervised, and reinforcement learning Data preprocessing, feature engineering, and model evaluation Linear regression, decision trees, and support vector machines Clustering and dimensionality reduction techniques Applications of machine learning in engineering projects	

UNIT **III**	**Deep Learning and Neural Networks** Introduction to artificial neural networks (ANNs) Building and training deep neural networks Convolutional Neural Networks (CNNs) for image analysis Recurrent Neural Networks (RNNs) for time-series data Transfer learning and pre-trained models for various engineering applications	
UNIT **IV**	**Advanced AI Applications in Engineering and Materials Science** AI in Electrical Engineering: Smart grids, fault detection AI in Energy Engineering: Energy optimization, renewable energy prediction AI in Civil Engineering: Structural health monitoring, risk assessment AI in Transport Engineering: Traffic management, autonomous vehicles AI in Materials and Metallurgical Engineering: Material discovery, quality control	
UNIT **V**	**AI Ethics, Safety, and Future Trends** Ethical challenges in AI, bias, fairness, and transparency Ensuring safety and reliability in AI applications Explainability and interpretability in AI models Emerging trends in AI and its impact on engineering and materials science Capstone project in which students apply AI to solve real-world problems in their respective disciplines	

TEXTBOOKs/REFERENCES

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig - This is a widely used textbook covering a broad range of AI topics and concepts.
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy - A comprehensive text on machine learning that provides a probabilistic perspective.
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville - A comprehensive reference on deep learning and neural networks.
4. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto - Focuses on reinforcement learning, which is essential for autonomous systems and control applications.
5. "Practical Machine Learning for Computer Vision" by Martin Görner, Ryan Gillard, and Valliappa Lakshmanan - Provides practical insights into machine learning in the context of computer vision, relevant for engineering applications.
6. "Pattern Recognition and Machine Learning" by Christopher M. Bishop - A detailed reference for pattern recognition and machine learning techniques.
7. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili - A hands-on guide for implementing machine learning algorithms using Python.
8. "Computer Vision: Algorithms and Applications" by Richard Szeliski - Focuses on computer vision techniques and applications, relevant to image analysis.
9. "Building Machine Learning Powered Applications" by Emmanuel Ameisen - Discusses practical aspects of deploying machine learning models in real-world applications.
10. "Artificial Intelligence: A Systems Approach" by Michael Negnevitsky - Offers a systems-oriented approach to AI, relevant to engineering applications.

COURSE OUTCOME	At the end of the course the students would be able to: 1. Explain machine learning concepts, milestones, types of intelligence and articulate their relevance to engineering and materials science. 2. Apply machine learning techniques of supervised and unsupervised including data preprocessing, feature selection and model evaluation 3. Implement deep learning models for building training and evaluating with utilization of AI in engineering and Science 4. Address Ethical and Societal Issues along with the anticipation of future trends

SIXTH SEMESTER

COURSE CODE	CSE01302	
COURSE TITLE	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce to the students the idea of intelligence and intelligent behavior from the perspective of the machine with the historical background. Also to help the students relate the ways machines acquire intelligence and proficiencies through deep learning under NLP and computer vision clubbed with societal and ethical implications and future trends.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to Artificial Intelligence** Definition and history of AI Key AI concepts: Agents, search, knowledge representation Problem-solving methods and AI applications Ethical and societal implications of AI	
UNIT **II**	**Machine Learning Fundamentals** Basics of machine learning: supervised, unsupervised, reinforcement learning Linear regression and classification algorithms Model evaluation, cross-validation, and bias-variance trade-off Feature engineering and dimensionality reduction	
UNIT **III**	**Artificial Neural Networks and Deep Learning** Introduction to artificial neural networks (ANNs) Feedforward neural networks and backpropagation Convolutional Neural Networks (CNNs) for image analysis Recurrent Neural Networks (RNNs) for sequential data Practical applications and hands-on exercises	
UNIT **IV**	**Natural Language Processing (NLP) and Computer Vision** Fundamentals of NLP: tokenization, stemming, and sentiment analysis Computer vision basics: image processing and feature extraction NLP and CV applications: chatbots, image recognition, and more Introduction to pre-trained models and libraries	

UNIT **V**	**Advanced AI Topics and Capstone Project** Reinforcement learning and its applications Ethical AI and bias mitigation Emerging trends: AI in healthcare, self-driving cars, and more Capstone project: Students apply AI techniques to solve a real-world problem and present their findings	

TEXTBOOKs/REFERENCES

1. **"Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig - This is a widely used and comprehensive textbook that covers a broad range of AI concepts and techniques.**
2. **"Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy - A valuable resource for understanding machine learning from a probabilistic viewpoint.**
3. **"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville - A comprehensive text on deep learning and neural networks, an essential topic in AI.**
4. **"Natural Language Processing in Action" by Lane, Howard, and Hapke - Provides practical insights into natural language processing, a crucial subfield of AI.**
5. **"Computer Vision: Algorithms and Applications" by Richard Szeliski - This text focuses on computer vision, which is essential for understanding image analysis and recognition.**
6. **"Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili - A practical guide for implementing machine learning and deep learning algorithms using Python.**
7. **"Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto - A reference for those interested in reinforcement learning, an important aspect of AI.**
8. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron - Offers practical guidance on implementing machine learning and deep learning models with popular libraries.**
9. **"Natural Language Processing in Python" by Bird, Klein, and Loper - An excellent resource for learning NLP techniques using Python.**
10. **"OpenAI Gym" - Documentation and resources available for reinforcement learning and experimentation with various environments.**
11. **"Ethics of Artificial Intelligence and Robotics" by Vincent C. Müller - A book that covers the ethical and societal implications of AI.**
12. J. Reed, et. Al, "A Generalist Agent", May 19, 2022
13. J. Sukis, "The Relationship Between Art and AI," May 20, 2018

COURSE OUTCOME	At the end of the course the students will be able to: 1. Explain AI Fundamentals dor its key concepts and historical context and applications and apply Machine Learning to solve problems, including data preprocessing, model building, and evaluation. 2. Utilize Deep Learning to Build and train artificial neural networks, CNNs, and RNNs for various applications, such as image analysis and sequence prediction. Also, work with NLP and CV to implement natural language processing and computer vision techniques for tasks like sentiment analysis, chatbot development, and image recognition. 3. Recognize and address ethical concerns in AI development and mitigate biases in AI models as well as understand reinforcement learning and be aware of emerging trends in AI, including its applications in various domains. 4. Apply AI techniques and methodologies learned throughout the course to solve a practical problem, and effectively communicate their findings and solutions.

COURSE CODE	CSE01304	
COURSE TITLE	COMPILER DESIGN	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce the basic theory underlying the different components and phases of a compiler like parsing, code generation etc. Simultaneously, the students will be familiarized with the various tools that are used for building modern compilers.	
COURSE CONTENT		

UNIT	**CONTENT**	**HRS**

UNIT **I**	**Introduction to Compiler:** Brief overview of the compilation process, structure of compiler & its different phases, Lexical Analysis – Role of Lexical AnalyzerSpecification of Tokens – Recognition of Tokens.	
UNIT **II**	**Syntax Analysis:**Working of Parser, Top down parsing, Bottom-up parsing, Operator precedence parsing, predictive parsers, LR parsers (SLR, Canonical LR, LALR), constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator.	
UNIT **III**	**Syntax Directed Translation:** Definitions, Inherited Attributes, L-attributed definitions, S-attributed definitions, Dependency graph, Construction of syntax trees, Top down translation, postfix notation, bottom up evaluation.	
UNIT **IV**	**Intermediate Code Generation:** Three address code, quadruple & triples, translation of assignment statements, Boolean expression and control structures, Backpatching, Run Time Memory Management: Static and Dynamic storage allocation.	
UNIT **V**	**Code Optimization and Generation:**Organization of code optimizer, basic blocks and flow graphs, DAG representation of basic blocks, loops in flow graph, peephole optimization, Basic of block optimization.	

TEXTBOOKs/REFERENCES

1. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education
2. K. Muneeswaran,CompilerDesign,FirstEdition,Oxford University Press
3. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003.
4. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
5. V Raghvan, " Principles of Compiler Design", McGraw-Hill,
6. Kenneth Louden," Compiler Construction", Cengage Learning.
7. Charles Fischer and Ricard LeBlanc," Crafting a Compiler with C", Pearson Education

COURSE OUTCOME	At the end of the course the students will be able to: 1. Infer the basics of compiler design and apply for real time applications. 2. Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis. 3. Design analyze and implement LL and LR parsers, different representations of intermediate code. 4. To understand the importance of code optimization in order to improve the performance of a program in terms of space and time complexity.

COURSE CODE	CSE01306	
COURSE TITLE	DATA MINING: CONCEPTS AND TECHNIQUES	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to introduce the students to the field of data mining (also known as knowledge discovery from data, or KDD for short) for data mining concepts and techniques for discovering interesting patterns from data in various applications as well as emphasize on techniques for developing effective, efficient, and scalable data mining tools for classification and clustering.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Data Mining:** Data–Types of Data–, Data Mining Functionalities– Interestingness Patterns– Classification of Data Mining systems– Data mining Task primitives –Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing-Data cleaning - Data integration -Data reduction - Data transformation.	
UNIT **II**	**Association Rule Mining:** Frequent Pattern Mining-Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods-Apriori algorithm, FP-Growth algorithm - Mining frequent item sets using vertical data format.	
UNIT **III**	**Clustering and Applications:** Cluster analysis–Types of Data in Cluster Analysis–Categorization of Major Clustering Methods– Partitioning Methods, Hierarchical Methods– Density–Based Methods, Outlier Analysis.	
UNIT **IV**	**Classification:** Classification and Prediction – Basic concepts– Decision tree induction–Bayesian classification, Rule–based classification, Lazy learner.	
UNIT **V**	**Datasets:** Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA and ORANGE tool, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Association–rule learners, Clustering algorithms and Classification algorithms.	

TEXTBOOKs/REFERENCES

1. J. Han and M. Kamber, "Data Mining Tools and Techniques", Morgan Kaufmann Publishers.
2. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. Prabhu, " Data warehousing - concepts, Techniques, Products and Applications", Prentice Hall of India.
5. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Edition, Tenth Reprint.
6. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Analyze data mining problems and reason about the most appropriate methods to apply to a given dataset and knowledge extraction needs. 2. Implement basic pre-processing, association mining, classification and clustering algorithms. 3. Apply and reflect on advanced pre-processing, association mining, classification and clustering algorithms. 4. Apply machine learning, pattern recognition, statistics, visualization, algorithm, database technology and high-performance computing in data mining applications.

COURSE CODE	CSE08308	
COURSE TITLE	SOFTWARE ENGINEERING	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	

COURSE OBJECTIVE	The objective of the course is to provide the idea of decomposing the given problem into Analysis, Designing, Implementation, Testing and Maintenance phases and elaborate on the idea of using various process models in the software industry according to given circumstances. Also to gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction and Software Process Models:** Software, Software Engineering, Importance of Software Engineering, Software Process, Software Process models, Waterfall Model, Prototyping Model, Iterative Enhancement Model, Spiral Model, RAD model.Software Development Life Cycle .	
UNIT **II**	**Requirement Engineering :** Requirements Specification ,, Characteristics of Requirements, Requirement verification and validation, Software Process and Project metrics.	
UNIT **III**	Software Design and Coding-Process, Design Concepts, Modularity, Coupling and Cohesion, Top-down and bottom-up design, Object-oriented Analysis, Function-oriented and Object-Oriented Design approach, Software Design Document, Coding styles and documentation.	
UNIT **IV**	**Testing and Software Quality:**Testing strategies, Black-box and White-box Testing Techniques, unit, integration, system, regression, Test Plan, Test Cases Specification, Software debugging, Software Maintenance, Software Quality Assurance (SQA), Software Quality Factors, ISO 9126, SEI CMM, CMMI.	
UNIT **V**	**Computer Aided Software Engineering and Advanced Topics:** Computer Aided Software Engineering (CASE) and its Scope, Component Based Software Engineering, Web Engineering, Reverse Engineering.	

TEXTBOOKs/REFERENCES	
1. Software Engineering-A Practitioner's Approach, By R. Pressman, McGraw Hill International edition, 2004 2. Software Engineering, N.S. Gill, Khanna Publishing Co., Delhi 2018. 3. Software Engineering, Ian Sommerville, Addison-Wesley, 2010 4. An Integrated Approach to Software Engineering, Pankaj Jalote, Narosa, 2014 5. Fundamentals of Software Engineering, By Rajib Mall, PHI Learning Pvt. Ltd, 2014 6. Software Engineering (3rd ed.), By K.K Aggarwal & Yogesh Singh, New Age International Publishers, 2007	
COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand the software product design process including the creation and maintenance of the same 2. Create platform independent applications and understand the risk factors and challenges of large scale software development. 3. Understand and meet ethical standards and legal obligations. 4. Work effectively as a member of a team or leader

COURSE CODE	CSE08310	
COURSE TITLE	SYSTEM ANALYSIS AND DESIGN	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to provide a solid foundation of systems principles and an understanding of how business functions, while heightening students to the issues analysts face daily.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**System definition and concepts:** Characteristics and types of system, Real-life Business subsystems: Production, Marketing, Personal, Material, Finance Systems models,Real-time and distributed systems,	
UNIT **II**	**System Development Life cycle (SDLC):** Phases : Analysis, Design, Development, Implementation, Maintenance Systems documentation.	

UNIT **III**	**System Planning, Data and fact gathering techniques:** Interviews, Group communication, Presentations, Site visits. Feasibility study , Cost-Benefit and analysis tools and techniques	
UNIT **IV**	**Systems Design and modeling:** Data flow diagrams , Common diagramming conventions and guidelines using DFD and ERD diagrams. Data Modeling and systems analysis , Designing the internals: Program and Process design, Basic Characteristics of Object-Oriented Systems; Object-Oriented System Analysis and Design (OOSAD)	
UNIT **V**	**System Implementation and Maintenance**: System Implementation, Maintenance activities and issues, Audit trails.	

TEXTBOOKs/REFERENCES

1. System Analysis and Design Methods, Whitten, Bentaly and Barlow, Galgotia Publication.
2. System Analysis and Design Elias M. Award, Galgotia Publication
3. Modern System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph S. Valacich Addison Weseley

COURSE OUTCOME	After completion of course, students would be able to: 1. Define and use common System Analysis and Design fundamental terminology. 2. Utilize current analysis and design tools to graphically characterize processes and flows in a business system. 3. Design and create effective Input/Output including Web pages/forms. 4. Design logical databases and demonstrate the technical and communication skills required for developing a Systems Proposal.

COURSE CODE	CSE08312	
COURSE TITLE	**SOFTWARE PROJECT MANAGEMENT**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to impart to the students the knowledge of project management and software project management and make them aware about the multiple techniques to estimate software tasks, projects and products. Also the demonstration, definition, implementation, analysis and uses of the metrics required to manage a software project.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	SPM concepts- Definition – components of SPM – challenges and opportunities, tools and techniques. Managing human resource and technical resource, costing and pricing of projects.	
UNIT **II**	Software Measurements- Monitoring & measurement of SW development – cost, size and time metrics – methods and tools for metrics.	
UNIT **III**	Software Quality- Quality in SW development ,quality assurance , quality standards and certifications	
UNIT **IV**	Risk Issues- The risk issues in SW development and implementation – identification of risks – resolving and avoiding risks – tools and methods for identifying risk management.	
UNIT **V**	Software project management tools and case study.	

TEXTBOOKs/REFERENCES

1. Walker Royce, “Software Project Management”, 1st Edition, Pearson Education, 2006
2. Bob Hughes and Mike Cotterell, “Software Project Management”, 3rd Edition, Tata McGraw Hill Edition, 2005.
3. Joel Henry, “Software Project Management”, 1st Edition, Pearson Education, 2006.
4. PankajJalote, “Software Project Management in practice”, 1st Edition, Pearson Education, 2005.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Identify the different project contexts and suggest appropriate management strategies for the same. 2. Identify and describe the key phases of project management. 3. Determine an appropriate project management approach through an evaluation of the business context and scope of the project. 4. Practice the role of professional ethics in successful software development.

COURSE CODE	CSE08314	
COURSE TITLE	**MOBILE COMPUTING**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to make the students aware of the mobile technologies in terms of hardware, software, and communications as well as the utilization of mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures. Also, ways to evaluate the effectiveness of different mobile computing frameworks and description of how mobile technology functions to enable other computing technologies.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	Principles of Cellular Communication, Motivation for IP Based Wireless Networks, GSM: Mobile Services, System Architecture, Localization and calling, Handover, Bluetooth Technologies, Motivation for Specialized MAC, SDMA, FDMA, TDMA, CDMA	
UNIT **II**	Mobile IP : Goals, assumptions, ,entities and terminology, IP Packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimization, DHCP,	

UNIT **III**	Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective Retransmission, Database Issues: Hoarding techniques, cache invalidation mechanisms, client server computing with adaptation, power-aware and context aware computing	
UNIT **IV**	Data Dissemination and Management, Mobile cache maintenance schemes, Mobile Web Caching, Mobile Ad-hoc Networks (MANETs), MAC Issues, Routing Protocols	
UNIT **V**	Mobile Operating System, Security in Wireless Network, Wi-Fi Security, Issues and Challenges in Security Provisioning, Layer wise attacks in wireless networks, possible solutions for jamming, tampering, black hole attack, flooding attack.	

TEXTBOOKs/REFERENCES

1.Richard Wheeler, Mobility: Processes, Computers and Agents, Pearson

2.Charles Perkins et.al.,Mobile IP: Design Principles and Practices, Pearson

3.Tomasz Imielinski, Mobile Computing, Springer Verlag

4. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif., Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.

5. W. Stallings, Wireless Communications and Networks, 2nd edition, Pearson Education, 2013

6. Dharma Prakash Agrawal and Qing-An Zeng, Introduction to Wireless and Mobile Systems, 3rd edition, Tomson, 2011

7. Theodore S. Rappaport, Wireless Communications -Principles Practice,2nd edition, Prentice Hall of India, New Delhi, 2010.

8. Jochen Schiller, Mobile Communications, Pearson Education, Second Edition 2002.

9. C.K.Toh, Adhoc Mobile Wireless Networks: Protocols and Systems, Pearson, 2002.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Display advanced networking and wireless networking knowledge, as well as an awareness of various types of wireless networks, standards, design, operation. 2. Assess wireless network design and protocols. 3. Analyze mobility management and the cellular network. 4. Critique wireless network security basics as well as current trends.

COURSE CODE	CSE08316	
COURSE TITLE	INFORMATION EXTRACTION AND RETRIEVAL	
NUMBER OF CREDITS	**3**	**(L: 2, T: 1, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to demonstrate the genesis and diversity of information retrieval situations for text and hypermedia and describe hands-on experience in storing, and retrieval of information from www using semantic approaches. Also to understand the usage of different data/file structures in building computational search engines.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Information Retrieval and Web Search:** Basic Concepts of Information Retrieval**,** Information Retrieval Models**,** Relevance Feedback**,** Evaluation Measures**,** Text and Web Page Pre-Processing Inverted Index and Its Compression, Latent Semantic Indexing Web Search, Meta-Search: Combining Multiple Rankings	

UNIT **II**	**Web Crawling:** A Basic Crawler Algorithm, Implementation Issues Universal Crawlers, Focused Crawlers, Topical Crawlers	
UNIT **III**	**Structured Data Extraction:** Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation, String Matching and Tree Matching, Multiple Alignment, Building DOM Trees Extraction Based on a Single List Page or Multiple Pages	
UNIT **IV**	**Information Integration:** Schema-Level Matching, Domain and Instance-Level Matching, Combining Similarities, 1:m Match, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface	
UNIT **V**	**Opinion Mining and Sentiment Analysis:** Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Opinion Mining, Opinion Search and Retrieval	

TEXTBOOKs/REFERENCES

1. Introduction to Information Retrieval. Manning, C.; Raghavan, P.; Schütze, H. Cambridge University Press (2008).
2. Search Engines: Information Retrieval in Practice. Croft, W. Bruce; Metzler, Donald; Strohman, Trevor. Addison Wesley (2008)
3. Information Retrieval: Implementing and Evaluating Search Engines, Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack. MIT Press. (2010)
4. Modern Information Retrieval, Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley, (1999)

COURSE OUTCOME	At the end of the course the students will be able to: 1. Define information retrieval and its importance, understand the information retrieval process and describe the challenges in information retrieval. 2. Understand text preprocessing techniques, create inverted indexes for efficient searching and implement tokenization and stemming. 3. Describe different retrieval models (e.g., Boolean, Vector Space Model), understand ranking algorithms (e.g., TF-IDF, BM25) and evaluate retrieval effectiveness. 4. Understand query processing steps, implement query expansion techniques, evaluate the impact of query expansion on retrieval and explore advanced retrieval techniques (e.g., learning to rank).

COURSE CODE	CSE08318	
COURSE TITLE	**BLOCKCHAIN AND CRYPTOCURRENCY TECHNOLOGIES**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	

COURSE OBJECTIVE	The objective of the course is to familiarize the students with the functional/operational aspects of the cryptocurrency ecosystem and lay down an overview of emerging abstract models for Blockchain Technology. Also, provide an identification roadman under major research challenges and technical gaps existing between theory and practice in cryptocurrency domain

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Introduction: Block chain or distributed trust, Protocol, Currency, Cryptocurrency, How a Cryptocurrency works, Crowdfunding	
UNIT **II**	Extensibility of Blockchain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Blockchain Environment.	
UNIT **III**	Blockchain Science: Gridcoin, Folding coin, Blockchain Genomics, Bitcoin MOOCs.	
UNIT **IV**	Currency, Token, Tokenizing, Campuscoin, Coindrop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency	
UNIT **V**	Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations.	

TEXTBOOKs/REFERENCES

1. Melanie Swan, Blockchain Blueprint for Economy, O'reilly.
2. Building Blockchain Apps, Michael Juntao Yuan, Pearson Education
3. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition
4. Bradley Lakeman, Blockchain Revolution: Understanding the Crypto Economy of the Future. A Non-Technical Guide to the Basics of Cryptocurrency Trading and Investing, ISBN: 1393889158.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Identify the research advances related to one of the most popular technological areas today. 2. Understand extensibility of blockchain concepts. 3. Critique and analyze blockchain science. 4. Infer to theunderlying technical and business model challenges in deploying blockchain computing models.

COURSE CODE	CSE08320	
COURSE TITLE	**WEB TECHNOLOGY**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to provide the students an understanding of the world wide web and the way communication happens with the deployment of web based services and the ways web page development started and have evolved through the close association of different web technologies, tools and architectures.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**Web Design Principles:** WWW, Web Standards – Basic Principles involved in developing a website – Planning Process – Five golden rules for website designing – Design Concept.	
UNIT **II**	**Introduction to HTML:** Structure of an HTML document - Basic Tags –Working with Text, List, Tables and Frames - Linking document, Image and Multimedia – Forms and Controls.	

UNIT **III**	**Cascading Style Sheets:** Introduction – Creating Style Sheet – CSS Properties – CSS Styling : Background, Text Format, Controlling Fonts – Working with block elements and Objects – Working with Lists and Tables – CSS Id and Class – Box Model : Border, Padding & Margin Properties – CSS Advanced: Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo Class, Navigation Bar, Image Sprites, Attribute Selector – CSS Color – Creating Page Layout and Design	
UNIT **IV**	**Java Script:** Introduction to Java script - Advantage of Java script Java script Syntax – Data type - Variable - Array - Operator and Expression - Looping Constructor - Function - Dialog box. **Event Handling:** Java script document object model - Introduction - Object in HTML - Event Handling - Window Object.	
UNIT **V**	**Document Object Model:** Document object - Browser Object - Form Object - Navigator object Screen object - Build in Object - User defined object - Cookies. **Website Design and Management:** Site Planning –Site navigation- Responsive Web Designing – Validating a Website	

TEXTBOOKs/REFERENCES

1. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India Private Limited, 2011.
2. Robert W.Sebesta, Programming the World Wide Web, 7th edition, Pearson Education, 2013.
3. Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
4. Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
5. B. M. Harwani, Developing Web Applications in PHP and AJAX, Tata McGraw-Hill, 2010.
6. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, and Harvey M. Deitel

COURSE OUTCOME	At the end of the course the students will be able to: 1. Describe the concepts of the World Wide Web, and the requirements of effective web development 2. Develop web pages with different layouts and features using the HTML and CSS and dynamic web page development using JavaScript 3. Understand the strengths and weaknesses of the client-server internet approaches to web design and implementation of the same. 4. Developa responsive website that works in the cross-platform environment and also of a host and maintain that website in the real-time environment.

COURSE CODE	CSE08322	
COURSE TITLE	**WEB TECHNOLOGY LAB**	
NUMBER OF CREDITS	**1**	**(L: 0, T: 0, P: 2)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to make the students have a hands-on-experience of developing an ability to design and implement static and dynamic websites with the choice of best technologies/software/scripts/databases for solving web client/server problems and create web pages with dynamic effects.	
LIST OF SUGGESTED LABORATORY EXERCISES		

1. Design the following static web pages required for an online book store web site. 1) HOME PAGE: The static home page must contain three frames. 2) LOGIN PAGE 3) CATOLOGUE PAGE: The catalogue page should contain the details of all the books available in the web site in a table. 4) REGISTRATION PAGE

2. Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contains alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty).

3. Develop and demonstrate the usage of inline, internal and external style sheet using CSS

4. Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: a) Input: Click on Display Date button using onclick( ) function Output: Display date in the textbox b) Input: A number n obtained using prompt Output: Factorial of n number using alert c) Input: A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert d) Input: A number n obtained using prompt and add another number using confirm Output: Sum of the entire n numbers using alert

5. Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next in the list. Add CSS to customize the properties of the font of the capital (color,bold and font size).

6. Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters

7. Develop and demonstrate PHP Script for the following problems: a) Write a PHP Script to find out the Sum of the Individual Digits. b) Write a PHP Script to check whether the given number is Palindrome or not

8. Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.

9. Implement the following web applications using (a) PHP (b) Servlets (c) JSP

COURSE OUTCOME	At the end of the course the students will be able to: 1. Analyze a web page and identify its elements and attributes. 2. Create web pages using XHTML and Cascading Style Sheets. 3. Build dynamic web pages using JavaScript (Client side programming). 4. Create XML documents and Schemas.

COURSE CODE	CSE09326	
COURSE TITLE	**Introduction to Machine Learning**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	**Open Elective Course**	
COURSE OBJECTIVE	1. To teach the theoretical foundations of various learning algorithms. 2. To train the students better understand the context of supervised and unsupervised learning through real-life examples. 3. Apply all learning algorithms over appropriate real-time dataset. 4. Evaluate the algorithms based on corresponding metrics identified.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	What Is Machine Learning? Applications of Machine Learning, Processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning	5

UNIT **II**	What are datasets and how to handle them? Feature sets, Dataset division: test, train and validation sets, cross validation.	10
UNIT **III**	Classification and Regression: K-Nearest Neighbour, Decision Tree, Linear Regression, Artificial Neural Networks etc., Evaluation Measures: confusion matrix, accuracy, Specificity, precision, recall, False Positive Rate, False Negative Rate, F-Score, ROC-Curve.	10
UNIT **IV**	Concept of Clustering, Measures of Similarity, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partition Clustering - K-means clustering.	10
UNIT **V**	Implementation of Machine Learning Algorithms	10

TEXTBOOKs/REFERENCES

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing Company, 2020
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

COURSE OUTCOME	At the end of this course, student will be able to: 1. Understand, visualize, analyze and preprocess the data from a real-time source. 2. Apply appropriate algorithms to the data. 3. Evaluate the performance of various algorithms that could be applied to the data and to suggest the most relevant algorithm according to the environment.

SEVENTH SEMESTER

COURSE CODE	CSE01401	
COURSE TITLE	MACHINE LEARNING	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	
COURSE OBJECTIVE	The objective of the course is to impart to the students the knowledge of the basics concepts of the learning mechanism employed under the idea of supervised and unsupervised learning in nature and ways machines can learn patterns from data without being explicitly programmed. Also develop among the students the ability to design and analyze various machine learning algorithms and techniques for optimizing model accuracy for real world problems.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction:** Machine Learning, Examples of Various Learning Paradigms, Applications of Machine Learning, Processes involved in Machine Learning, Real life examples of Machine Learning.	
UNIT **II**	**Introduction to Machine Learning Techniques:** Supervised Learning, Unsupervised Learning and Reinforcement Learning, Datasets, Dataset division: test, train and validation sets, cross validation.	
UNIT **III**	**Supervised learning:** Classification and Regression: K-Nearest Neighbor, Decision Tree, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Bayes Theorem and Naive Bayes classifier, Artificial Neural Networks, Evaluation Measures: confusion matrix, accuracy, Specificity, precision, recall, False Positive Rate, False Negative Rate, F-Score, ROC-Curve.	
UNIT **IV**	**Unsupervised learning:** Concept of Clustering, Measures of Similarity, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partition Clustering - K-means clustering.	
UNIT **V**	**Class Imbalance** – SMOTE, **Ensembles**: Introduction, Bagging and boosting, Random forest, **Recommender System:** Content based system, Collaborative filtering based. Introduction to Deep Learning, Introduction to Natural Language Processing	

TEXTBOOKs/REFERENCES

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Nasrabadi, Nasser M. "Pattern recognition and machine learning." Journal of electronic imaging 16.4 (2007): 049901.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Appreciate the importance of visualization in data analytics solutions. 2. Extract features that can be used for a particular machine learning approach in various applications e.g. IOT 3. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach. 4. To mathematically analyze various machine learning approaches and paradigms for optimized solutions.

COURSE CODE	CSE01403	
COURSE TITLE	INTRODUCTION TO DATA ANALYTICS USING PYTHON	
NUMBER OF CREDITS	**3**	**(L: 2, T: 1, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to demonstrate to the students the role of python in statistical data analysis and how to analyze patterns in data for creating meaningful insights, visualization and prediction based on data.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Python Fundamentals:** Python data structures, Control statements, Functions, Object Oriented programming concepts using classes, objects and methods, Exception handling, Implementation of user-defined Modules and Package, File handling in python.	

UNIT **II**	**Introduction to Data Understanding and Preprocessing:** Knowledge domains of Data Analysis, Data Analysis process, Dataset generation, Importing Dataset: Importing and Exporting Data, Basic Insights from Datasets, Cleaning and Preparing the Data: Identify and Handle Missing Values.	
UNIT **III**	**Data Processing and Visualization:** Data Formatting, Exploratory Data Analysis, Filtering and hierarchical indexing using Pandas. Data Visualization: Basic Visualization Tools, Specialized Visualization Tools, Seaborn Creating and Plotting Maps.	
UNIT **IV**	**Mathematical and Scientific applications for Data Analysis:**Numpy and Scipy Package, Understanding and creating N-dimensional arrays, Basic indexing and slicing, Boolean indexing, Fancy indexing, Universal functions, Data processing using arrays, File input and output with arrays.	
UNIT **V**	**Analyzing Web Data:** Data wrangling, Web scrapping, Combining and merging data sets, Reshaping and pivoting, Data transformation, String Manipulation. **Model Development and Evaluation**: Model development, Model Visualization, Prediction and Decision Making, Model Evaluation: Over-fitting, Under-fitting and Model Selection.	

TEXTBOOKs/REFERENCES

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
2. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
3. Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. “John Wiley & Sons, Inc”.
4. Anderson Sweeney Williams (2011). Statistics for Business and Economics. “Cengage Learning”.
5. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. “John Wiley & Sons, Inc”
6. Jay L. Devore (2011). Probability and Statistics for Engineering and the Sciences. “Cengage Learning”.
7. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). “Wiley-Interscience Publication”.
8. Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. “
9. Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. “John Wiley & Sons, Inc”.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Explore the basics of data understanding from the perspective of python programming. 2. Understanding the data, performing preprocessing, post-processing and data visualization to get insights from data. 3. Use different python packages for mathematical, scientific applications and for web data analysis. 4. Develop the model for data analysis and evaluate the model performance.

COURSE CODE	CSE08405	
COURSE TITLE	**PRINCIPLES OF CLOUD COMPUTING**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to provide the students an insight into the basics of cloud computing along with virtualization, as the fastest growing domain to migrate over.	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**Computing Paradigms:** High-Performance Computing, Parallel Computing and Distributed Computing, Cluster Computing, Grid Computing.	
UNIT **II**	**Cloud Computing Fundamentals:** Introduction and Applications, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Essential Characteristics, Cloud Deployment Models	
UNIT **III**	**Cloud Computing Architecture and Management:** Cloud architecture, Layer, Network Connectivity in Cloud Computing, Managing the Cloud, Migrating Application to Cloud, Phases of Cloud Migration Approaches.	
UNIT **IV**	**Cloud Service Models:** Infrastructure as a Service, Characteristics of IaaS, IaaS Providers.Platform as a Service, Characteristics, PaaS Providers, Software as a Service, Characteristics, SaaS Providers, Other Cloud Service Models.	
UNIT **V**	**Cloud Service Providers:** Cloud Platforms, Cloud Storage, , Amazon Web Services, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit.	

TEXTBOOKs/REFERENCES

1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
3. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Explain the core concepts of the cloud computing fundamentals and paradigm 2. Understand various service delivery models of a cloud computing architecture. 3. Apply fundamental concepts in cloud infrastructures e.g infrastructure as service to understand the tradeoffs in power, efficiency and cost 4. Ability to program and deploy cloud based applications closely in comparison with different cloud service providers.

COURSE CODE	CSE08407	
COURSE TITLE	NEXT GENERATION NETWORKS	
NUMBER OF CREDITS	**3**	**(L: 2, T: 1, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	1. Student will be able to exposure to the new technologies & services that telecommunication operators. 2. Students will be able **to learn a wide range of current and next-generation wireless networking protocols and technologies.** 3. Understand the core technologies, and architectures of the Next Generation Networks 4. Summarize technology options for Multi-Service Networks	

COURSE CONTENT

UNIT	**CONTENT**	
UNIT **I**	Introduction to Next Generation network, New Era of Networking, Building Blocks of NGN, VOIP, VPN, Optical Network, NGN Services	
UNIT **II**	IP Network, IP version 4, IP version 6, LAN switching, WAN Technologies and Topologies, Wireless IP LAN, Global IP Networks, Globally Resilient IP	
UNIT **III**	Multi-Service Network, Origin of multi service ATM, Next Generation Multi-service Network, Next Generation multi service ATM Servicing, Multi protocol Label switching, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits,	

UNIT **IV**	NGN Application Internet Connectivity, e-commerce, Call center, third party application service provision, integrated billing, security and directory enabled networks	
UNIT **V**	Overview of Potential 5G Communications System Architecture – Security Issues and Challenges in 5G Communications Systems – Self Organising Networks: Self Organising Networks in UMTS and LTE,WAP, WiMAX	

TEXTBOOKs/REFERENCES

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
2. Yin Zhang, Min Chen, "Cloud Based 5G Wireless Networks – Springer Briefs in Computer Science", Springer, 2016.
3. Neill Wilkinson, " Next Generation Network Services, Technologies and Strategies", Wiley
4. Robet Wood, " Next Generation Network Services", Pearson
5. Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis (Takis) Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", CRC Press, 2017.

COURSE OUTCOME	1.Evaluate the importance of packet switching for NGN 2.Analyze and differentiate various architectures of a next generation network (NGN) 3.Students will gain proficiency in a diverse array of contemporary and upcoming wireless networking protocols and technologies. 4.Comprehend the multiple services offered by NGN

COURSE CODE	CSE08409	
COURSE TITLE	INTRODUCTION TO INDUSTRY 4.0	
NUMBER OF CREDITS	**3**	**(L: 2, T: 1, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course covers key concepts of future smart factories, the cyber-physical systems and physical processes within these factories and the virtualization techniques and intelligent decision making capabilities which would support managers in leading these initiatives.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Overview of Industry 4.0:** Introduction to Industry 4.0, Historical context of industrial revolutions, Key technologies and trends	
UNIT **II**	**Core Technologies of Industry 4.0:** Internet of Things (IoT), Artificial Intelligence (AI) and Machine Learning (ML), Data Analytics in Industry 4.0	
UNIT **III**	**Digital Twins and Cyber-Physical Systems:** Introduction to Digital Twins, Cyber-Physical Systems (CPS), Applications of Digital Twins and CPS in Industry 4.0	
UNIT **IV**	**Data Security and Privacy in Industry 4.0:** Data Security Challenges, Data Privacy Regulations, Data Protection Strategies in Industry 4.0	
UNIT **V**	**Industry 4.0 Applications and Case Studies:** Industry 4.0 in Manufacturing, Industry 4.0 in Logistics and Supply Chain, Case Studies and Future Trends	

TEXTBOOKs/REFERENCES

1. "Industry 4.0: The Fourth Industrial Revolution" by Klaus Schwab.
2. : "The Fourth Industrial Revolution" by Klaus Schwab (World Economic Forum).
3. "The Internet of Things: Key Applications and Protocols" by Olivier Hersent, David Boswarthick, and Omar Elloumi.
4. "AI and Machine Learning for Business: A No-Nonsense Guide to Data-Driven Technologies" by John K. Thompson and Ian McCord.
5. "Digital Twin Technologies and Smart Cities" by Satyam Priyadarshy and Aniruddha Gokhale.
6. "Cyber-Physical Systems" by Rajkumar Rajagopal and Madhur Behl (MIT Press).
7. "Industrial Cybersecurity: Efficiently secure critical infrastructure systems" by Pascal Ackerman and Silas Cutler.
8. "Data Privacy and Security for Smart Cities: A Case Study in Industry 4.0" by Raouf Boutaba, Quan Zhang, and Bin Hu.
9. "Industry X.0: Realizing Digital Value in Industrial Sectors" by Eric Schaeffer and David Rizzo.
10. Industry-specific reports and case studies from leading consulting firms and industry associations.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Define Industry 4.0 and its key characteristics, explain how Industry 4.0 is different from previous industrial revolutions and identify the technologies and trends that underpin Industry 4.0. 2. Describe the Internet of Things (IoT) and its applications in Industry 4.0, explain the role of Artificial Intelligence (AI) and Machine Learning (ML) in smart manufacturing and understand the importance of data analytics for decision-making in Industry 4.0 3. Define digital twins and cyber-physical systems, describe how digital twins are used to simulate and optimize physical systems and understand the role of cyber-physical systems in real-time monitoring and control. 4. Identify Industry 4.0 security challenges and applications in manufacturing, logistics, and other sectors, evaluate the benefits and challenges of Industry 4.0 through case studies and understand the future potential and trends of Industry 4.0.

COURSE CODE	CSE08411	
COURSE TITLE	**Internet of Things**	
NUMBEROF CREDITS	**3**	**(L: 2, T: 1, P: 0)**
COURSE CATEGORY	ProgramElective Course	
COURSE OBJECTIVE	The objective of the course is to provide the students with a comprehensive understanding of the concepts, technologies, and applications related to IoT systems where the students will learn about IoT architecture, communication protocols, data analytics, and security, equipping students with the skills to design, implement, and manage IoT solutions for diverse industries, including healthcare, transportation, smart cities, and more.	

COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	FUNDAMENTALS OF IoT: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT.	5
UNIT **II**	Architecture and Core IoT Functional Stack: Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.	10
UNIT **III**	IoT PROTOCOLS: IoT Access Technologies; Physical and MAC layers, topology, IoT Security.	10
UNIT **IV**	DESIGN AND DEVELOPMENT: Design Methodology,Microcontroller, System on Chips IoT system building blocks.	10
UNIT **V**	IoT applications in Home appliances , Agriculture, Healthcare,Smart Cities ,Infrastructures, buildings, security, Industries, other IoT electronic equipment's, future of IoT	10

TEXTBOOKs/REFERENCES

1. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More Paperback – 2013
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.
5. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015
6. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understanding of IoT concepts, technologies, and applications, allowing students to effectively design and implement IoT solutions. 2. Develop proficiency in IoT architecture, communication protocols, and data analytics, enabling them to harness the potential of interconnected devices for real-world applications. 3. Expertise in IoT security to protect data and privacy in IoT ecosystems. 4. Contribute to the development and deployment of IoT solutions across various industries, driving innovation and efficiency in the rapidly evolving IoT landscape.

COURSE CODE	CSE08413	
COURSE TITLE	**Nature Inspired computing for Data Science**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to introduce to the students to the algorithms and techniques inspired by natural processes, including genetic algorithms, neural networks, and swarm intelligence. It focuses on applying these methods to solve complex computational problems and optimization tasks. Also, generate a practical understanding on how to adapt and utilize nature-inspired approaches in various real-world applications.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introduction to nature-inspired computing and Cellular Automata:** History, Major tasks, Natural paradigms, Cellular automata, Dynamical systems simulation, Self-replication	
UNIT **II**	**Evolutionary Computing:** Background and history of evolutionary computation (EC), Different branches of EC: GA, GP, EA, EP, DE; Selected applications of EC methods	
UNIT **III**	**Swarm Intelligence:** Background and history of collective and swarm intelligence, Examples of swarm intelligence in biology, Mechanisms of swarm behaviour (such as recruitment, quorum sensing), Selected application of swarm methods	

UNIT **IV**	**Neural Networks:** Background and history of artificial neural networks (ANNs), Learning algorithms based on ANNs, Optimization with ANNs, Selected applications of ANNs	
UNIT **V**	**Complex networks and emergence and Artificial Life:** Background and history of network science, Random networks, small-world networks and networks in nature, Artificial networks and their features, Selected phenomena in network science, Artificial Life, Background and history of Artificial Life research, Self-organizing systems, Artificial Chemistry.	

TEXTBOOKs/REFERENCES

1. "Introduction to Evolutionary Computing" by A.E. Eiben and J.E. Smith.
2. "Swarm Intelligence" by Russell C. Eberhart and Yuhui Shi.
3. Research papers on PSO and swarm-based techniques in data science.
4. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
5. Online courses and tutorials on deep learning frameworks (e.g., TensorFlow, PyTorch).

COURSE OUTCOME	At the end of the course the students will be able to: 1. Define nature-inspired computing and its relevance in data science and identify the key types of nature-inspired algorithms. 2. Understand the basic principles of evolutionary and swarm-based algorithms and describe the principles of swarm intelligence. 3. Implement particle swarm optimization (PSO) for optimization tasks and apply PSO for clustering and data-driven problems. 4. Explain the structure and function of artificial neural networks and implement basic feedforward neural networks as well as deep learning and its applications on real datasets.

COURSE CODE	CSE08415	
COURSE TITLE	**INTRODUCTION TO CRYPTOGRAPHY**	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to familiarize students with the fundamental concepts and techniques used to secure communication and data. Students will learn about encryption, decryption, cryptographic protocols, and the mathematical foundations of cryptography. The course also aims to provide a solid foundation for understanding the principles behind secure communication and data protection, enabling students to apply cryptographic techniques in various domains, such as cybersecurity, network security, and information protection.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introductory Concepts:**Security trends – Attacks and services – Classical crypto systems – Different types of ciphersBasic Number theory – Congruences – Chinese Remainder theorem – Modular exponentiation – Fermat and Euler's theorem	
UNIT **II**	Simple DES – Differential cryptoanalysis – DES – Modes of operation – Triple DES – AES – RC4 – RSA – Attacks – Primality test – factoring. Discrete Logarithms – Computing discrete logs – Diffie-Hellman key exchange – ElGamal Public key cryptosystems –RSA – ElGamal.	
UNIT **III**	Authentication requirements - Authentication functions – Message Authentication Codes, Hash Functions- Security of Hash Functions and MACs - MD5 message Digest algorithm - Secure Hash Algorithm – HMAC	

UNIT **IV**	Digital Signatures - Authentication Protocols - Digital Signature Standard. Authentication Applications: Kerberos - X.509 Authentication Service - Electronic Mail Security - PGP - /MIME - IP Security - Web Security	
UNIT **V**	Intrusion detection - password management - Viruses and related Threats - Virus Counter measures - Firewall Design Principles – Trusted Systems.	

TEXTBOOKs/REFERENCES

1. "Handbook of Applied Cryptography" by Alfred J. Menezes, Paul C. van Oorschot, and Scott A. Vanstone.
2. "Cryptography and Network Security: Principles and Practice" (Instructor's Resource Manual) by William Stallings.
3. "Cryptography and Network Security: Principles and Practice" (Practice Set Solutions) by William Stallings.
4. "Cryptography: Theory and Practice" by Douglas R. Stinson.
5. "Understanding Cryptography: A Beginner's Guide" by Christof Paar and Jan Pelzl.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understanding of cryptographic principles and algorithms 2. Apply encryption techniques to secure communication and data, proficiency in analyzing the security of cryptographic systems. 3. Capacity to design secure solutions for various applications for digital signatures and intrusion detection. 4. Develop a foundational knowledge of the discrete mathematical concepts supporting cryptography, enabling them to contribute to cybersecurity and information protection efforts.

COURSE CODE	CSE05419
COURSE TITLE	**Engineering Project -I**
NUMBER OF CREDITS	**5**
COURSE CATEGORY	**Project**
COURSE OBJECTIVE	The objective of the course is to expose the students to the world of their own learning from doing i.e. exposing them sufficiently through hands on experiences in the respective areas enhancing their skills of software/technology product development design or research, and analysis for deploying a process technology over a suitable platform so as to make them an industry ready technocrat for the rapidly growing digital workforce for cutting edge industry demands.

COURSE CONTENT

1. Project may be a practical or theoretical approach to a software/technology or social/economic problem in nature which can be modeled & simulated, experimented and analyzed through prototype design and data analysis in the areas of relevance.

2. Project as the curriculum design would span for a semester but depending on the nature and scope of the problem it could also be taken for the consecutive semester subject to fulfilling the academic regulations.

3. The Project could either be carried out within the university's supervision or outside the campus either in collaboration with a relevant industry or research institution.

4. The project could either be carried individually or be worked out within a group with a maximum of 3 students subject to project report of each student specifying the individual's contribution in the report.

COURSE OUTCOME	At the end of the course the students would be able to: 1. Analyze and discuss software/technology/product development techniques and methodologies and application of various computer science methods and algorithms for specific problem solving 2. Apply the above in group based development 3. Demonstrate skills in investigating, analyzing and using various software tools and techniques 4. Demonstrate appropriate professional conduct and present the work through technical report/presentation: Engineering Project Report-I.

EIGHT SEMESTER

COURSE CODE	CSE08402	
COURSE TITLE	**Knowledge Representation and Reasoning**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to teach students how to represent and manipulate knowledge effectively within computational systems through various logical formalisms and techniques for representing information in a structured and meaningful way, such as semantic networks, frames, and logic-based languages like First-Order Logic and Description Logics. Also the course introduces the students to impart reasoning skills, enabling students to derive conclusions, make inferences, and solve complex problems based on the represented knowledge.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to Knowledge Representation** Basics of knowledge representation, Different types of knowledge (declarative, procedural, meta), Representational choices and trade-offs, Semantic networks and frames	5
UNIT **II**	**Logic-Based Knowledge Representation** Introduction to First-Order Logic (FOL), Syntax and semantics of FOL, Inference rules and proof techniques, Knowledge representation using FOL, Ontologies and Description Logics	10
UNIT **III**	**Non-Logic-Based Knowledge Representation** Conceptual graphs and semantic networks, Frames and scripts, Taxonomies and inheritance, Conceptual modeling techniques, Semantic web and RDF	10
UNIT **IV**	**Reasoning and Inference** Deductive reasoning and theorem proving, Forward and backward chaining, Default and non-monotonic reasoning, Abductive reasoning and diagnosis, Common-sense reasoning	10
UNIT **V**	**Applications and Advanced Topics** Expert systems and knowledge-based systems, Natural language processing and knowledge extraction, Knowledge representation in AI planning, Knowledge representation in robotics, Emerging trends in knowledge representation and reasoning.	10

TEXTBOOKs/REFERENCES

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Schank, Roger C., Robert P. Abelson: Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures. Hillsdale, NJ: Lawrence Erlbaum, 1977.
3. R. C. Schank and C. K. Riesbeck: Inside Computer Understanding: Five ProgramsPlus Miniatures, Lawrence Erlbaum, 1981.
4. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
5. Schank, Roger C., Robert P. Abelson: Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures. Hillsdale, NJ: Lawrence Erlbaum, 1977.
6. Murray Shanahan: A Circumscriptive Calculus of Events. Artificial Intelligence 77(2), pp. 249-284, 1995.
7. John F. Sowa: Conceptual Structures: Information Processing in Mind and Machine, Addison–Wesley Publishing Company, Reading Massachusetts, 1984.
8. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand representation formalisms and the ability to choose the most suitable one for a given problem. 2. Develop proficiency in applying First-Order Logic and Description Logics for knowledge representation and reasoning tasks. 3. skillful in designing and implementing knowledge-based systems capable of logical inference and common-sense reasoning. 4. Leverage knowledge representation and reasoning techniques in practical applications such as expert systems, natural language processing, and semantic web technologies.

COURSE CODE	CSE08404	
COURSE TITLE	**Parallel Algorithm**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	ProgramElective Course	
COURSE OBJECTIVE	The objective of the course is to impart to the students the knowledge and understanding of parallel architectures and models of computation. To introduce the various classes of parallel algorithms.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	**INTRODUCTION:** Need for Parallel Processing - Data and Temporal Parallelism - Models of Computation - RAM and PRAM Model – Shared Memory and Message Passing Models- Processor Organisations - PRAM Algorithm – Analysis of PRAM Algorithms- Parallel Programming Languages.	9
UNIT **II**	**PRAM ALGORITHMS:** Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching - Sorting - Merging Two Sorted Lists – Matrix Multiplication - Graph Coloring - Graph Searching.	9
UNIT **III**	**SIMD ALGORITHMS -I:** 2D Mesh SIMD Model - Parallel Algorithms for Reduction - Prefix Computation - Selection - Odd-Even Merge Sorting - Matrix Multiplication	9
UNIT **IV**	**SIMD ALGORITHMS -II:** Hypercube SIMD Model - Parallel Algorithms for Selection- Odd-Even Merge Sort- Bitonic Sort- Matrix Multiplication Shuffle Exchange SIMD Model - Parallel Algorithms for Reduction -Bitonic Merge Sort - Matrix Multiplication - Minimum Cost Spanning Tree.	9
UNIT **V**	**MIMD ALGORITHMS:** UMA Multiprocessor Model -Parallel Summing on Multiprocessor- Matrix Multiplication on Multiprocessors and Multicomputer - Parallel Quick Sort - Mapping Data to Processors.	9

TEXTBOOKs/REFERENCES

1. Michael J. Quinn, "Parallel Computing : Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", University press, Second edition , 2011.
3. V Rajaraman, C Siva Ram Murthy, " Parallel computers- Architecture and Programming ", PHI learning, 2016.
4. S.G. Akl, “Design and Analysis of Parallel Algorithms”
5. S.G. Akl, ”Parallel Sorting Algorithm” by Academic Press
6. Ananth Grame, George Karpis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", 2nd Edition, Addison Wesley, 2003.
7. M Sasikumar, Dinesh Shikhare and P Ravi Prakash , " Introduction to Parallel Processing", PHI learning , 2013.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understanding of parallel computing principles and techniques, enabling students to design and analyze efficient algorithms for parallel processing. 2. Acquire the skills to exploit parallelism in various computing architectures, such as multi-core processors, clusters, and GPUs, to solve complex problems faster. 3. Develop expertise in performance evaluation and optimization of parallel algorithms, ensuring they can achieve maximum computational efficiency. 4. Tackle real-world computational challenges and contribute to the advancement of parallel computing technology and its applications.

COURSE CODE	CSE08406	
COURSE TITLE	**Soft Computing**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to introduce to the students to a diverse set of computational techniques inspired by human-like reasoning and learning processes. It aims to provide students with a foundational understanding of fuzzy logic, neural networks, genetic algorithms, and other soft computing approaches.	
COURSE CONTENT		

UNIT	CONTENT	HRS
UNIT **I**	INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics	5
UNIT **II**	FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations,Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	10
UNIT **III**	NEURAL NETWORKS: Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Reinforcement Learning,Unsupervised Learning Neural Networks, Adaptive Resonance architectures	10
UNIT **IV**	GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning;Machine Learning Approach to Knowledge Acquisition, advantages and limitations and applications of genetic algorithm	10
UNIT **V**	Differential Evolution Algorithm, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	10

TEXTBOOKs/REFERENCES

1). Jyh:Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro:Fuzzy and Soft Computing ,Prentice:Hall of India, 2003.

2) George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications ,Prentice Hall, 1995.

3) MATLAB Toolkit Manual

4) Zadeh, Lotfi A. "Soft computing and fuzzy logic." Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems: Selected Papers by Lotfi a Zadeh. 1996. 796-804.

5) Sivanandam, S. N., and S. N. Deepa. Principles of Soft Computing (With CD). John Wiley & Sons, 2007

6) N. P Padhy: Artificial Intelligence and Intelligent Systems, 1st Edition, Oxford University Press India, 2005. 7) Dan W. Patterson: Introduction to Artificial Intelligence and Expert Systems, 1st Edition, Phi Learning, 2009.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Identify and describe soft computing techniques and their roles in building intelligent machines. 2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. 3. Apply genetic algorithms to combinatorial real-world problems, especially those involving uncertainty, imprecision, and non-linearity for optimization. 4. Evaluate and compare solutions by various soft computing approaches for a given problem

COURSE CODE	CSE08408	
COURSE TITLE	**Quantum Computing**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to introduce to the students the basics of quantum computing where the students will learn about qubits and gating operations, construct quantum circuits and learn about quantum algorithms.	
COURSE CONTENT		

UNIT	**CONTENT**	**HRS**
UNIT I	**Introduction to Quantum Mechanics and Quantum Computing** Basic principles of quantum mechanics,Quantum bits (qubits) and their properties, Quantum superposition and entanglement,Quantum gates and circuits, Quantum parallelism and computational advantages	5

UNIT **II**	**Quantum Algorithms** Introduction to key quantum algorithms (e.g., Grover's algorithm, Shor's algorithm), Quantum algorithm design principles, Analysis of quantum algorithms' speedup over classical counterparts, Quantum algorithmic complexity	10
UNIT **III**	**Quantum Hardware and Technologies** Quantum computing platforms (e.g., superconducting qubits, trapped ions), Quantum error correction and fault-tolerance, Quantum hardware development challenges and progress, Quantum software development tools and languages (e.g., Qiskit, Cirq)	10
UNIT **IV**	**Quantum Applications and Use Cases** Quantum cryptography and secure communication, Optimization problems and quantum annealing, Machine learning and quantum-enhanced algorithms, Quantum simulations for scientific research, Potential impact of quantum computing in various industries	10
UNIT **V**	**Ethical and Societal Considerations** Ethical implications of quantum computing, Quantum computing's role in cybersecurity and national security, Intellectual property and quantum computing, Preparing for a quantum computing-enabled future	10

TEXTBOOKs/REFERENCES

1) Nielsen, Michael A., and Issac L. Chuang, Quantum Computation and Quantum Information, Cambridge, UK: Cambridge University Press, September 2000, ISBN: 9780521635035
2) Peres, Asher, Quantum Theory: Concepts and Methods. New York, NY: Springer, 1993, ISBN: 9780792325499
3) Benenti G., Casati G and Strini G., Principles of Quantum Computation and Information, Vol. I: Basis Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004
4) Pittenger A.O., An Introduction to Quantum Computing Algorithms, 2000
5) Noson S. Yanofsky and Mirco A. Mannucci, Quantum Computing for Computer Scientists, 2008.
6) 2 Abraham Asfaw et al, Learn Quantum Computation using Qiskit, http:// qiskit.org/textbook, 2020.
7) 3 RishwiThimmaraju and Harika Vajha. Beyond Classical: A crash course on Quantum Computing using Qiskit and IBM, 2020.
8) Kaye P., Laflamme R., Mosca M. (2007). *An Introduction to Quantum Computing*. Oxford University Press
9) Nielsen M.A., Chuang I.L. (2010). *Quantum Computation and Quantum Information. Cambridge University Press.*
10) Mermin N.D. (2007). *Quantum Computer Science: An Introduction*. Cambridge University Press.
11) Hirvensalo M. (2001). *Quantum Computing*. Springer.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Familiar with subsets of linear algebra to express quantum concepts. 2. Define concepts in quantum theory and be able to elicit the consequences of different quantum scenarios. 3. Interpret and analyze simple quantum circuits and identify fault-tolerant quantum devices. 4. write code in Qiskit to implement quantum algorithms and understand the applications of Quantum Computing.

COURSE CODE	CSE05412
COURSE TITLE	**Engineering Project -II**
NUMBER OF CREDITS	**10**
COURSE CATEGORY	**Project**
COURSE OBJECTIVE	The objective of the course is to further introduce to the students the product/technology/solution development roadmap and guidelines including project management, requirement gathering techniques, process modeling, architectures, system modeling testing, cost modeling and safety for software and industry ready product with formal specifications.

COURSE CONTENT

1. Problem Solving, abstraction and design with the professional knowledge of ethics, expectations, teamwork concepts and issues, interpersonal communication as well as understanding of ICT as a profession.
2. The efficient use of technology as a resource including hardware/software, data and information and networking.
3. Technology building, including programming, human factors, system development and systems acquisition also the ICT management techniques for governance and organizations including IT project management as well as service and security management.
4. Publications in the peer reviewed journals / International conferences will be an added advantage

COURSE OUTCOME	At the end of the course the students would be able to: 1. Search, define and formulate specific problem statements in their chosen domain of work or carry forward significant contributions in the Engineering Project I. 2. Perform feasibility study through relevant product/literature and / or patent search in the area of interest for robust feasibility study. 3. Conduct experimental analysis/simulation for a prototype design solution as well as iterations and documentation of the results with error analysis / benchmarking and costing 4. Develop a finished product and document the results in the form of technical report/presentation: Engineering Project Report-II as well as conference or journal publication.

NINTH SEMESTER

COURSE CODE	CSE08501	
COURSE TITLE	**Big Data Analytics**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to equip students with the knowledge and skills needed to effectively analyze and derive valuable insights from large and complex datasets. It aims to provide an understanding of big data technologies, including data storage, processing, architecture and management tools.	

COURSE CONTENT

UNIT	**CONTENT**	**HRS**
UNIT **I**	Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks.	5
UNIT **II**	**Hadoop –** Requirement of Hadoop Framework, HDFS (Hadoop Distributed File System)**,** HDFS Architecture:Name Node, Secondary Name Node, Data Node, Data storage in HDFS, HDFS Block Size, HDFS Commands, Configuration of Hadoop Cluster	10
UNIT **III**	**MapReduce:** Map Reduce architecture, Job Tracker, Task Tracker, Data Types in hadoop, Mapper, Reducer, Combiner, Partitioner, Distributed Cache, Counters, Joins, Compression Technique, Map Reduce Schedulers, Map Reduce programming model, Debuggind Map reduce jobs, YARN (Next Generation Map Reduce), Data locality, Speculative execution	10
UNIT **IV**	**Introduction to Hadoop ecosystem technologies:** Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features	10
UNIT **V**	**Advanced and new technologies architecture discussions:** Spark, Storm (Real time data streaming), Cassandra (NOSQL database), Mongo DB (NOSQL database), Scala, Cloudera, Hortonworks, mapR, Amazon EMR (Distributions)	10

TEXTBOOKs/REFERENCES
1. Tom White,"Hadoop: The Definitive Guide", O' Reilly, 4th Edition, 2015. 2. Mohammed Guller, Big Data Analytics with Spark, Apress, 2015 3. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012 4. Chuck Lam, "Hadoop in Action", Manning Publications, 2010. 5. Seema Acharya, Subhashini Chellapan, "Big Data and Analytics", Wiley, 2015

COURSE OUTCOME	At the end of the course the students will be able to: 1. Analyze the Big Data using Map-reduce programming in Both Hadoop and Spark framework. 2. Develop Big Data solutions using Hadoop Framework and its ecosystems. 3. Design and implement different frame work tools by taking sample data sets. 4. Program and develop efficient algorithms to analyze live streaming data using Spark, also data from high volumes.

COURSE CODE	CSE08503	
COURSE TITLE	**Artificial Neural Network**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	ProgramElective Course	
COURSE OBJECTIVE	The objective of the course is to enable students to comprehend, design, and apply neural network models effectively. This includes gaining an understanding of the fundamental principles of neural networks, their various architectures, and the mathematical foundations that underlie their functioning. Students will also learn to implement and train neural networks for tasks like classification, regression, and sequence modeling under different application areas.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to Neural Networks** Overview of neural networks and their historical context, Biological inspiration: neurons and synapses, Perceptrons and the basic building blocks of artificial neurons, Activation functions and neural network architectures, Forward and backward propagation algorithms	5

UNIT **II**	**Feedforward Neural Networks** Multilayer feedforward networks, Training algorithms: gradient descent, backpropagation, Weight initialization and regularization techniques, Hyperparameter tuning and optimization, Practical applications: image classification, natural language processing	10
UNIT **III**	**Convolutional Neural Networks (CNNs)** Introduction to CNNs and their architecture, Convolutional layers, pooling layers, and fully connected layers, Object detection and localization with CNNs, Transfer learning and pre-trained models **CNN applications:** image recognition, object detection, and image generation	10
UNIT **IV**	**Recurrent Neural Networks (RNNs)** Introduction to RNNs and sequential data processing, Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) cells, Training RNNs and handling vanishing gradient problem, Applications of RNNs in natural language processing and time series analysis, Sequence-to-sequence models and attention mechanisms	10
UNIT **V**	**Advanced Topics and Applications** Autoencoders and unsupervised learning, Generative Adversarial Networks (GANs), Reinforcement learning and neural network-based agents, Ethical considerations in neural network applications, Current trends and future directions in neural network research	10

TEXTBOOKs/REFERENCES

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, In preparation for MIT Press, Available online: http://www.deeplearningbook.org, 2016

2. Sivanandam, S Sumathi, S N Deepa; "Introduction to Neural Networks", 2nd ed.,TATA McGraw HILL : 2005.

3. S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010

4. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013

5. B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999

6. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand the difference between biological neuron and artificial neuron 2. Understand the application areas of neural networks 3. Understand building blocks of Neural Networks. 4. Develop neural network models and design applications using neural networks.

COURSE CODE	CSE08505	
COURSE TITLE	**Deep Learning**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	ProgramElective Course	
COURSE OBJECTIVE	The objective of the course is to provide students with a comprehensive understanding of advanced neural network architectures and techniques for solving complex problems. This includes delving into deep neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs). The course aims to equip students with the skills to design, train, and optimize deep learning models for tasks such as image recognition, natural language processing, and reinforcement learning.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Deep learning Architecture**: Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications	5
UNIT **II**	**CNN:**ArchitecturalOverview,Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet– Application	10
UNIT **III**	**Transfer Learning:** Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.	10
UNIT **IV**	**Sequential Modelling:** Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.	10
UNIT **V**	**Autoencoder:** Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders.	10

TEXTBOOKs/REFERENCES	
	1. Ian Good fellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016. 2. Michael Nielsen, Neural Networks And Deep Learning, Determination Press, 2015. 3. Pattern Classification-Richard O.Duda, Peter E. Hart, David G.Stork, John Wiley &SonsInc. 4. Cosma Rohilla Shalizi, Advanced Data Analysis from Elementary Point of View, 2015 5. Deng Yu, Deep Learning: Methods and Applications, Now Publishers, 2013 6. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
COURSE OUTCOME	At the end of the course the students will be able to: 1. Apply various deep learning techniques to design efficient algorithms for real-world applications. 2. Recognize the characteristics and understand deep learning models and methodologies that are useful to solve real-world problems using deep nets. 3. Identify and apply appropriate deep learning algorithms for analyzing the data for a variety of problems. 4. Design and implement and compare different deep learning algorithms to test procedures and assess the efficacy of the developed model and gain better results.

COURSE CODE	CSE08507	
COURSE TITLE	**Natural Language Processing**	
NUMBEROF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to equip students with the knowledge and skills necessary to understand, process, and extract meaning from human language using computational techniques. This includes mastering fundamental concepts in text analysis, linguistic feature extraction, and machine learning for language-related tasks. The course aims to empower students to build and apply NLP models for a wide range of applications, including sentiment analysis, language translation, question answering, and chatbot development.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to NLP** Fundamentals of natural language processing, Key challenges and applications, Text preprocessing and tokenization, NLP tools and libraries (e.g., NLTK, spaCy)	5
UNIT **II**	**Text Analysis and Linguistic Features** Part-of-speech tagging and syntactic parsing, Named entity recognition, Sentiment analysis and opinion mining, Feature engineering for text data	10
UNIT **III**	**Language Models and Machine Learning** N-grams and language modeling, Introduction to machine learning for NLP, Text classification and sentiment analysis, Word embeddings and distributed representations	10
UNIT **IV**	**Sequence-to-Sequence Models** Introduction to sequence-to-sequence tasks, Recurrent Neural, Networks (RNNs) and LSTMs, Attention mechanisms and Transformers, Machine translation and text generation	10
UNIT **V**	**Advanced Topics and Applications** NLP for information retrieval and question answering, Named entity recognition in real-world applications, Dialogue systems and chatbots, Ethical considerations and bias in NLP	10

TEXTBOOKs/REFERENCES

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: A Paninian perspective, PHI, 2000
3. Collobert, Ronan, et al. "Natural language processing (almost from scratch." Journal of machine learning research12. Aug(2011): 2493-2537
4. Manning, Christopher D., and Hinrich Schutze.. Foundations of Statistical natural language processing. MIT press, 1999

COURSE OUTCOME	At the end of the course the students will be able to: 1. Encompass a deep understanding of the foundational principles and techniques in NLP, including text analysis, syntax, and semantic processing. 2. Develop proficiency in applying machine learning and deep learning methods to solve complex language-related tasks such as sentiment analysis and machine translation. 3. Design and implement NLP models for real-world applications, fostering skills in natural language understanding and generation. 4. Address ethical considerations, biases, and challenges in NLP, contributing to responsible and innovative advancements in the field.

COURSE CODE	CSE08509	
COURSE TITLE	**Research Methodology and Intellectual Property Rights**	
NUMBER OF CREDITS	**2**	**(L: 2, T: , P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to familiarize students with the different aspects of research into good scientific writing and proper presentation skills for an understanding of philosophical questions behind scientific research. Also, to provide a brief background on the historical legacy of science for an insight of the nature of Intellectual Property and new developments in IPR.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Science / Engineering and Research, Research ethics. Meaning of research problem, Basic steps of doing research, Sources of research problem, Criteria Characteristics of a good research problem, formulation of research problem. Approaches of investigation of solutions for research problems, data collection, analysis, interpretation.	5
UNIT **II**	Significance and purpose of literature review, Effective literature studies approaches, Elements in a Literature Review .	10
UNIT **III**	Writing scientific reports, structure and components of research reports, revision, writing project proposals, writing a research paper. Citation and impact factor, Indexing-science citation index(SCI), science citation index expanded(SCIE), scopus. H-index, i-index.	10

UNIT **IV**	Plagiarism, forms of plagiarism, ways to avoid plagiarism, Intellectual Property, Types of intellectual property, Copyright, Patents, Process of Patenting.	10
UNIT **V**	Intellectual property rights, Patent Rights, Scope of Patent Rights, Licensing and transfer of technology. Patent information and databases. Geographical Indications. New developments in IPR.	10

TEXTBOOKs/REFERENCES

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 ndEdition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand research problem formulation and analyze research related information and follow research ethics 2. Understand that today's world is controlled by computer , information technology but Tomorrow's world will be ruled by ideas, concepts and creativity 3. Understand that IPR would take such important place in growth of individuals and nation , it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general and Engineering 4. Understand the nature of Intellectual Property and IPR in International Scenario

COURSE CODE	CSE05511
COURSE TITLE	**Dissertation - I**
NUMBER OF CREDITS	**12**
COURSE CATEGORY	**Project**
COURSE OBJECTIVE	The objective of the course is to onboard the students for a research skill development providing sufficient hands-on learning related to the technical reviews of literatures, research problem scope definition and finding, topic modeling and methodology reviews along with the understanding of the various tools and techniques for an ethical practice measure in research and methodology selection process.

COURSE CONTENT

1. Introduction to the objective of a quality technical research in the field of computer science, Computer Engineering and Computer Applications and in other related interdisciplinary domains.
2. Definition and motivation in order to encapsulate different types of research approaches involving various steps in the research process
3. Understanding of the criterion of a good research through the knowledge of ethical practices in research formulation and literature reviews
4. Problem definition through the understanding and critical reviews of the state of art for the selection of a good research question
5. Research design and methodology selection for a quality research involving good practices in the design process and selection of appropriate tools and technology involved.

COURSE OUTCOME	At the end of the course the students would be able to: 1. Understand different aspects of a systematic and procedural research through deeper insight into current research and development work 2. Review literature in the respective domains with a holistic view of critical and independent identification of various problems and complex issues 3. Formulate strategies for methodology selection and organization of the key aspects of the findings 4. Arrive at a conclusion in terms of methodology selection and presentation along with the review of literature and patents in the form of a concise synopsis turned in to report: **Dissertation I**.

TENTH SEMESTER

COURSE CODE	CSE05502
COURSE TITLE	**Dissertation - II**
NUMBER OF CREDITS	**20**
COURSE CATEGORY	**Project**
COURSE OBJECTIVE	The objective of the course is to further let the students dive deep into the studies and critical reviews for a research outcome development providing sufficient hands-on learning related to methodology development with constraints definition, results generation through requirements analysis of the core the tools and techniques sought as well as feasibility testing through data understanding and evaluation of the results for a technical presentation of the key findings.

COURSE CONTENT

1. Data preparation through the collection and selection in terms of their origin from the primary of secondary sources with methods involved for processing and classification and the use of various statistical measure for the desired analysis.
2. Understanding of the induction and deduction in the research design process and the formulation of hypothesis & testing in the relevant areas of research either qualitative or quantitative.
3. Evaluation of the types of probable hypothesis involved and testing of the hypothesis for improved decision making with error types evaluation and appropriate receiver operating characteristics measures
4. Design, implementation and test procedures for evaluation of results over the selected measure and technological interventions, programming and methods involved
5. Analysis and synthesis of the of research outcomes in the form of a technical document of the relevant findings with literature comparison generation overview

COURSE OUTCOME	At the end of the course the students would be able to: 1. Distinguish research methods for a suitable choice of method in their topic of research through reasonable assumptions and constraints. 2. Able to prepare effective design/simulation paradigm through the reasonable choice of the tools and techniques in their design of experiments. 3. Able to analyze data and set up experiments and perform iterations according to the theoretical background of the topic to conclude research and explain the trends. 4. Synthesize and document the results, arrive at a scientific conclusion and present the same in the form of a technical report: **Dissertation II** and publish in international conferences/journals.

MINOR SPECIALIZATION COURSES (MSC)

COURSE CODE	CSE02410	
COURSE TITLE	**Virtual and Augmented Reality**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Program Elective Course	
COURSE OBJECTIVE	The objective of the course is to provide students with a thorough understanding of the principles, technologies, and applications of virtual reality (VR) and augmented reality (AR). This includes gaining knowledge about the hardware and software components, development techniques, and interaction design specific to VR and AR systems. The course aims to prepare students to create immersive and interactive experiences in both virtual and augmented environments, catering to various domains such as gaming, education, training, and industry.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to VR and AR** Overview of virtual reality (VR) and augmented reality (AR), Historical development and applications, Hardware and software components, Human-computer interaction principles	
UNIT **II**	**VR Technology and Development** Immersive VR environments and displays, 3D modeling and content creation for VR, Interaction devices and tracking systems, VR software development platforms (e.g., Unity, Unreal Engine)	
UNIT **III**	**AR Technology and Development** Overlaying digital information on the real world, Marker-based and markerless tracking, Mobile AR development (e.g., ARKit, ARCore), Creating AR applications for smartphones and wearables	
UNIT **IV**	**Applications of VR and AR** VR and AR in gaming and entertainment, Training and simulation in various industries, Medical, educational, and architectural applications, Enterprise and marketing use cases	
UNIT **V**	**Ethical and Future Considerations** Ethical and privacy concerns in VR and AR, Social and psychological implications, Emerging trends and future directions, Challenges and opportunities in VR and AR technology	

TEXTBOOKs/REFERENCES

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
5. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
6. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
7. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Encompass a deep understanding of the core principles and technologies behind VR and AR systems, allowing students to design immersive experiences. 2. Proficient in developing VR and AR applications, including 3D modeling, content creation, and interaction design, fostering practical skills in creating interactive digital environments. 3. Apply VR and AR solutions across diverse fields, from gaming and entertainment to education, healthcare, and industrial training. 4. Possess the knowledge to critically assess and address ethical and societal considerations in VR and AR, contributing to responsible and innovative use of these technologies.

COURSE CODE	CSE02212	
COURSE TITLE	**COMPUTER GRAPHICS**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 1 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to provide the students with a comprehensive understanding of the principles and techniques involved in creating, manipulating, and rendering visual images using computers where the students will learn the fundamentals of graphics programming, 2D and 3D graphics rendering, and techniques for creating realistic and interactive graphical simulations. The course also aims to equip students with the skills necessary to develop computer graphics applications, ranging from video games and animation to scientific visualization and virtual reality.	

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to Computer Graphics** Fundamentals of computer graphics, Hardware and software components, Graphics pipeline and rendering process, Basics of 2D and 3D graphics	
UNIT **II**	**Graphics Programming** Graphics libraries and APIs (e.g., OpenGL, DirectX), Coordinate systems and transformations, Drawing basic shapes and lines, Color models and shading techniques	
UNIT **III**	**3D Graphics and Rendering** 3D modeling techniques and primitives, Lighting and shading models, Texture mapping and materials, Rendering algorithms and techniques	
UNIT **IV**	**Animation and Interactive Graphics** Keyframe animation and interpolation, Particle systems and physics-based animation, User interaction and event handling, Developing interactive graphics applications	
UNIT **V**	**Advanced Topics and Applications** Ray tracing and global illumination, Computer graphics in virtual reality (VR) and augmented reality (AR), Computer-aided design (CAD) and scientific visualization, Graphics in gaming and entertainment	

TEXTBOOKs/REFERENCES

1. Donald Hearn, M. Pauline Baker, Computer Graphics, 2nd edition, C version, Prentice Hall, 1996.
2. James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics : Principles & Practices, Addison Wesley Longman, 2nd edition in C, 1994
3. Computational Geometry Algorithm Library (CGAL): http://www.cgal.org
4. M. de Berg, M. Van Kreveld, M. Overmars, and O. Schwarzkopf, Computational Geometry: Algorithms and Applications (3rd Edition), Springer, 2008.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Understand the basics of computer graphics, different graphics systems as well as various algorithms for object filling and comparative analysis 2. Use of geometric transformations on graphics objects and clipping methods to graphic display device 3. Explore projections and visible surface detection techniques for display of 3D scene on 2D screen using OpenGL 4. Render projected objects to naturalize the scene in 2D view and use of illumination models

COURSE CODE		
COURSE TITLE	**INTRODUCTION TO CYBER SECURITY**	
NUMBER OF CREDITS	**3**	**(L: 3, T: 0, P: 0)**
COURSE CATEGORY	Professional Elective Course	
COURSE OBJECTIVE	The objective of the course is to make the students aware of the various types of cyber-attacks and cyber-crimes and learn threats and risks within the context of cyber security. The course also emphasizes on the overview of the cyber laws & concepts of cyber forensics in the study of the defensive techniques against these attacks	
COURSE CONTENT		
UNIT	**CONTENT**	**HRS**
UNIT **I**	**Introduction to Cyber Security:** Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats- Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.	
UNIT **II**	**Cyberspace and the Law** Introduction, Cyber Security Regulations, Historical background of Cyber forensics, The Need for Computer Forensics, Cyber Forensics, Challenges in Computer Forensics	

UNIT **III**	**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones	
UNIT **IV**	**Cyber Security: Organizational Implications:** Introduction, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations	
UNIT **V**	**Privacy Issues: Basic Data Privacy Concepts:** Data Privacy Attacks, Data linking and profiling, privacy in different domains- medical, financial, etc Cybercrime: Examples and Mini-Cases Financial Frauds in different domains.	

TEXTBOOKs/REFERENCES

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018
3. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
4. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Analyze and evaluate the cyber security needs of an organization. 2. Understand Cyber Security Regulations and Roles of International Law. 3. Design and develop a security architecture for an organization. 4. Understand fundamental concepts of data privacy attacks

COURSE CODE	CSE02324	
COURSE TITLE	NETWORK AND SYSTEM SECURITY	
NUMBER OF CREDITS	**4**	**(L: 3, T: 1, P: 0)**
COURSE CATEGORY	Professional Core Course	

COURSE OBJECTIVE	The objective of the course is to impart among the students the fundamental principles of information security followed in the real world where the students will systematically explore the potential security vulnerabilities in the modern systems and networks and will have an understanding in identifying, assessing, and mitigating security threats and vulnerabilities. Also the students will delve into the principles and practices of securing computer systems and operating systems with a discussion of the state-of-the-art countermeasures against attacks exploiting these vulnerabilities.

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	**Introduction to Network and System Security:** Fundamental Security Concepts, Security Threats and Vulnerabilities, Security Terminology, Security Models, Security Principles,	
UNIT **II**	Security Standards and Regulations, Security Technologies, Security Risk Assessment, Security Policies and Procedures, Ethical and Legal Aspects of Security, Emerging Trends in Security. Foundations of Information Security:Symmetric Key, Cryptography, Asymmetric Key Cryptography	
UNIT **III**	**Network Security:** Key Distribution, Access Control, Transport-Level Security (HTTPS, SSH), Wireless Network Security, Electronic Mail (Email) Security, Internet Protocol Security (IPSec), Virtual Private Network (VPN), Firewall, Network Intrusion Detection	
UNIT **IV**	**System Security:** Malware, Program Analysis, Penetration Testing, Embedded System and Hardware Security	
UNIT **V**	**Security of Evolving Technologies:** Software-Defined Networking, Security, Cloud Security, Adversarial Machine Learning, Security of Internet of Things (such as Smart Home), Security of Cyber-Physical Systems (such as Cars and Drones), Anonymous Communication Networks (such as Tor), Peer-to-Peer Communication and Payments (such as Bitcoin)	

TEXTBOOKs/REFERENCES

1. "Computer Security: Principles and Practice" by William Stallings and Lawrie Brown.
2. "Network Security Essentials: Applications and Standards" by William Stallings.
3. "Firewalls and Internet Security: Repelling the Wily Hacker" by William R. Cheswick and Steven M. Bellovin.
4. "Security in Computing" by Charles P. Pfleeger and Shari Lawrence Pfleeger.
5. "Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne.
6. "Hacking: The Art of Exploitation" by Jon Erickson.
7. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto.
8. "CISSP All-in-One Exam Guide" by Shon Harris and Fernando Maymí.
9. Online resources, industry publications, and security blogs for staying updated on emerging trends.

COURSE OUTCOME	At the end of the course the students will be able to: 1. Define key security concepts and terminology and the importance of security in computer networks and systems. 2. Identify common security threats and vulnerabilities and explain network security protocols and encryption. 3. Implement, analyze and configure firewalls and intrusion detection systems, network based attacks to manage secure operating system environments. 4. Apply access control and authentication mechanisms as well as implement security patches and updates.

COURSE CODE	CSE02417	
COURSE TITLE	**Distributed Systems**	
NUMBEROF CREDITS	**3**	**(L: 3, T:0 , P: 0)**
COURSE CATEGORY	Program Elective Course	

COURSE OBJECTIVE	The objective of the course is to introduce to the students the principles and foundations on which the Internet and other distributed systems are based and application of different approaches for supporting distributed system applications. Also, analyze the sharing of data in a distributed environment using various distributed algorithms.

COURSE CONTENT

UNIT	CONTENT	HRS
UNIT **I**	Introduction to Distributed Systems : Goals of Distributed Systems, Hardware and Software concepts, the client server model, Remote procedure call, remote object invocation, message and stream oriented communications.	5
UNIT **II**	Process and synchronization in Distributed Systems : Threads, clients, servers, code migration, clock synchronization, mutual exclusion, Bully and Ring Algorithm, Distributed transactions.	10
UNIT **III**	Consistency, Replication, fault tolerance and security : Object replication, Data centric consistency model, client-centric consistency models, Introduction to fault tolerence, process resilience, recovery, distributed security architecture, security management, KERBEROS, secure socket layer, cryptography	10
UNIT **IV**	Distributed Object Based and File Systems : CORBA, Distributed COM, Goals and Design Issues of Distributed file system, types of distributed file system, sun network file system.	10
UNIT **V**	Distributed shared memory, DSM servers, shared memory consistency model, distributed document based systems : the world wide web, distributed coordination based systems: JINI Implementation: JAVA RMI, OLE, ActiveX, Orbix, Visbrokes, Object oriented programming with SOM	10

TEXTBOOKs/REFERENCES

8. Distributed Systems, Concepts and Design, George Coulouris, J Dollimore and Tim Kindberg, Pearson Education, Edition. 2009.
9. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.
10. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor & Fransis Group, 2007
11. Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, PHI
12. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore,Tim Kindberg, Pearson
13. Distributed Operating Systems by Andrew S Tannebaum, Pearson 4. Distributed Computing by Sunita Mahajan & Seema Shah OXFORD
14. Distributed Systems: Principles and Paradigms by Andrew S Tanebaum, Maarten Van Steen, PHI
15. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition, Hagit Attiya and Jennifer Welch, Wiley Indi

COURSE OUTCOME	At the end of the course the students will be able to : 1. Understand the design principles in distributed systems and the architectures for distributed systems. 2. Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, voting etc. 3. Analyze fault tolerance and recovery in distributed systems and algorithms for the same. 4. Assess and implement the design and functioning of existing distributed system algorithms and file systems over current distributed platforms