Academic Programme Guide
of
Integrated Bachelor of Engineering - Master of Engineering
(Computer Science and Engineering)

Based on Choice Based Credit System (CBCS)/Elective Course System

CHITKARA UNIVERSITY
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w.e.f.
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1. General Information

Computer Science and Engineering is an evolving stream that is directly or indirectly affecting all other disciplines. Computers are becoming ubiquitous, appearing in a variety of forms in homes, industries and academia. This stream involves modelling of all other engineered, natural, and human systems.

The five-year Integrated B.E.-M.E. (CSE) Program is designed to provide conceptual knowledge of core courses in the field of Computer Science and Engineering. Various courses offered are in the areas of programming languages, database management, computational complexity theory, software engineering, algorithms, system architecture, operating system and many more. The program will emphasize on teaching fundamentals of basic courses along with the practical applications. Apart from core courses, students will be offered discipline electives and specialization elective courses in a view to provide in-depth knowledge and encourage research in integrated areas. In project courses, students are required to give practical shape to the concepts they have learned in various courses. Besides above, the students must complete one-semester training/internship in the final academic year, towards the fulfilment of degree requirements.

1.1 Programme Educational Objectives (PEO)

PEO 1. To use Computer Science and Engineering principles for solving complicated engineering problems.

PEO 2. To effectively communicate for working autonomously and productively in multi-disciplinary teams.

PEO 3. To gain extra information and abilities via continuous enlightenment.

PEO 4. To have a significant impact on finding long-term remedies for environmental and social problems.

1.2 Programme Outcomes (PO)

The department expects graduating students to be able to demonstrate the following outcomes. The students are expected to be able to:

PO1. Solve difficult engineering challenges by integrating your background in mathematics, physics, the basics of engineering, and your area of engineering expertise.

PO2. Recognize difficult engineering issues, create solutions, and evaluate alternatives utilizing fundamental principles in mathematics, the natural sciences, and engineering sciences.

PO3. Make sure public health and safety, as well as cultural, socioeconomic, and environmental factors are taken into account while designing solutions for complex engineering challenges and make sure system components or processes match the required demands.

PO4. Valid findings should be reached by using research-based knowledge and research procedures, such as experimental design, data analysis and interpretation, and synthesis.

PO5. Develop, evaluate, and implement novel approaches, materials, and state-of-the-art engineering and information technology (IT) tools, including forecasting and modeling, for challenging engineering tasks while being cognizant of their constraints.

PO6. Evaluate the impact on society, health, safety, law, and culture, as well as the resulting obligations, of professional engineering practice using reasoning based on this contextual knowledge.
PO7. Demonstrate an awareness of, and commitment to, sustainable development by comprehending the repercussions of professional engineering solutions within social and environmental frameworks.
PO8. Employ moral reasoning, and pledge allegiance to the engineering profession's code of ethics, obligations, and standards.
PO9. Ability to work well both alone and as a team member or leader in interdisciplinary and culturally diverse contexts.
PO10. Comprehend and create effective reports and design documentation, give and receive clear directions, and give and receive effective presentations are all examples of how to communicate successfully on complicated engineering operations with the technical community and society at large.
PO11. Prove one well-versed in engineering and management concepts and able to use them in one's own work, as a team member or leader, in the management of projects, and in the context of interdisciplinary settings.
PO12. Understand the significance of lifelong learning in the context of rapid technological advancement, and be self-motivated to pursue it.

1.3 University Vision and Mission

Vision:

To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.

Mission:

M1. To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.
M2. To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.
M3. To inculcate high moral, ethical and professional values amongst our students, faculty & staff.
M4. To contribute in building skillful society.

The Programme Educational Objectives (PEOs) of Integrated B.E.-M.E. Computer Science and Engineering programme, are well-designed on the mission of imparting the knowledge and expertise required in the field of Computer Science and Engineering and equip the students with the necessary technical and interpersonal skills for working in industries or to become an entrepreneur.

This programme prepares the students to compete in a global environment with ample opportunities available around different business domains. Every year, faculty from different reputed universities across the globe visit Chitkara University to provide international exposure, cross-cultural competence and knowledge sharing among the students. This programme offers “Engineering Exploration” course to the students which provide an opportunity for students to be aware of the diverse technology that best meets their interest which in turn develops confidence and motivation among the students. To

develop students' personality through community services, NSS activities are offered with the idea of social welfare and to provide service to the society. Variety of extra-curricular activities such as "Algorythm" have been organised every year to enrich student's interpersonal skills. Apart from these, the department in association with various technical societies like IEEE organises industrial visits, technology-focused workshops, technical quizzes, hackathons and coding competitions for overall grooming of the students. Students also participate in sports activities which emphasize good health and their well-being. These activities have been designed taking into account various Programme Objectives like PO3, PO6, PO7, PO8, PO9 and PO10, and have been in accordance with the Programme Educational Objectives (PEO). The programme Integrated B.E.-M.E. Computer Science and Engineering is designed to build innovators, entrepreneurs, leaders, and responsible citizens with the above-mentioned skills and knowledge that will help them to achieve the UN 2030 agenda for sustainable development.

Programme Educational Objectives (PEO) and Programme Outcomes (PO) are designed and oriented to meet the mission of the university. The PEOs ensure that the graduating students are well equipped with strong technical knowledge, excellent communication skills, leadership quality, serving the community and society, helping establish a balanced social and professional environment which in turn transform the society into a knowledgeable and sustainable society.

2. Eligibility for Admission

The student seeking admission in Integrated B.E.-M.E. program should have a minimum aggregate of 60% marks or must have secured 60% in Physics, Chemistry and Mathematics in 12th grade. He / She should have appeared in JEE Mains for that admission year. The admission is based purely on merit.

3. Programme Duration

The duration of the Integrated B.E.-M.E. program is five years - divided into 10 semesters. University conducts end term examination at the end of each semester, except in the case of Co-op project at Industry or Internship at Industry, which is evaluated by a jury appointed by the University.

The maximum duration of completion of the degree is 7.5 years.

4. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided into lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is one hour.

Lecture Sessions: Lectures are delivered by traditional - chalkboard method, supplemented by modern Information Communication Technology (ICT) methods. The students are encouraged to ask questions and involve in a group discussion to the extent

allowed by the teacher. In some courses where case study-based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application-oriented analytical problems. The tutorial sessions are very interactive and inculcate problem-solving skills in the students.

Lab/Practical Sessions: During lab/practical sessions, the students work on a prescribed list of experiments and do what they have learnt in the lecture/tutorial sessions.

5. Programme Structure

The various courses prescribed for a Program is categorized in terms of their functional objectives as follows:

Core Courses: Core courses are the foundation courses that cater to develop the breadth of Computer Science stream and also include Humanities, Social Science, Management, Mathematics, Basic Science and Engineering Science courses. Core courses are compulsory and can be offered in any semester during the program tenure provided it meets the pre-requisite requirement. It is divided into these four categories:

a) Humanities, Social Science and Management (HSM)
b) Basic Science (BSC)
c) Engineering Science (ESC)
d) Professional Core (PC)

Elective Courses: The technical courses apart from core courses are offered as electives to the students. These are the professional courses that are offered to students to cover the depth in a specific area of computer science for their employment, research or higher education. It also includes courses from other departments and/or streams. The students may also choose a specialization track to enhance their skills in a particular area and to gain industry exposure. It includes:

a) Professional Electives (PE)
b) Open Electives (OE)

Special Courses (SC):
a) Projects and Co-op project at Industry: These are hands-on courses to apply the knowledge gained through core/elective courses. The students identify their team-mates and work on a unique project. The projects can be suggested by faculty or by students after getting due approval from faculty-in-charge. The projects are allotted to them at the start of the semester. The project statements are made in such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted.

b) Engineering Exploration Courses: Students are given a choice of technical and industry-oriented courses to get the knowledge of new technologies/skills. Students also

have an option of choosing the courses from online platforms like MOOC (NPTEL/SWAYAM).

Model Programme Structure

Semester-1			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Calculus and Statistical Analysis	5-0-0	5
2	Python Basics	5-0-0	5
3	Engineering Exploration-I (Internet of Things)	2-0-0	2
4	Basics of Electronics Engineering	4-0-0	4
5	Basics of Electronics Engineering Lab	0-0-2	1
		18	**17**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Differential Equation and Transformations	5-0-0	5
2	Computer Programming-I	5-0-0	5
3	Computer System Architecture	4-0-0	4
4	Basics of Electrical Engineering	3-0-2	4
5	Human Values and Professional Ethics	0-0-2	1
6	Modern and Computational Physics	4-0-0	4
		25	**23**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Discrete Structures	4-0-0	4
2	Object Oriented Programming	5-0-0	5
3	Introduction to Linux	0-0-4	2
4	Operating Systems	4-0-0	4
		17	**15**

Semester-4			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Introduction to Web Technologies	4-0-0	4
2	Data Structures	4-0-0	4
3	Database Management System	5-0-0	5
4	Engineering Exploration	0-0-4	2
5	Digital Electronics and Logic Design	3-0-0	3
6	Digital Electronics and Logic Design Lab	0-0-4	2
7	Cyber Security	2-0-0	0
		26	**20**
Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Object Oriented Software Engineering	4-0-0	4
2	Advanced Web Programming	4-0-0	4

3	Advance Java Programming	4-0-2	5
4	Engineering Exploration (Getting Started Competitive Programming)	0-0-4	2
5	Design & Analysis of Algorithms	5-0-0	5
6	Integrated Project-I	0-0-4	2
		27	**22**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	OOPS and IT design Concepts	4-0-0	4
2	Front End Development	4-0-0	4
3	Back End Development	4-0-0	4
4	Java Framework	3-0-0	3
5	Full Stack Database Integration	3-0-0	3
6	Principles of Computer Networks	4-0-0	4
7	Principles of Computer Network Lab	0-0-2	1
8	Integrated Project-II (Full Stack Development)	0-0-4	2
9	Modern and Computational Physics (Lab)	0-0-2	1
		30	**26**

Semester-7			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Open Elective-I	3-0-0	3
2	Open Elective-II	3-0-0	3
3	Open Elective-III	3-0-0	3
4	Open Elective-IV	3-0-0	3
5	Professional Electives-I	**	8#
6	Professional Electives-II		
		20	**20#**

Semester-8			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	---	12
2	Professional Electives-III	**	8#
3	Professional Electives-IV		
		---	**20**

Semester-9			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Co-op project at Industry Module-I	- - -	12
		- - -	**12**

Semester-10			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Co-op project at Industry Module-II	- - -	12
2	Research Project Dissertation	- - -	

		- - -	**12**

 # Credits can vary according to student'schoice-based credit system
**** L-T-P will be based on the different electives chosen by the students.**

6. Assessment and Evaluation

The evaluation will be continuous and the weight-age of various components is as given in Tables specified for each type of course. The evaluation of all courses will be detailed in the course handout document prepared by the course coordinator with the approval of Head of the Department. The document will be shared with students before the start of the session.

Evaluation for Core / Elective / Specialization Course:

Courses can be evaluated in one of these three ways depending upon the course					
Component	**Weightage (%)**	**Component**	**Weightage (%)**	**Component**	**Weightage (%)**
Quizzes/Assignments/ Class Tests/Case Studies	10	Formative Assessments (FAs)	20	Sessional Tests (STs)	40
Sessional Tests (STs)	30	Sessional Tests (STs)	30		
End Term Examination	60	End Term Examination	50	End Term Examination	60
Total	**100**	**Total**	**100**	**Total**	**100**

Evaluation components for Theory Courses

There are three Sessional Tests (STs) for all theory papers, the average of the best two are considered. However, the course coordinator, with the approval of Head of the Department may decide the number of STs required for a specific course. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments' (if applicable else weightage is merged in STs) as decided by the course coordinator and Head of the Department and is announced separately for each course.

The evaluation components for Lab Courses have weightage for regular lab performances, internal viva-voce, conducted at the end of the academic semester. The End Term Examination for lab courses includes the conduct of experiments and an oral examination (viva voce).

Lab Courses	
Component	**Weightage (%)**
Lab Performances / File work	40
Internal Viva – Voce	20
End Term	40
Total	**100**

Evaluation Components for Lab Courses

Evaluation for Integrated / Lab Oriented Project Courses:

Project Courses	
Component	**Weightage (%)**
Planning	10
Performance	20
Internal Viva-Voce/Presentation/ Project Report	30
End Term/ Project Display/ External viva-voce	40
Total	**100**

Evaluation Components for Project Courses

Evaluation for Co-op Projects / Industry Oriented Hands-on Experience Courses:

Industry Oriented Specific Courses	
Component	**Weightage (%)**
Employer / Industry Expert Assessment	20
Synopsis	10
Mid Term Evaluation	30
Final Evaluation	40
Total	**100**

Evaluation Components for Skill Oriented Industry Specific Courses

Evaluation for Engineering Exploration Courses: There are two mid-term evaluation and one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of course Expert. It is decided before the commencement of the course and provided prior information to the students.

7. Rules for Attendance

The program being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to a student's interest. Therefore, the University's requirements in this regard are very stringent.

The University expects its students to be regular in attending the classes. 75% attendance (of all held sessions – lectures, tutorials, project work) is compulsory in a course to be eligible to appear for End Term Examination. The students are also encouraged for participation in co-curricular activities and can do so in 25% cushion provided in the attendance requirements. 10% concession in attendance requirements is possible only in case of extreme circumstances and at the sole discretion of the Vice-Chancellor.

8. Grading System

The list of Letter Grades is given below:

% Marks Range of total	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	I	0	Incomplete / Absent

If a student obtains grade P or above, he/she is declared pass in that course. The grade F is equivalent to failing in that course, in which case, the student has to reappear in the end term examination of that course again, whenever its exam is conducted again with the regular examination, after payment of appropriate examination fee. The rules for grading in reappear exam will be applicable as per the examination policy of the University.

If the student is detained from appearing in the end term examination because of the shortage of attendance in the regular semester or is absent at the end term exam, his/her grade in that course is I, till he/she appears again in the end term examination and obtains a new grade.

Calculation of CGPA:

The CGPA (calculated on a 10-point scale) would be used to describe the overall performance of a student (from the semester of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. SGPA will indicate the performance of the student for any particular semester. Formulas for calculation of SGPA and CGPA have been provided as below:

$$SGPA_i = \frac{\sum_{j=1}^{n} C_{ij} G_j}{\sum_{j=1}^{n} C_{ij}} \qquad \boldsymbol{CGPA} = \frac{\sum_{i=1}^{N}\left(\boldsymbol{GPA_i} * \sum_{j=1}^{n} \boldsymbol{C_{ij}}\right)}{\sum_{i=1}^{N}\left(\sum_{j=1}^{n} \boldsymbol{C_{ij}}\right)}$$

Where n = number of courses in the semester; N = number of semesters; $SGPA_i$ = SGPA for the ith semester; C_{ij} = number of credits for the j^{th} course in the i^{th} semester; and G_j = Grade point corresponding to the grade obtained in the j^{th} course.

Example to Understand the Calculation of SGPA:

Suppose a student is registered in four courses 'W', 'X', 'Y' and 'Z' in a particular semester as mentioned below in the Column - I of the table given below. Column - II in the table below depicts the number of credits, which those courses carried. At the end of

the semester, the student was awarded the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Courses in which student registered (Column – I)	Credits (Column – II)	Letter Grade (Column – III)	Grade Value (Column – IV)	Credit Value (Column – V)	Grade Points (Column – VI)
Course W	3	B+	7	3 x 7	21
Course X	3	A	8	3 x 8	24
Course Y	3	A+	9	3 x 9	27
Course Z	2	O	10	2 x 10	20
Total	**11**			**Total**	**92**

Thus, the total SGPA of the student would be

$$SGPA = \frac{Total\ grade\ pts.}{Total\ no.of\ credits} = \frac{92}{11} = 8.36$$

Suppose the SGPA of the student in two successive semesters is 7.0 and 8.0 with respective course credits being 12 and 11, then theCGPA would be

$$CGPA = \frac{7 \times 12 + 8 \times 11}{12 + 11} = \frac{84 + 88}{23} = 7.48$$

9. Promotion and Registration

Any bonafide student, who appears for the examination conducted by the University, shall be promoted to the next higher semester and shall carry forward all course(s) in which he/she is declared fail. The student shall have to pass all papers within the stipulated maximum duration as prescribed by the University to qualify for the award of the degree.

All students are eligible to register for next semester irrespective of the number of backlogs.

A student is not permitted to register in a term if

(a) He/She has dues outstanding to the University, hostel, or any recognized authority or body of the University, or
(b) His/Her grade sheet in his/her immediately preceding term is withheld, or
(c) He/She has been specifically debarred or asked to stay away from that term

Late registration may be granted in case a student fails to register on the stipulated date. Students failing to register on the specified day of registration will be allowed to register only after permission from Head of Department and after paying the stipulated late fee. Any student who has not registered will not be allowed to attend classes.

The registration of the student may be cancelled, if at the later stage, it is found that the student is not eligible for registration due to the following reasons:

(a) If the registration of a student in a course is not found to be as per the regulations, his/her registration in that course will be cancelled and the grade obtained, if any, will be rejected.
(b) The registration of a student in a course or complete set of courses in a term can be cancelled by the concerned authority when he is found guilty in case of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his dues.
(c) Absence for a period of four or more weeks at a stretch during a term shall result in automatic cancellation of the registration of a student from all the courses in that term.

A student who is duly registered in a term is considered to be on the rolls of the university. After registration, if he/she withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the University the loss of time from studies and its consequences cannot be helped by the University.

If for any valid reason a student is unable to register in a term, he/she must seek prior permission of Head of Department to drop the term. If such permission has not been requested or after a request, the permission has been denied, his/her name would be struck off the rolls of the University and he would no longer be a student of the University.His/her case will be automatically processed and the file will be closed. However, if such a student, after his/her name has been struck off the rolls of the University, is permitted to come back, his/her case can be considered at the sole discretion of the competent authority of the University with the provision that all his/her previous records as a former student are revived under the current academic and administrative structure, regulations and schedule of fees.

10. Migration/Credit Transfer Policy

The following procedures will be followed for credit transfer for a student under migration, studied in other Universities in India and Abroad:

"The credits earned by the student from the other universities in India or abroad shall be transferred as such. The Degree shall only be awarded to the candidate subject to the condition that student earned the minimum no. of credit defined by Academic Regulation/APG of the Programme run by the Chitkara University."

In case a student undergoes international exchange programme or internship for 1 semester/ 1 year/ 2 years, then the courses, credits and grades earned by the student in abroad during that period should be reflected on the grade card issued by the Chitkara University. The courses will be marked as (*) on the grade card/transcript. The description of the (*) will be "credits and grades as adopted university/institute name . . . . during the international exchange programme.

In case of availability of seats, a student can apply for branch change. The student shall have to pass all papers of the first year and possess minimum CGPA criteria. Preference will be given to high CGPA.

11. Eligibility to Award the Degree

To be eligible for award of Integrated B.E.-M.E. degree in Computer Science and Engineering, a student must complete all the courses in which he/she has registered with minimum 180 credits and a minimum CGPA of 4.5.

12. Program Overview

Course type	HSM	BSC	ESC	PC	PE	OE	SC	Total
Credits	1	19	19	74	16	12	46	**187**

- The number of courses may vary in a semester based on the choice of electives/specializationcourses.
- Student may earn credits of the eighth and ninth semester by taking co-op training.
- Student can choose additional electives instead of co-op training in the eighth semester.

List of Courses:

Course Code	Course Name	L-T-P	Credits
Humanities, Social Science and Management Courses (HSM)			**1**
CS501	Cyber Security	2-0-0	0
HR101	Human Values and Professional Ethics	0-0-2	1

Basic Science Courses (BSC)			**19**
AM121	Calculus and Statistical Analysis	5-0-0	5
AM122	Differential Equations and Transformations	5-0-0	5
AM103	Discrete Structures	4-0-0	4
PH121	Modern and Computational Physics	4-0-0	4
PH111	Modern and Computational Physics Lab	0-0-2	1

Engineering Science Courses (ESC)			**19**
EC101	Basics of Electronics Engineering	4-0-0	4
EC102	Basics of Electronics Engineering Lab	0-0-2	1
EC105	Digital Electronics and Logic Design	3-0-0	3
EC106	Digital Electronics and Logic Design Lab	0-0-4	2
EE101	Basics of Electrical Engineering	3-0-0	3
EE102	Basics of Electrical Engineering Lab	0-0-2	1
CS104	Computer Programming-I	5-0-0	5

Professional Core Courses (PC)			**74**
CS106	Object Oriented Programming	5-0-0	5
CS107	Object Oriented Software Engineering	4-0-0	4
CS110	Introduction to Linux	0-0-4	2
CS111	Introduction to Web Technologies	4-0-0	4
CS112	Advanced Web Programming	4-0-0	4
CS114	Data Structures	4-0-0	4
CS115	Operating Systems	4-0-0	4
CS116	Database Management System	5-0-0	5
CS118	Computer System Architecture	4-0-0	4
CS122	Design & Analysis of Algorithms	5-0-0	5
CS184	OOPS and IT design Concepts	4-0-0	4
CS145	Front-end Development	4-0-0	4
CS159	Back-end Development	4-0-0	4
CS185	Java Framework	3-0-0	3
CS186	Full Stack Database Integration	3-0-0	3
CST102	Principles of Computer Network	4-0-0	4
CSP102	Principles of Computer Network Lab	0-0-2	1
CS108	Python Basics	5-0-0	5
CS135	Advanced Java Programming	4-0-2	5

Professional Electives (PE)			**16**
a) Data Science			
CS133	Data Visualization and Query Language	2-0-4	4
CS134	Business Analytics	2-0-4	4
CS138	Machine Learning	2-0-4	4
b) Cyber Security			
CS129	Introduction to Cyber Security	2-0-4	4
CS130	Cyber Security for Forensics & Investigation	2-0-4	4
CS131	Malware and Reverse Engineering – I	2-0-4	4
CS132	Malware and Reverse Engineering – II	2-0-4	4
c) Game Development			
GPP101	Fundamentals of Game Programming	2-0-4	4
GPP103	Graphics Programming	1-0-2	2
GPL104	Game Design – BG	1-0-2	2
GPL102	Game Design – 2D & 3D	2-0-4	4
GPP107	Unity Game Development	2-0-4	4
d) Digital Marketing			

CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	2-0-4	4
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4
CS144	Affiliate Marketing and Online Reputation Management (ORM)	2-0-4	4
e) Entrepreneurship Development Program			
EP101	Entrepreneurship and Opportunity	2-0-4	4
EP102	Consumer & Market Research for Entrepreneurs	2-0-4	4
CS142	Search Engine Marketing (SEO&PPC), Web Analysis and Email Marketing & Management	2-0-4	4
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4
g) UI/UX Design			
CS168	UX Design & Digitization	1-0-2	2
CS169	User Interface Design	1-0-2	2
CS170	Empathy & Its Tools	2-0-4	4

Open Elective (OE) Courses			**12**
CS122	Business Intelligence & Data warehousing	3-0-0	3
CS181	Software Quality Assurance and Testing	3-0-0	3
CS249	Cloud Computing and Applications	3-0-0	3
CS245	Big Data Analytics	3-0-0	3
CS256	Ethical Hacking	3-0-0	3
CS162	Full Stack development	3-0-0	3
CS154	Computer Graphics	3-0-0	3
CS243	Artificial Intelligence and Machine Learning	3-0-0	3
CS4003	Network Security	3-0-0	3
CS244	Professional Practices-Coding (Self-Paced)	3-0-0	3
CS257	Agile Methodology (Online Platform: Self-paced)	3-0-0	3
CS183	Lab-Oriented Project (Self-paced)	3-0-0	3

Special Courses (SC)			**46**
a) Project			**40**
CS203	Integrated Project - I	0-0-4	2
CS187	Integrated Project-II (Full Stack Development)	0-0-4	2

CS251	Co-op project at Industry Module I	-	12
CS253	Industry Oriented Hands-on Experience	-	12
CS252	Co-op project at Industry Module II	---	12
CS248	Research Project Dissertation	---	
b) Engineering Exploration			**6**
CS201A01	Engineering Exploration-I(Internet of Things)	0-0-4	2
CS201	Engineering Exploration	0-0-4	2
CS121	Engineering Exploration (Getting Started Competitive Programming)	0-0-4	2

*** Students can also earn these credits by opting co-op training in eighth and ninth semesters**
 # Credits can vary according to student's choice-based credit system

Course Outline

Course Code	Course Name	L-T-P	Credits
ES101	Environmental Sciences	1-0-0	1

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.

CLO.2 Identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming).

CLO.3 Understand and hone skills to the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs.

CLO.4 Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and real-world issues.

CLO.5 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.

Course Outline:

Definition, scope, importance, need for public awareness, natural resources, renewable and non-renewable resources, water resources, ecosystems, biodiversity & its conservation, threats to biodiversity, environmental pollution, disaster management, environment protection acts, welfare program.

Recommended Book(s):

1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, First Edition, University Grants Commission, Universities Press (India) Private Limited.
2. Manish Randhawa, The Basics of Environmental Sciences, Chitkara University publications, First edition
3. R. Rajagopalan, Environment And Ecology – A Complete Guide, Lexis Nexis, First edition
4. Dorothy F. Bourse and Richard T. Wright, Environmental Science: Toward A Sustainable Future, Benjamin-Cummings Pub Co, 13th edition
5. Meg Keen, Valerie A. Brown, Rob Dyball, Social Learning in Environmental Management: Towards a Sustainable Future, Routledge, 1st edition
6. William P. Cunningham and Mary Ann Cunningham, Principles of Environmental Science,McGraw-Hill Science Engineering, 7th edition

Course Code	Course Name	L-T-P	Credits
CS501	Cyber Security	2-0-0	2

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Acquire Information and risk models including confidentiality, integrity and availability
CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities
CLO.3 To gain knowledge on Cyber security architecture and operations
CLO.4 Understand how Cyber security is conceptualized and carried out
CLO.5 Articulate informed opinion about issues related to cyber security

Course Outline:

Introduction to Security, Security principles, threats and attack techniques, Basics of Cryptography, Cryptographic mechanisms, Classical Encryption Techniques, Symmetric and Asymmetric cryptography,Introduction to cybercrime, cybercrime and information security, Classifications of cybercrimes, Cybercrime and the Indian ITA 2000, Cyber offenses, Botnets- The fuel for cybercrime, Phishing, Password cracking, key loggers and SQL injection, attacks on wireless networks, Cost of cybercrimes and IPR issues, lessons for organization, web threats for organization, security and privacy implications from cloud computing, social media marketing, security risks and perils for organizations, social computing and the associated challenges for organizations, protecting people's privacy in the organization, organizational guidelines for internet usage, safe computing guidelines and computer usage policy, incident handling, Cyber Forensics, Best practices for organizations, Media and Asset Protection, Importance of endpoint security in organizations, cybercrime and cyber terrorism, Intellectual property in the cyberspace, the ethical dimensions of cybercrimes, the Psychology, mindset and skills of hackers and other cybercriminals, Cybercrime, Illustrations of financial frauds in cyber domain, digital signature related crime scenarios.

Recommended Book(s):

1. M. Merkow, J. Breithaupt, "Information Security Principles and Practices", Pearson Education, Second Edition"
2. G.R.F. Snyder, T. Pardoe, "Network Security", Cengage Learning, Second Edition
3. Basta, W.Halton, "Computer Security: Concepts, Issues and Implementation, Cengage Learning India", Wiley& Sons Inc, Second Edition
4. William Stallings," Network Security Essentials", Pearson Publication, FourthEdition
5. Bruce Schneier, "Applied Cryptography", Wiley& Sons Inc, Second Edition
6. Network security and Cryptography' by Bernard Menezes, FirstEdition, Cengage LearningPublication.
7. C K Shyamala, N Harin i, Dr T R Padmanabhan, "Cryptography and Network Security:",Wiley India,First Edition
8. Forouzan Mukhopadhyay,"Cryptography and Network Security", MC Graw Hill, SecondEdition.
9. Mark Stamp,"Information Security, Principles and Practice", Wiley India, First Edition

Course Code	Course Name	L-T-P	Credits
HR101	Human Values and Professional Ethics	0-0-2	1

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Get awareness on human values and professional ethics
CLO.2 Understand the core values that shape their ethical behaviour.
CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.
CLO.4 Gain thorough knowledge in the field of human rights and this will add to the academic qualification
CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.

Course Outline:

Concept of human values and value education, aim of education and value education; Evolution of value-oriented, education, Personal development, Self-analysis and introspection; sensitization towards gender equality, physically challenged, intellectually challenged. Respect to - age, experience, maturity, family members, neighbours, co-workers. Social and environmental sensitivity, Principles for Harmony, Customs and Traditions, Aspirations and Harmony (I, We & Nature– Emotional Competencies – Conscientiousness, Trust, respect and harmony – in the family and nature, Duties and Rights, Problem Solving, Value Education and Professional Values– Religious, social and constitutional values, Impact of global development on ethics and values, Conflict of cross-cultural influences, mass media, cross-border education, materialistic values, professional challenges and compromise, Human rights, Indian and International Perspectives, Definitions under Indian and International documents, Human rights of women andchildren andInstitutions forimplementation ofHuman Rights atinternational and national level

Recommended Book(s):

1. S. Dinesh Babu,"Professional Ethics and Human Values", Firewall Media, First Edition
2. R.R. Gaur, R. Sangal, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, First ediion.
3. R.S. Naagarazan, 'Professional ethics and Human values', New Age International Private Limited, First edition
4. Ritu Soryan, Human Values And Professional Ethics (Paperback), S Chand publishing , Fourth edition

Course Code	Course Name	L-T-P	Credits
AM121	Calculus and Statistical Analysis	5-0-0	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.

CLO.2 Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.

CLO.3 Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.

CLO.4 Interpret statistical inference skills with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ appropriate regression models in determining statistical relationships.

CLO.5 Equip with the skills to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.

Course Outline:

Differentiation, matrices, normal form, Eigen values and vectors, partial differentiation & its applications, Euler's theorem, Taylor's series expansion, Maclaurin's series, Lagrange's method of undetermined multipliers, multiple integration & its applications, change of order, change of variables, Beta and Gamma functions, introduction to scalar & vector, Green's theorem, Stokes' theorem, Gauss divergence theorem.

Recommended Book(s):

1. Erwin Kreyszig,"Advanced Engineering Mathematics", Wiley India Pvt. Ltd, Second Edition
2. Srimanta Pal & Subodh C. Bhunia,"Engineering Mathematics", Oxford University Press, First Edition
3. The Engineering Mathematics, Chitkara University Publication, Vol. I. Second Edition,
4. B.V. Ramana, "Higher Engineering Mathematics, Tata McGraw-Hill Education, Third Edition
5. R.K. Jain and S.R.K. Iyengar, " Advanced Engineering Mathematics", , Alpha Science International Ltd.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications.
7. N. P. Bali and Manish Goyal,"A text book of Engineering Mathematics", Laxmi Publications.
8. Vector Analysis with applications, by MD. Ali Ashraf, MD. Abdul Khaleq Hazra, Published by New Age International (New Delhi).
9. Calculus, by Howard Anton, Irl Bivens Stephens Davis.Advanced Engineering Mathematics, H.C. Taneja, I.K. International, Vol I.

Course Code	Course Name	L-T-P	Credits
AM122	Differential Equations and Transformations	5-0-0	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Analyse and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).

CLO.2 Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.

CLO.3 Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.

CLO.4 Analyse functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.

CLO.5 Develop skills required to find the appropriate differential equations that can be used as mathematical models.

Course Outline:

Problems related to Fourier series on arbitrary intervals, Fourier transform, differential equations of first order & first degree, complementary function, Laplace transform, formation of partial differential equations, second order linear partial differential equations, separation of variables, limits, continuity, Cauchy's theorem, Taylor's & Laurent's expansion.

Recommended Book(s):

1. The Engineering Mathematics, , Chitkara University Publication, Vol. II, FirstEdition
2. B V Ramana, Higher Engineering Mathematics, McGraw Hill, Second Edition 2009
3. Dr. H. C. Taneja, Advanced Engineering Mathematics (Vol. I & Vol. II), I K International Publishing House Pvt. Ltd
4. RK Jain, SRK Iyengar," Advanced Engineering Mathematics ", Narosa; 1st edition
5. HK Dass,"Advanced Engineering Mathematics",S Chand; Reprint Edn. 2006 edition.

Course Code	Course Name	L-T-P	Credits
AM103	Discrete Structures	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Apply the knowledge obtained to investigate and solve a variety of live problems related to Sets, Relations and Functions.

CLO.2 Solve real life problems using combinatorics.

CLO.3 Understand and apply the theory and techniques of Lattice, Logic and Boolean algebra

CLO.4 Comprehend Graph Theory and its relevance within the context of computer science and finding solutions of live problems related to shortest path etc.

CLO.5 Able to develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms

Course Outline:

Introducing sets, relations, functions, permutations & combinations, recurrence relation, characteristic polynomial & introduction to generating functions, logic, lattices, Boolean algebra, graph theory, multi-graph, adjacency matrix, complete bipartite graph & spanning graph, Euler's formula & its applications, trees, shortest path algorithm, Warshall's algorithm, Prim's algorithm.

Recommended Book(s):

1. C.L. Liu,"Elements of Discrete Mathematics", McGraw-Hill,Third Edition.
2. Babu Ram, "Discrete Mathematics", Pearson Education India,First Edition
3. Lipschutz Lipson, Schaum series, "Discrete Mathematics, TMH, Second edition,
4. Trembly Grassmann,"Logic and Discrete Mathematics ",Pearson Education, Third Edition
5. The Discrete Mathematics, Chitkara University Publication

Course Code	Course Name	L-T-P	Credits
PH121	Modern and Computational Physics	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Analyse and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.

CLO.2 Should differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.

CLO.3 Should differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.

CLO.4 Should describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.

CLO.5 Develop skills for critical thinking and problem solving involving the various concepts of physics.

Course Outline:

Electrodynamics,Vector and scalar fields, Gradient, divergence, curl, Gauss's theorem and Stoke's theorem, Laser, Laser characteristics such as coherence, monochromaticity, collimated and angular divergence, laser action, stimulatedabsorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser, Semiconductor laser, concepts of Holography, LASER Applications in engineering. Fiber Optics, Basic principle of optical fibre,Parameters of optical fibers, acceptance angle, acceptance cone, numerical aperture, normalized frequency, Attenuation in optical fibers, Magnetic Materials: Terminology and classification, Derivation of Magnetic moments of an atom,Ferromagnetism and related phenomena, Ferrites, The domain structure, The hysteresis loop, Types of magnetic materials, soft magnetic materials, hard magnetic materials, comparison between ferromagnetic and super-paramagnetic materials, applications of magnetic materials in engineering.Superconductivity, Introduction, Meissner effect, critical field, critical current, Isotope effect , Types of superconductors: type I superconductors, type II superconductors, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors. Applications of superconductivity e.g Lavitation Effect, SQUID,Quantum Mechanics, Introduction to Quantum Mechanics, Group velocity and phase velocity, de-Broglie waves, Uncertainty principle, Wave function and its significance, Normalised wavefunction, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equation.

Recommended Book(s):

1. H. K. Malik and A. K. Singh, "Engineering Physics", Mc Graw Hill Education,First Edition
2. Engineering Physics by Chitkara Publication 2nd Edition.
3. Donald A Neamen and Dhrubes Biswas,"Semiconductor Physics and devices", , Mc Graw Hill, Second Edition
4. Practical physics by Squirres , Cambridge University press.

Course Code	Course Name	L-T-P	Credits
PH111	Modern and Computational Physics Lab	0-0-2	1

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.
CLO.2 Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.
CLO.3 Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.
CLO.4 Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.
CLO.5 Possess an ability to evaluate and analyze scientific measurement and error analysis.
CLO.6 Apply the fundamental concepts of physics to related engineering problems.

Course Outline:

Electrodynamics, Gauss's theorem, Stoke's theorem, equation of quantity, Green's theorem, Maxwell's equations, Laser and its types, fiber optics, optical fiber, magnetic materials, ferromagnetism and related phenomena, superconductivity, isotopes, quantum mechanics, wave function, gaming science, basic physics behind flight of drone and GPS navigation.

Recommended Book(s):

1. Engineering Physics by Chitkara Publication 2nd Edition.
2. AK Katiar, C.K Pandey, Engg.Physics Theory and Practicals, Wiley (1 January 2015)
3. Donald A Neamen and Dhrubes Biswas,"Semiconductor Physics and devices",Mc Graw Hill, Second Edition
4. Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K.S Rudramba, Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K.S Rudramba, Engg.Physics Practicals, Laxmi Publications Pvt Ltd, Second edition

Course Code	Course Name	L-T-P	Credits
EC101	Basics of Electronics Engineering	3-0-0	3

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the basic concepts of semiconductor devices for use in electronic circuits.
CLO.2 Gain skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.
CLO.3 Acquire the knowledge of digital logic gates for implementing basic digital circuits.
CLO.4 Recognize the primary functions of integrated circuits such as timer and voltage regulator.
CLO.5 Familiarize with generic IoT device and applications using case studies.

Course Outline:

Atoms & nuclei, semiconductor materials, theory of PN junction diode, V-I characteristics of a PN junction diode, Zener diode, use of diodes in rectifiers, Bipolar Junction Transistor (BJT), operation of NPN and PBP BJT, transistor amplifier, Number systems, binary arithmetic, logic gates, combinational and sequential logic, Boolean algebra, universal gates, flip-flops, integrated circuits, IC 741, Op-amps, IC 555 timer, voltage regulator IC 7805.
AC Analysis of BJT circuits and small signal amplifier - Coupling and bypass capacitors, AC load lines, Transistor models and parameters, Common emitter circuit analysis, common base circuit analysis, common collector circuit analysis, Comparison of CE, CB and CC circuits, Transistor as a switch.

Recommended Book(s):

1. R. Muthusubramanian, S. Sahlivahanan,"Basic Electrical and Electronics Engineering",McGraw Hill, First Edition, 2010.
2. N. N Bhargava, D. C Kulshreshtha, S. C Gupta," Basic Electronics and Linear Circuits", McGraw Hill Publications, Second Edition.
3. D. P. Kothari, I. J. Nagrath," Basic Electronics", McGraw Hill, Second Edition.
4. D. K. Bhattacharya, Rajnish Sharma, "Solid State Electronic Devices", Oxford University Press", Second Edition.
5. Albert Malvino, David J. Bates," Electronic Principles" Mcgraw Hill Education, Seventh Edition.

Course Code	Course Name	L-T-P	Credits
EC102	Basics of Electronics Engineering Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the basics of electronics elements, their functionality and applications.

CLO.2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.

CLO.3 Analyze and characterize the electronic circuits and have basic understanding for their implementation.

CLO.4 Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.

CLO.5 Gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.

Course Outline:

Familiarization with basic electronic components and measuring instruments, Plot and analyze the forward and reverse characteristics of PN junction Si / Ge diode and determine the knee voltage, Analyze Zener diode as voltage regulator and observe the output voltage with variable input voltage and fixed load resistance for zener diodes with different breakdown voltages, Study and observe the output waveform of half-wave and full wave rectifiers on CRO and calculate the average and rms values of output voltage, Analyze the NPN / PNP transistors in common emitter configuration and plot their input and output characteristics, Analyze the truth tables of various basic digital gates and implement 2-input XOR and 2-input XNOR gate using basic gates, Study the operation of astable, monostable and bistable multivibrators using IC-555 timer, Plot and analyze the V-I characteristics of light emitting diode in forward biasing, Plot and analyze the V-I characteristics of Photodiode, Analyze the varactor diode by applying reverse voltage for corresponding change in capacitance across PN junction. Plot the graph between applied reverse voltage (Vr) and capacitance (C).
To plot V-I Characteristics of Silicon and Germanium P-N Junction Diodes. To find cut-in voltage for Silicon and Germanium P-N Junction diodes. To find static and dynamic resistances in both forward and reverse biased conditions.

Recommended Book(s):

1. R. Muthusubramanian, S. Sahlivahanan," Basic Electrical and Electronics Engineering", McGraw Hill, First Edition.
2. D. P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill, Second Edition.
3. B.R. Patil, "Basic Electrical and Electronics Engineering", Oxford Higher, Education Revised Second Edition.
4. T.K Nagsarkar & M.S Sukhija,"Basic Electrical Engineering",Oxford, Second Edition.
5. D.C, Kulshreshtha, "Basic Electrical Engineering ", TMH, First Edition.

Course Code	Course Name	L-T-P	Credits
EC105	Digital Electronics and Logic Design	3-0-0	3

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Recognize the underlying differences between analog and digital systems, and interconversion between the two.

CLO.2 Understand and apply mathematical skills to solve digital design problems involving Boolean logic.

CLO.3 Realize the underlying differences between combinational and sequential circuits.

CLO.4 Understand and apply the design methodologies skills for implementing combinational and sequential circuits.

CLO.5 Realize the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

Introduction to Digital and Analog systems, logic levels & Pulse waveform, Logic Gates, Number systems, Representation of signed numbers, Classification of binary codes, 8421 BCD code, Excess three code, Gray code, Parity and checksum, Boolean algebra and De Morgan's Theorem, Boolean Functions and their representation, canonical forms. Karnaugh map (upto 5 variable), Q-M method, Digital IC families (DTL, TTL, ECL, MOS and CMOS), Logic families, Combinational circuit, Multiplexer and Demultiplexer, Encoder and Decoder, Code Converters, Parity bit generators and checkers, Sequential circuits, Flip flops SR, JK, T, D, Race around condition and Master slave flip flops, Shift Registers, Counters, D/A and A/D converters, Semiconductor Memories, SRAM and DRAM, Programmable Logic Devices, ROM, PAL, PLA, PROM.

Recommended Book(s):

1. Anand Kumar, "Fundamentals of digital circuits", Pearson publication, ThirdEdition,
2. Thomas L. Floyd, 10th Edition, Digital Fundamentals, Pearson Publications, First EDITION
3. M. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd., New Delhi, Sixth impression /Pearson Education (Singapore) Pvt. Ltd., New Delhi, Fourth Edition
4. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003, FifthEdition

Course Code	Course Name	L-T-P	Credits
EC106	Digital Electronics and Logic Design Lab	0-0-4	2

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the digital logic and create various systems by using these logics
CLO.2 Develop an understanding of design and simulation of digital logic circuits
CLO.3 Get a basic understanding of layout of electronic circuits
CLO.4 Practical implementation of design methodologies skills for implementing combinational and sequential circuits.
CLO.5 Implenetation of the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

Logic gates, design circuit using universal gates, 1-bit half-adder, 1-bit full-adder, 4-bit full-adder, comparator, convertor, combinational circuit, registers, data transfer, SISO, SIPO, PISO, PIPO, LED 7-segment, sequencer.

Recommended Book(s):

1. Lab Manual prepared by faculty of ECE.
2. Anand Kumar, “Fundamentals of digital circuits”, PHI, Third Edition,
3. Thomas L. Floyd, “Digital Fundamentals”, Pearson Publications, Tenth Edition.
4. M. Morris Mano, “Digital Design”, Prentice Hall of India Pvt. Ltd., New, Fourth Edition.
5. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003, Fifth Edition

CourseCode	CourseName	L-T-P	Credits
EE101	BasicsofElectricalEngineering	3-1-0	4

CourseLearningOutcomes:

Students will be able to:

CLO.1 Understandandanalysetheconceptsof DCcircuits

CLO.2 UnderstandACcircuitsandtheirpowermeasurements

CLO.3 Understandfundamentalprinciplesofmagneticeffects,magnetismandthei rapplicationinelectricalmachines.

CLO.4 Understandthebasicknowledgeoftransducersandmeasuringinstrume nts

CLO.5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices

CourseOutlines:

DCCircuitsand relatedterminology,SeriesandParallel combinationofresistances,Kirchhoff's Laws: KVL and KCL, Mesh or loop Analysis and Nodal Analysis, MagneticCircuits, Comparison between Electric and Magnetic circuits, Magnetic Effect of ElectricCurrent, Law of EMI, Induced EMF, AC circuits, Concept of 3phase EMF generation,AnalysisofACcircuits,RL,RC,RLCseriescircuitsanditsPowercalculatio ns,Resonance in series AC circuits, Three Phase AC circuits, Star and Delta connections,Electrical Machines, Transformer, DC Motor, Three Phase Induction Motors,Electricalmeasuringinstrumentsandtransducers,LVDT,RTD,Thermocoup le,Thermistor,Piezoelectrictransducer,Photoelectrictransducer.

Recommended Book(s):

1. Muthusubramanian, R. (2009). Basic ElectricalandElectronicsEngineering. McGraw Hill Education.
2. Patil, B.R. (2016). Basic Electrical and Electronics Engineering. (2nd ed). Oxford Higher Education.
3. Nagsarkar, T.K. & Sukhija, M.S. (2017). Basic Electrical Engineering Oxford. (2nd ed). Pearson.
4. Kulshreshtha, D.C. (2015). Basic Electrical Engineering.TMH. First edition.

CourseCode	CourseName	L-T-P	Credits
EE102	BasicsofElectricalEngineeringLab	0-0-2	1

CourseLearningOutcomes:

Students will be able to:

CLO.1 Knowthebasicscomponentsofelectricalelements,equipmentandtheirfunctionalitywithapplications.

CLO.2 Possessanabilitytoanalyzeandcharacterizetheelectricalequipment'sandinstruments basicsfortheirimplementation

CLO.3 Measurepowerandpowerfactorofaccircuitsandunderstand three-phasestaranddeltaconnectionswithandwithoutapplyingloadstocalculate3-phasepower.

CLO.4 PossessanabilitytoperceivetheconceptofFuse/MCBcharacteristicsfordifferentfault currents.

CLO.5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices

CourseOutlines:

To study the use of multi-meter and testing of various components. Verification of Kirchoff's Laws i.e KCL and KVL in DC circuits. Analysis of AC circuits. To verify the relation between line and phase quantities in three phase circuits. Measurement of self-inductance, mutual inductance and coupling coefficient of windings. To study speed control of the D.C. shunt motor. Measurement of temperature using RTD. Measurement of displacement using LVDT.

Recommended Book(s):

1. Muthusubramanian, R. (2009). Basic ElectricalandElectronicsEngineering. McGraw Hill Education.
2. D.C,Kulshreshtha. (2014). BasicElectricalEngineering.McGraw Hill Education.
3. Rao, Uma (2017). Basic Electronic Dreamtech Press.
4. Patil, B.R. (2016). Basic Electrical and Electronics Engineering. (2nd ed). Oxford Higher Education.

CourseCode	CourseName	L-T-P	Credits
CS104	ComputerProgramming–I	5-0-0	5

CourseLearningOutcomes:

Students will be able to:

CLO.1 Analyze theproblemstatement.

CLO.2 ChoosetheappropriateCprogrammingconstructstosolvetheproblems.

CLO.3 Demonstratetheadvantagesanddisadvantagesofspecifictechniquestobeused.

CLO.4 Differentiatebetweenefficientandinefficientwayofprogramming skills.

CLO.5 Determineanddemonstratebugsinaprogramandrecognizeneededbasicoperations.

CLO.6 Formulatenewsolutionsforprogrammingproblemsorimproveexistingco detoprogrameffectively.

CourseOutlines:

Introductiontoproblemsolvingtechniques,flowchart,algorithm,introductiontoC,Structure of a C program, compilation, linking, execution, comments in C, pre-processordirectives, data types, variables, identifiers, constants, operators, control structures, loops,functions & pointers, call by value, call by reference, storage classes, arrays, dynamicmemoryallocation,2-Darrays,arrays&pointers,strings,structure&union.

Recommended Book(s):

1. Thareja, Reema (2016). Programming in C (2nd ed). Oxford University Press.
2. Kernighan, Brain W. & Ritchie, Dennis (2014). The C Programming Language. (2nd ed). Pearson.
3. Schildt, Herbert (2015).The Complete Reference (4th ed), McGraw Hill Education.
4. Kamthane, (2014). Programming in C (3rd ed), Pearson.

Course Code	Course Name	L-T-P	Credits
CS106	Object Oriented Programming	5-0-0	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Implement the concept of object-oriented techniques and methodologies using Java
CLO.2 Use Exception Handling concepts and skills for a Robust Application in Java.
CLO.3 Demonstrate an understanding of Java Input and Output
CLO.4 Develop applications using multithreading concept of Java.
CLO.5 Use and Implement several Data structures using Collection Framework
CLO.6 Use database connectivity for a complete Java application.

Course Outline:

Introduction to object-oriented programming, benefits and applications of OOP,class and objects, methods, constructors, inheritance, polymorphism, abstract class and methods, encapsulation, static and dynamic binding, Java basics, control statements, looping constructs & arrays, working with arrays, strings, packages & interfaces, strings & StringBuilder, exception handling, IO streams, multithreading, synchronization, generics, generic interface, collection framework, stack, queue, linked list, sets, JDBC connectivity.

Recommended Book(s):

1. Schildt, Herbert, and Danny Coward, “Java: the complete reference. New York: McGraw-Hill Education”, Ninth Edition
2. Sierra, Kathy, and Bert Bates,” Head first java”, " O'Reilly Media, Inc.", Third Edition
3. Herbert Schildt, “Java:The Complete Reference”, Seventh Edition
4. OCA Java SE8 Programmer I Study Guide by Edward G. Finegan, Oracle Press

Course Code	Course Name	L-T-P	Credits
CS107	Object Oriented Software Engineering	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.

CLO.2 Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CLO.3 Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.

CLO.4 Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

CLO.5 Learn and understand various object oriented concepts along with their applicability contexts

Course Outline:

Software engineering concepts, software development life cycle, software process models, modeling with UML, projectorganization& communication, requirements elicitation, analysis & system design, object design & code, mapping models to code, testing, project management strategies, project estimation, project scheduling, risk management, quality management.

Recommended Book(s):

1. Roger S. Pressman," Software Engineering, A practitioner's Approach", McGraw-Hill International Edition,Sixth Edition
2. Ian Sommerville," Software Engineering", Adison- Wesley Pub. Co, Sixth Edition
3. Pankaj Jalota," An Integrated Approach to Software Engineering", Narosa Publishing, Third Edition
4. Bernd Bruegge and Allen H. Dutoit," Object-Oriented Software Engineering", Pearson, Third Edition

Course Code	Course Name	L-T-P	Credits
CS110	Introduction to Linux	0-0-4	2

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, anddevelop shell scripts to perform more complex tasks.
CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.
CLO.3 Monitor system performance and network activities.
CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.
CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.

Course Outline:

Introduction, history of Linux, installation, mounting, introduction to GCC compiler, Linux commands, system configuration from the graphical interface, command-line operations, working with files, directory-oriented commands, searching, GCC, file system, communication-oriented commands, managing users, local security principles, network operations, regular expressions, redirections & filters in Linux, advanced Bash shell scripting, process scheduling, process priority, bash shell scripting.

Recommended Book(s):

1. John Purcell,"Linux the Complete Reference", Seventh Edition
2. Richard Blum,"Linux Command Line and Shell Scripting Bible", ThirdEdition
3. Sumitabha Das ,"Your Unix - The Ultimate Guide", Tata McGraw-Hill , FourthEdition
4. John Goerzen ,"Linux Programming Bible",IDG Books, New Delhi, Eight Edition
5. Mark G. Sobell ,"A Practical Guide to Linux" , Pearson Education,Second Edition
6. Yashwant kanetkar, "Unix Shell programming ",BPB Publications, FirstEdition

Course Code	Course Name	L-T-P	Credits
CS111	Introduction to Web Technologies	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.
CLO.2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.
CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.
CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.
CLO.5 Demonstrate and develop web-portals independently or in teams.

Course Outline:

Web programming and HTML5, document tags, HTML5 formatting, lists, introduction to link, images, tables, HTML frames, form, DHTML & CSS, CSS properties, introduction to JavaScript, working with data, functions & objects, event handling, regular expressions, JavaScript & DOM, events, form validation.

Recommended Book(s):

1. Ivan Bayross," Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP", BPB Publications, FourthEdition
2. Thomas Powell ,"The Complete Reference HTML & XHTML", Tata McGraw-Hill Company Limited, FifthEdition,
3. E. Stephen Mack, Janan Platt," HTML 4.0", Multimedia publication., Fourth Edition
4. Laura Lemay, Rafe Coburn, Jennifer Kyrnin,"Mastering HTML, CSS & JAVAScript",SAMS publication, Seventhedition,
5. Niederst Robbins ,"Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics", Oreilly Publication, FourthEdition

CourseCode	CourseName	L-T-P	Credits
CS112	AdvancedWebDevelopment	0-0-8	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Manipulate elements on a webpage and responding to user interactions
CLO.2 Develop web, desktop, and mobile applications skills
CLO.3 Use Angular JS to develop cross-platform applications
CLO.4 Explore core jQuery features which would help in designing GUI.
CLO.5 Use Angular JS to develop cross-platform applications

CourseOutlines:

jQuery, jQuery effects, jQuery callback, jQuery chaining, jQuery HTML, jQuery AJAX, bootstrap, BS tables, images, jumbotron, glyphicons, BS forms, BS media objects, BS carousel, bootstrap grids, angular js, databinding, controllers, scopes, filters, forms & validations, file structures.

Recommended Book(s):

1. Robbins, Niederst (2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics (4th ed). Oreilly Publication.
2. Bayross, Ivan (2016). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP (4th ed)., BPB Publications.
3. Thomas Powell(2016). The Complete Reference HTML & XHTML. (5th ed). Tata McGraw-Hill.
4. Laura, Janan Lemay & Rafe, Coburn (2017). Mastering HTML, CSS & JAVAScript. (7th ed) SAMS publication.

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Course Code	Course Name	L-T-P	Credits
CS114	Data Structures	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Analyse algorithms and algorithm correctness.
CLO.2 Analyse time complexities of algorithms using asymptotic analysis.
CLO.3 Summarize searching and sorting techniques.
CLO.4 Describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.
CLO.5 Gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Course Outline:

Introduction, elementary data organization, asymptotic notations for complexity, array, linked list, stacks & queues, implementation of recursive and non-recursive procedures, trees, binary trees, balanced binary tree, AVL tree, heap tree, graphs, directed and undirected graphs, graph traversals (DFS and BFS), searching & sorting, hashing.

Recommended Book(s):

1. Seymour Lipschutz," Data Structures", Published By Tata McGraw-Hill, Second Edition.
2. Hubbard,AnitaHuray, "Data Structures with Java, R",Prentice Hall of India, Second Edition,
3. Richard Gilberg, Behrouz Forouzan,"Data Structures", McGraw-Hill, Second edition
4. Narasimha Karumanchi,"Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Pearson publication, Third Edition.

Course Code	Course Name	L-T-P	Credits
CS115	Operating System	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify different types of Operating System and their components.
CLO.2 Design and implementation of new system calls for any open source operating system.
CLO.3 Implement existing resource management algorithms in Linux operating system.
CLO.4 Identify various system security and protection issues.
CLO.5 Completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.

Course Outline:

Introduction to operating system, computer system architecture, single processor and multiprocessor systems, OS structure, components of OS, process management, I/O management, storage management, protection and security, OS services, process and threads, CPU scheduling, process synchronization, semaphores, deadlock, memory management, paging and segmentation, virtual memory, file system, case studies.I/O burst cycle, Context Switching, Scheduling, Short Term, Long Term, Scheduling Criteria, Algorithms, First Come First Serve, Shortest Job First, Priority Scheduling, Round Robin

Recommended Book(s):

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, John Wiley & Sons (ASIA) Pvt. Ltd, Ninth Edition,
2. D.M. Dhamdhere, “System Programming & Operating Systems”, Tata McGraw Hill Second Edition
3. Andrew S. Tanenbaum, “Modern Operating System”, Prentice-Hall, Second Edition
4. Andrew S. Tanenbaum,” Operating Systems: Design and Implementation”, Prentice-Hall, Third Edition

Course Code	Course Name	L-T-P	Credits
CS116	Database Management Systems	5-0-0	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.
CLO.2 Describe relational algebra expression and tuple relation expression from queries.
CLO.3 Implement the concept of normalization and functional dependency while designing the databases.
CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.
CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.
CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.

Course Outline:

Introduction to database and Characteristics of Data Base approach. Advantages and Disadvantages of DBMS approach. Introduction to Data Models: Hierarchical Model, Network Model, ER Model, Relational Model. Schemas, Instances, Schema architecture and Data Independence, three tier Architecture for DBMS, ER Model: Data base design process, Entity Types, Entity sets, Attributes, keys and their types, Weak entity types, ER diagrams, naming convention and design issues. Relational Algebra: Unary operation Relation, Relational Algebra Operations from Set Theory. Introduction to Normalization, their practical uses. Functional Dependencies (Full, Partial, Transitive, Multi-valued & Join Dependencies), SQL queries programming: The Forms of a Basic SQL Query, Null Values, Introduction to Concurrency Control Techniques. Two Phase Locking Techniques for Concurrency Control. Dealing with Deadlocks, Introduction to Database Recovery Techniques, Distributed Databases: Introduction to distributed databases, Advantages and Functions of distributed databases.

Recommended Book(s):

1. Abraham Silberscatz, Henry F.Korth, Sudharsan," Database System Concepts", McGraw-Hill, Fifth Edition
2. C.J.Date, "An Introduction to Database Systems", O'Reilly Media, Eighth Edition
3. Bipin.C.Desai," An Introduction to Database Systems", West Group Division, Eleventh Edition
4. Ramez Z. Elmasri, Shamkant B. Navathe, "Database Systems",Pearson Education, Seventh Edition
5. Ramez Elmasri, Shamkant B. Navathe," Fundamentals of Database Design", Wesley Publications, Seventh Edition
6. Ivan Bayross," Introduction to PL/SQL", BPB Publications, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CS118	Computer System Architecture	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand Basic structure of computer
CLO.2 Perform Computer's Arithmetic Operations
CLO.3 Understand control unit operations
CLO.4 Learn the design skills of memory organization that uses different word size operations
CLO.5 Understand concept of cache memory technique.
CLO.6 Conceptualize instruction level parallelism.

Course Outline:

Evolution of computers, Von Neumann machine, Flynn's classification, basic computer organization, instruction codes, introduction to 8085 microprocessor, add, subtract, multiply algorithms, micro programmed control, central processing unit, input-output organization, DMA, IO interface, IOP, memory organization, virtual memory.

Recommended Book(s):

1. M. Morris Mano, 'Computer System Architecture', Pearson Education, Third Edition
2. John P Hayes, "Computer Architecture and Organization", Prentice Hall,Third Edition
3. David A Patterson, "Computer Architecture A Quantitative Approach", Pearson Education,Fifth Edition
4. J.P. Hayes, "Computer System Architecture", Pearson Education Asia, Third Edition

Course Code	Course Name	L-T-P	Credits
CS122	Design & Analysis of Algorithms	5-0-0	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Analyze algorithms and algorithm correctness.
CLO.2 Analyze time complexities of algorithms using asymptotic analysis.
CLO.3 Summarize searching and sorting techniques.
CLO.4 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.
CLO.5 Explain the major graph and tree algorithms and their analysis skills. Employ graphs to model engineering problems.

Course Outline:

Introduction, divide & conquer, greedy method, Knapsack problem, dynamic programming, backtracking, branch &bound, B-trees, NP hard & NP complete problems, polynomial time approximation.

Recommended Book(s):

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications, SecondEdition,
2. Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein, "Introduction to Algorithms", Prentice-Hall India, Thirdedition
3. Seymour Lipschutz, "Data Structures"' Outline Indian Adapted Edition, 2006 Tata McGraw-Hill Edition
4. 'Computer algorithms' by Horowitz, Ellis, 2008, University Press.
5. Baase, sara ,"Computer algorithms: Introduction to Design and Analysis', Pearson Education, Third Education

Course Code	Course Name	L-T-P	Credits
CS184	OOPS and IT Design Concepts	4-0-0	4

Course Learning Outcomes:

Students will be able to:
CLO.1 Understanding annotation and creating custom annotation
CLO.2 Understand the usage of Generics
CLO.3 Understanding of Logging and working with Log4J
CLO.4 Understanding of XML elements and Schema, Working with files and Serialization
CLO.5 Understanding and usage of the Design patterns

Course Outlines:

Version Control with GIT, Maven, Java Platform and Fundamentals, OOP's, Collections, Java Annotations and Generics, Java 8 - Lambdas & Functional Interfaces, Streams, Optionals and DateTime, Logging & Log4J XML, IO/Serialization, Design Patterns, Design Principles.

Suggested Books:

1. Tittel, E., Dykes, L. (2011). XML For Dummies. (1st ed). Germany: Wiley.
2. Yashavant, K. (2019). Let us Java. (5th ed). India: BPB Publications.
3. Horstmann, C. S. (2019). Core Java: Fundamentals. (5th ed). United Kingdom: Pearson.
4. Horstmann, C. S. (2015). Core Java for the Impatient. (2nd ed). United Kingdom: Pearson Education.

Course Code	Course Name	L-T-P	Credits
CS145	Front-end Development	4-0-0	4

Course Outcomes:

Students will be able to:

CLO.1 Identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.
CLO.2 Describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.
CLO.3 Use Javascript to manipulate elements in the DOM to change appearance and visibility.
CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.
CLO.5 Understanding the role and functions of Web servers and server frameworks. Skilled to worked front-end techniques.

Course Outline:

History of Web, client-server architecture, front-end and back-end, introduction to HTML, forms, introduction to CSS, styling with CSS, resume project, flex, responsive design, animations and 3D space, bootstrap, starting with Javascript, Javascript functions and arrays, object and timing events, understanding DOM, calculator project, constructors and prototypes, JQuery.

Recommended Book(s):

1. Alex Banks and Eve Porcello, Learning React: Functional Web Development with React and Redux, O'Reilly, 1st edition
2. Francesco Strazzullo, Frameworkless Front-End Development: Do You Control Your Dependencies Or Are They Controlling You?, Apress, 1st ed. Edition
3. Jon Duckett, Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback, Wiley, 1st edition
4. https://www.w3schools.com/react/
5. https://www.codecademy.com/learn/react-101
6. https://www.codecademy.com/learn/react-101

Course Code	Course Name	L-T-P	Credits
CS159	Back-end Development	4-0-0	4

Course Outcomes:

Students will be able to:

CLO.1 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.
CLO.2 Understand the concept of full stack development and APIs.
CLO.3 Learn debugging issues and end-to-end testing.
CLO.4 Deliver features in an agile development environment.
CLO.5 Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.

Course Outline:

Introduction and setup of NodeJS, ExpressJS and middlewares, session handling, templating using EJS, SQL and No SQL databases, introduction to AWS and IAM, AWS-EC2, RDS, Route 53, AWS S3, docker, elastic bean talk.

Recommended Book(s) and References:

1. Ethan Brown,Web Development with Node and Express: Leveraging the JavaScript Stack, O'Reilly Media, 2nd edition
2. Jon Duckett, Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback, Wiley, 1st edition
3. DT Editorial Services, HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, Dreamtech Press; 2nd edition
4. https://expressjs.com/
5. https://www.w3schools.com/react/

Course Code	Course Name	L-T-P	Credits
CS185	Java Framework	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Design thewebsite.
CLO.2 Develop project using Spring framework skill.
CLO.3 Maintain and enhanceexisting web platform.
CLO.4 Implement several Data structures using Collection Framework.
CLO.5 Use database connectivity for a complete Java application.

Course Outlines:

Version Control with GIT, Maven, Java Platform and Fundamentals, OOP's, Collections, Java Annotations and Generics, Java 8 - Lambdas & Functional Interfaces, Streams, Optionals and DateTime, Logging & Log4J XML, IO/Serialization, Design Patterns, Design Principles.

Suggested Books:

1. Schildl, Herbert. (2015). The Complete Reference Java. (8th ed). McGraw Hill Education India.
2. Lipschutz, Seymour. (2010). SchaumData Structures Outline. (2nd ed). Tata McGraw-Hill.
3. Sierra, Kathy. (2009).Head First Java. (2nd ed).Pearson.
4. Finegan, Edward G.(2014).OCA Java SE8 Programmer I Study Guide. (3rd ed). Oracle Press.

Course Code	Course Name	L-T-P	Credits
CS186	Full Stack Database Integration	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the functionality of the various database systems.
CLO.2 Practice the codes and study about the case studies.
CLO.3 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.
CLO.4 Learn the installation of the software.
CLO.5 Design a commercial relational database system, skilled in Oracle, MySQL.

Course Outlines:

Version Control with GIT, Maven, Java Platform and Fundamentals, OOP's, Collections, Java Annotations and Generics, Java 8 - Lambdas & Functional Interfaces, Streams, Optionals and DateTime, Logging & Log4J XML, IO/Serialization, Design Patterns, Design Principles.

Suggested Books:

1. Forouzan (2017). Data Communications and Networking. (5th ed).McGraw-Hill.
2. Andrew, S. (2016). Computer Networks by Andren. (4th ed), Pearson Education.
3. Stallings, William (2017) . Data and computer Communications. (8th ed). Pearson.
4. Lammle, Todd. (2018). CCNA Cisco Certified Network Associate Study Guide. (2nd ed). Wiley.

Course Code	Course Name	L-T-P	Credits
CST102	Principles of Computer Networking	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Describe and analyze the hardware, software, components of a network and the interrelations.
CLO.2 Explain networking protocols and their hierarchical relationship hardware and software.
CLO.3 Compare protocol models and select appropriate protocols for a particular design.
CLO.4 Manage multiple operating systems, systems software, network services and security.
CLO.5 Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
CLO.6 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure
CLO.7 Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.
CLO.8 Effectively communicate technical information verbally, in writing, and in presentations.

Course Outline:

Uses of computer networks, network hardware, network software, ISO-OSI architecture, TCP/IP reference model, physical layer, data link layer, network layer, transport layer, application layer, wireless WAN, routing protocols, network security.

Recommended Book(s):

1. Forouzan,"Data Communications and Networking", McGraw-Hill, 5TH edition
2. Andrew S,"Computer Networks by Andrew", Pearson Education, Fourth Edition
3. William Stallings,"Data and computer Communications",Pearson, EigthEdition

Todd Lammle,"CCNA Cisco Certified Network Associate Study Guide", Wiley, Second Edition

Course Code	Course Name	L-T-P	Credits
CSP102	Principles of Computer Networks Lab	0-0-2	1

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the practical approach to network communication protocols.
CLO.2 Understand network layers, structure/format and role of each network layer.
CLO.3 Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.
CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.
CLO.5 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

Course Outline:

Introduction to computer network devices, Cabling and Connecting Computers through Cross cables, Introduction to Wire-shark, How to capture packets in Wire-shark, Subnetting –Class C, B and A, VLSM, Connecting Computers through Switches

Recommended Book(s):

1. Forouzan (2014). Data Communications and Networking. (3rd ed).McGraw-Hill.
2. Andrew, S. (2012). Computer Networks by Andren. (2nd ed), Pearson Education.
3. Stallings, William (2011) . Data and computer Communications. (6th ed). Pearson.
4. Lammle, Todd. (2012). CCNA Cisco Certified Network Associate Study Guide. (2nded). Wiley.

Course Code	Course Name	L-T-P	Credits
CS249	Cloud Computing and Applications	3-0-0	3

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Students will be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

CLO.2 Students will be able to explain the core issues of cloud computing such as security, privacy, and interoperability.

CLO.3 Students will be able to identify problems, and explain, analyze, and evaluate various cloud computing solutions.

CLO.4 Students will be able to provide the appropriate cloud computing solutions and recommendations according to the applications used.

CLO.5 Students will be able to build skills to generate new ideas and innovations in cloud computing.

Course Outline:

Introduction to cloud computing, cloud computing platforms, parallel programming in the cloud, distributed storage systems, virtualization, cloud security, multicore operating system.

Recommended Book(s):

1. Daniel Kirsch and Judith Hurwitz, “Cloud Computing for Dummies, Wiley, Second edition,
2. Rajkumar Buyya, James Broberg and Andrzej Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley, First edition.
3. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud ”,O'Reilly Media, Fistedition
4. Rajkumar Buyya, Cloud Computing Principles and Paradigms, Wiley, 1st edition

Course Code	Course Name	L-T-P	Credits
CS256	Ethical Hacking	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1: Identify common network security vulnerabilities/attacks.
CLO.2: Explain the foundations of Cryptography and network security
CLO.3: Critically evaluate the risks and threats to networked computers.
CLO.4: Demonstrate detailed knowledge of the role of encryption to protect data, skilled to analyze security issues.
CLO.5: Identify the appropriate procedures required to secure networks.

Introduction to Security: Security Attacks – Types of attacks, Vulnerabilities. Access Control – Authentication and Authorization. Basics of Cryptography: Classical Encryption Techniques – Symmetric and Asymmetric cryptography. Substitution Techniques – Mono alphabetic ciphers, Polyalphabetic ciphers. Transposition Techniques: Block Ciphers and Stream Ciphers. Data Encryption Standard (DES), Strength of DES and Triple DES. AES, Overview of Block cipher modes of operation. Public-Key Cryptography: Principles of Public-Key Cryptosystems – The RSA Algorithm, Security of RSA. Key Management: Digital Certificates, PKI. Diffie-Hellman Key Exchange. Cryptographic Hash: Applications of cryptographic Hash Function, Properties of Hash Function. Hash Algorithms—MD5, Secure Hash Algorithm (SHA). MAC Algorithms—HMAC. Digital Signatures and authentication protocols – DSS – EI Gamal. Web Security: Kerberos and Secure Socket Layer. Electronic Commerce Security: Electronic Payment System, Secure electronic transaction (SET), Ecash (Digi cash). Electronics mail security: PRETTY GOOD PRIVACY (PGP), S/MIME. Intruders and Viruses: Networks intrusion detection system (NIDS) and its role in Perimeter defence, Intrusion prevention systems (IPS) and its limitations, Viruses.

Recommended Book(s):

1. Network Security Essentials by William Stallings, 4th Edition, Pearson Publication
2. Applied Cryptography by Bruce Schneier, Edition 2001, Wiley& Sons Inc
3. Network security and Cryptography' by Bernard Menezes, Ist Edition, Cengage LearningPublication.

Course Code	Course Name	L-T-P	Credits
CS243	ArtificialIntelligenceandMachine Learning	3-0-0	3

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Learning the basic concepts and skills of Artificial Intelligence.
CLO.2 Represent Knowledge using propositional calculus and predicate calculus.
CLO.3 Use inference rules to produce predicate calculus expression.
CLO.4 Demonstrate awareness of informed search and uninformed search techniques.
CLO.5 Explain about AI techniques for planning, knowledge representation and management.
CLO.6 Outline the process involved in Expert systems and in building such systems.

Course Outline:

Overview of artificial intelligence, knowledge, general concepts, knowledge manipulation, first order logic, knowledge engineering in first order logic, inference, forward chaining, backward chaining, propositional logic, predicate logic, conceptual dependencies, scripts, expert systems, neural networks, fuzzy expert system, TIERES, MYCIN, Genetic Algorithms.

Recommended Book(s):

1. Dan W. Patterson, 'Introduction to Artificial Intelligence & Expert Systems', Englewood Cliffs, NJ, 1990 (Prentice Hall International)
2. Elaine Rich, Kevin Knight, Shivashankar B Nair, 'Artificial Intelligence', (McGraw-Hill)
3. Giarratano & Riley, 'Expert Systems Principles and Programming', Course Technology; 4th edition
4. N.P. Padhy, Soft Computing techniques, Oxford University Press, UK ed. edition

Course Code	Course Name	L-T-P	Credits
CS257	Agile Methodology	3-0-0	3

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.

CLO.2 Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CLO.3 Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.

CLO.4 Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

Course Outline:

Introduction to Software Engineering:The Evolving Role of Software, Changing nature of software

Getting the basics of Agile: Looking Back at Software Development Approaches, Code-and-Fix/Big Bang development, Waterfall, The Spiral model, Introducing the Agile Manifesto, the 12 principles that drive the Agile Manifesto, Redefining Today's Agile

An Agile View of Process: what is agility, what is an agile process, agile process models: extreme programming(XP), ASD, ScrumRequirements Engineering:Requirements Engineering Tasks: Initiating Requirement, engineering Process, Eliciting RequirementsBuilding Analysis Model: Requirement Analysis, Data modeling Concepts, Flow Oriented Modelling, Risk Management: Software Risks & Risk Strategies, Risk Identification, Risk Projection, Risk Mitigation, Monitoring and Management (RMMM) plan, Overview of Quality Management, Quality Management, Change Management

Introduction to UML: Object-Oriented Analysis and Design with Use-Case View, Different types of views in UML, Use-Case Diagrams, Creating Use Cases, Class Diagrams, Finding Classes, Discovering Object Interaction, Specifying Relationships, Object Diagrams, Software Design and Software Engineering, The Design Process, Design Principles, Design Concepts, Effective Modular Design, Design Concepts and Principles with UML, Collaboration Diagrams, Sequence Diagrams, State Diagrams, Activity Diagrams, Component Diagrams and Deployment Diagrams

Software Testing Strategies and Tactics:A strategic approach for Software Testing, Software Testing Strategies: Unit Testing, Integration Testing, Validation Testing, System Testing, White-Box Testing Techniques: Basis Path Testing, Control Structure Testing, Black -Box Testing Techniques: Equivalence Partitioning and Boundary Value Analysis.

Recommended Book(s):

1. Roger S. Pressman," Software Engineering, A practitioner's Approach", McGraw-Hill International Edition,Sixth Edition
2. Ian Sommerville," Software Engineering", Adison- Wesley Pub. Co, Sixth Edition
3. Pankaj Jalota," An Integrated Approach to Software Engineering", Narosa Publishing, Third Edition
4. Bernd Bruegge and Allen H. Dutoit," Object-Oriented Software Engineering", Pearson, Third Edition

Course Code	Course Name	L-T-P	Credits
CS108	Python Basics	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Run basic python programs.

CLO.2 Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.

CLO.3 Logic building using looping and decision statements.

CLO.4 Develop problem solving abilities using Python.

CLO.5 Learn building packages and modules for reusability.

CLO.6 Learn GUI development using Widgets in Python.

Course Outline:

Introduction to python programming, Applications in All Engineering Domains, Origin and intentions, Differences to other programming languages, Introduction to logic building and flowcharts. Anaconda Installation, Running Python Programs , Writing Python Scripts with Jupyter Notebook. Logic building, Algorithm and Flowchart. Fundamentals: Data Types, Variables and literals, Blocks and Syntax Rules , Operators and Expressions, Assignment Statements , Expression Statements , Multiway Branching. Looping, Decisions, Control Flow- Conditionals and loops, pattern designing. Defining Functions , Scope Rules, Global Statements , Closures, Argument Matching , Passing Arguments, Recursive Functions, Lambda Expressions. Lists , Indexing and Slicing, References and Copies, List Comprehension, map, filter & reduce functions. Searching & Sorting: Imports and Attributes , Creating Modules , Searching & Sorting, Namespaces , Reloading, Generating Random values. Two Dimensional Lists, Strings and its relative methods and properties, Tuples, Set and Dictionaries- introduction, methods and its relative properties. Files and Directories, File I/O, File positioning, File operators. Introducing Widgets, Adding and Working with Widget, Displaying Text and Images With Label Widgets, Getting User Input With Entry Widgets,Displaying Clickable Buttons With Button Widgets, Controlling Layout With Geometry Managers, Using Events and Event Handlers.

Recommended Book(s):

1. Lutz, Mark," Learning python: Powerful object-oriented programming ", O'Reilly Media, Inc., Fifth edition
2. Shaw, Zed A, "Learn Python the hard way: A very simple introduction to the terrifyingly beautiful world of computers and code",Addison-Wesley, Third edition 2013.
3. Dierbach, Charles, "Introduction to computer science using python: A computational problem-solving focus", Wiley Publishing, First edition
4. Luty, Mark, "Programming python", Shroff Publication,Fifth edition

Course Code	Course Name	L-T-P	Credits
CS120	Advance Java Programming	4-0-2	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Design the website
CLO.2 Develop project using Spring framework skills
CLO.3 Maintain and enhance existing web platform
CLO.4 Use and Implement several Data structures using Collection Framework.
CLO.5 Use database connectivity for a complete Java application.

Course Outline:

Object oriented concepts, exception handling, version control, build tools, introduction to JSON and XML, DBMS and MySql, database connectivity, servlets, n-tier architecture, MVC and spring, ORM and hibernate.

Recommended Book(s):

1. Head First Java, O'Reilly Publication
2. OCA Java SE 8 Programmer I Study Guide (Exam 1Z0-808) (Oracle Press) by Edward G. Finegan, Robert Liguori.
3. OCA/OCP Java SE 7 Programmer I & II Study Guide (Exams 1Z0-803 & 1Z0-804) byKathy Sierra
4. Pro Spring 5, An In-Depth Guide to the Spring Framework and Its Tools, 5th Edition

Course Code	Course Name	L-T-P	Credits
CS133	Data Visualization and Query Language	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Infer skills for various performance measures and benchmarking progress towards business goals.
CLO.2 Analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.
CLO.3 Create database and work on complex queries.
CLO.4 Differentiate various mapping tools.
CLO.5 Learn web mapping services requirements.

Course Outline:

Introduction to Excel, data preparation, pivots, Vlookup, Hlookup, bar charts, pie charts, dynamic data filters, dynamic data validation, Tableau 10.0, creating a dashboard layout, introduction to maps, custom geocoding, web mapping services, case studies, SQL.

Recommended Book(s):

1. Microsoft Business Intelligence Tools for Excel Analysts (WILEY)
2. Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software.
3. Ivan Bayross," Introduction to PL/SQL", BPB Publication , Third Edition.
4. Dr. Anil Maheshwari, Data Analytics Made Accessible.

Course Code	Course Name	L-T-P	Credits
CS134	Business Analytics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and critically apply the concepts and methods of business analytics
CLO.2 Use basic functions and packages in Python.
CLO.3 Understand statistical concepts, skills and different hypothesis tests.
CLO.4 Learn how to prepare data using Python.
CLO.5 Learn how to prepare data using Python.

Course Outline:

About data, probability theory, inferential statistics, metrics & charts, hypothesis testing, Python, data preparation using Python, working with relational database in Python, data ingestion & inspection, concatenating data, merging data.

Recommended Book(s):

1. Magnus Vilhelm Persson, Luiz Felipe Martins," Mastering Python Data Analysis", PACKT Publications, Second Edition
2. Richard L. Halterman," Learning to program with python", Pearson publication, Second Edition
3. Andriy Burkov,"The Hundred-Page Machine Learning", Pearson publication, First Edition
4. Wayne L. Winston ,"Microsoft Excel Data Analysis and Business Modeling", Microsoft Press,U.S,Second Edition

Course Code	Course Name	L-T-P	Credits
CS138	Machine Learning	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and implement classical models and algorithms in machine learning as well as python programming concepts.
CLO.2 Analyze the data, identify the problems.
CLO.3 Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.
CLO.4 Understand the comparative study of the related approaches.
CLO.5 Able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.

Course Outline:

Python & flow control, data structures & functions in Python, AI-ML, expert systems, unsupervised & supervised learning, linear algebra, fundamentals & types of metrices, statistics, NumPy, probability, Bayes theorem, random variables, Gaussian distribution, Pandas, exploratory data analysis (EDA), feature engineering, linear & logical regression, performance measurement of models, support vector machines, principal component analysis (PCA), introduction to deep learning.

Recommended Book(s):

1. Tom M Mitchell,"Machine Learning" Tata MacGraw Hills, Second Edition
2. Garrett Grolemund and Hadley Wickham, "R for Data Science", Shroff/O'Reilly; First Edition
3. Oliver Theobald," Machine Learning For Absolute Beginners: A Plain English Introduction", pearson publication, Second Edition.
4. Jiawei Han and MichelineKamber, T," Data Mining: Concepts and Techniques"', Morgan Kaufman Publishers. Third Edition

Course Code	Course Name	L-T-P	Credits
CS129	Introduction to Cyber Security	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Review and practice computer and network etiquette and ethics found in working environments
CLO.2 Perform risk assessment
CLO.3 Install, configure, use and manage anti malware software on a working network
CLO.4 Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems
CLO.5 Articulate informed opinion about issues related to cyber security

Course Outline:

Information security, basic networking & TCP/IP, introduction of malwares, attacks and offensive security, virtualization, Debian hands-on, Wireshark, Internet Information Service (IIS), TCP headers, IP tables, SNORT, SDLC, security tools and sites, fingerprinting, cryptography, system vulnerability test, Metasploit, HTTP basics, CTF challenges.

Recommended Book(s):

1. Chwan-Hwa Wu and J David Irwin,"Introduction to Computer Networks and Cybersecurity",CRC Press, Second Edition
2. J Brooks," Cybersecurity Essentials", Wiley, Second Edition
3. Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing, John Slavio
4. Kevin Mitnick,"The Art of Invisibility: The World's Most Famous Hacker Teaches You How to Be Safe in the Age of Big Brother and Big Data", Back Bay Books; Second edition

Course Code	Course Name	L-T-P	Credits
CS130	Cyber Security for Forensics & Investigation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.

CLO.2 Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).

CLO.3 Use tools for faithful preservation of data on disks for analysis.

CLO.4 Find data that are hidden on a computer disk.

CLO.5 Learn the skills to use of computer forensics tools used in data analysis, such as searching, absolute disk sector viewing and editing, recovery of files, password cracking, etc.

Course Outline:

Introduction, CIA tried with case study, introduction to digital forensics, hard disk structure, booting sequence, cyber laws & case studies, file system overview, FAT and NTFS, data wiping, forensic image, digital investigation process, zip and Windows password cracking and bypass, analyzing server logs, steganography & tools.

Recommended Book(s):

1. Dejey Murugan, “Cyber Forensics”, Oxford Press, First Edition
2. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing, First Edition
3. Marjie T Britz, “Cyber Forensics and Cyber Crime An Introduction”Pearson, Second Edition
4. Cengage,“Hands on Ethical Hacking and Network Defence”, pearson, Second Edition

Course Code	Course Name	L-T-P	Credits
CS131	Malware and Reverse Engineering – I	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply malware analysis methodology and technology
CLO.2 Apply static malware analysisskills.
CLO.3 Identify basic and some malware functionality
CLO.4 Identify known anti-reverse engineering techniques
CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.

Course Outline:

Introduction to malwares, RE & malware analysis lab setup guide, introduction to Windows internal, Windows PE file format, assembly programming, reverse engineering basics, case study – Root kit, detection and removal of malwares, anti-reverse engineering techniques, decrypting communications of a RAT.

Recommended Book(s):

1. Eldad Eilam, “Reversing: Secrets of Reverse Engineering”, Wiley, 1st Edition
2. Michael Sikorski, Andrew Honig, “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software” 1st Edition
3. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition
4. Practical Reverse Engineering by Bruce Dang, Wiley

Course Code	Course Name	L-T-P	Credits
CS132	Malware and Reverse Engineering – II	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply malware analysis methodology and technologyskills.
CLO.2 Apply advanced static malware analysis.
CLO.3 Identify basic and some advanced malware functionality
CLO.4 Identify known anti-reverse engineering techniques
CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.

Course Outline:

Introduction to malware analysis & reverse engineering, types of analysis, dynamic analysis, programming in Linux, basics of assembly language programming, loop program, hands-on.

Recommended Book(s):

1. Eldad Eilam, "Reversing: Secrets of Reverse Engineering" , Wiley, 1st Edition
2. Michael Sikorski, Andrew Honig, "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" 1st Edition
3. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition
4.Bruce Dang, "Practical Reverse Engineering",John Wiley & Sons Inc, First edition

Course Code	Course Name	L-T-P	Credits
GPP101	Fundamentals of Game Programming	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop the skill to be able to program for a game.
CLO.2 Develop their own games.
CLO.3 Perform their games on multiple platforms.
CLO.4 Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.
CLO.5 Seek new knowledge of games development through self-directed study.

Course Outline:

Introduction with SFML, sprites, textures, shapes draw, font, audio, sprite animation, scrolling BG, key inputs, mouse inputs, mobile technologies, animation for Android & iOS, Cocos2DX, collider, HUD, gameplay, runner game.

Recommended Book(s):

1. Michael Dawson , ”Beginning C++ Through Game Programming”, Course Technology PTR,Third Edition
2. Fletcher Dunn, “3D Math Primer for Graphics and Game Development”, CRC Press, 2nd Edition
3. Robert Nystrom, “Game Programming Patterns Paperback”, Lightning Source Inc,First edition.
4. Jason Gregory, “Game Engine Architecture”, CRC Press, 2nd Edition

Course Code	Course Name	L-T-P	Credits
GPP103	Graphics Programming	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Program computer graphics renderers.
CLO.2 Learn the skills to develop OpenGL applications.
CLO.3 Perform transformations on objects in graphics application.
CLO.4 Analyze, synthesize, and utilize design processes and strategy from concept to delivery to creatively solve communication problems.
CLO.5 Create and develop skill in communication solutions that address audiences and contexts, by recognizing the human factors that determine design decisions.

Course Outline:

Game engine architecture, advanced C++, modern OpenGL, lighting, model loading, advanced OpenGL, advanced lighting, PBR, 2D game.

Recommended Book(s):

1. David Wolff, OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++17, 3rd Edition, Paperback
2. Eric Lengyel, Foundations of Game Engine Development, Volume 1: Mathematics
3. John Kessenich, Graham Sellers, Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V (9th Edition) 9th Edition, Paperback.
4. Alan Thorn, John P.Doran, Alan Zucconi, Jorge Palacios. Complete Unity 2018 Game Development: Explore techniques to build 2D/3D application using real-world examples, Packt.

Course Code	Course Name	L-T-P	Credits
GPL104	Game Design – BG	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Generate the skill of innovative ideas, and go beyond the obvious and predefined.
CLO.2 Listen to, evaluate, and respond critically to the ideas of others.
CLO.3 Identify steps, develop and manage a successful professional workflow.
CLO.4 Synthesize trends, theories, and movements in the development of new ideas
CLO.5 Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work

Course Outline:

Game design, iteration & rapid prototyping, role of game designer, how the system works, three stages of documentation, game flow summary, game progression, screen flow, control system, opponent and enemy AI, support AI, game art.

Recommended Book(s):

1. Alan B. Craig, “Understanding Augmented Reality, Concepts and Applications”, Morgan Kaufmann Publishers Inc, First Edition
2. Eric Lengyel,”Foundations of Game Engine Development, Volume 1: Mathematics”, Papeback,CRC Press, First edition.
3. Jesse Schell,”The Art of Game Design: A Book of Lenses”, A K Peters/CRC Press,Third Edition
4. Scott Rogers, “Level Up! The Guide to Great Video Game Design”, Wiley, 2nd Edition
5. Steve Swink,” Game Feel: A Game Designer's Guide to Virtual Sensation”,CRC Press,First edition.

Course Code	Course Name	L-T-P	Credits
GPL102	Game Design – 2D & 3D	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Generate the skill of innovative ideas, and go beyond the obvious and predefined.
CLO.2 Listen to, evaluate, and respond critically to the ideas of others.
CLO.3 Identify steps, develop and manage a successful professional workflow.
CLO.4 Generate innovative ideas, and go beyond the obvious and predefined.
CLO.5 Synthesize trends, theories, and movements in the development of new ideas.

Course Outline:

Level constraints, bubble diagram, rough maps, path finding for 2D platforms, modeling social problems as a game, mathematical theory of human behavior, mixed strategy equilibrium, generating ideas for games, mechanics, dynamics, rules and discovery, explaining & imagination, the friend and the enemy.

Recommended Book(s):

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, ,FirstEdition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders,New Riders, FirstEdition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, FirstEdition
4. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", Papeback,CRC Press, First edition.

Course Code	Course Name	L-T-P	Credits
GPP107	Unity Game Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop 2D & 3D games using the learned skills.
CLO.2 Develop special effects and Multiplayer games
CLO.3 Apply mathematical and game programming knowledge and skills to solve development tasks.
CLO.4 Build familiarity and appreciation of the programmatic components of an industry standard game development engine.
CLO.5 Seek new knowledge and skill development of games development through self-directed study.

Course Outline:

UI, unity programming, 2D games, raycast, line renderer, Mario type games, 3D games, rigidbody3D, RPG type games, post production, lighting, materials, camera, walkthrough, particles, occlusion, culling, memory management, networking (Photon & UNET), creating server, join room.

Recommended Book(s):

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, ,FirstEdition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders,New Riders, FirstEdition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, FirstEdition
4. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", Papeback,CRC Press, First edition.

Course Code	Course Name	L-T-P	Credits
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand key concepts,and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Gain conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.
CLO.4 Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.
CLO.5 Interpret for entrepreneur development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.

Course Outline:

Introduction to digital marketing, types of digital marketing, domain selection & registration, web space, park a domain, WP installation and dashboard, use of visual composer & its elements, WooCommerce pages and settings, tools of trade and social book marketing, B2B directories and forum postings, various online tools for content marketing, Google AdSense.

Recommended Book(s):

1. Brad Williams and David Damstra," Professional WordPress: Design and Development", Wrox, Third Edition
2. Venakataramana Rolla, "Digital Marketing Practice Guide for SMBs: SEO,SEM and SMM Practice Guide",Wiley,Second Edition
3. Damian Ryan," Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation",Kogan page, Fourth Edition
4. Shivani Karwal, "Digital Marketing Handbook: A Guide to Search Engine Optimization, Pay Per Click Marketing, Email Marketing, Social Media Marketing and Content Marketing", Reilly, First Edition.

Course Code	Course Name	L-T-P	Credits
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Gain the understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.

CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.

CLO.3 Identify conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills, entrepreneurship & InternetTechnologies.

CLO.4 Analyze the confluence of marketing, operations, and human resources in real-time delivery.

CLO.5 Demonstrate cognitive knowledge of the skills required in conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities.

Course Outline:

What is search engine optimization, how to make search engine friendly page, what are off-page factors, search engine marketing (SEM), pay per click advertising (PPC), web analytics, Google analytics, email marketing, MailChimp, Interspire, autoresponder.

Recommended Book(s):

1. Jennifer Grappone and Gradiva Couzin, “Search Engine Optimization (SEO): An Hour a Day”,Wiley, Second Edition.
2. Adam Clarke,”Search engine optimization 2016: Learn SEO with smart internet marketing strategies”, Pearson, Second Edition
3. Jason McDonald ,SEO Fitness Workbook, 2016 Edition: The Seven Steps to Search Engine Optimization Success on Google by Search Engine Marketing, Inc.: Driving”, Wiley, First Edition
4. Mike Moran and Bill Hunt, “Search Traffic to Your Company's Website”,(IBM Press), Third Edition

Course Code	Course Name	L-T-P	Credits
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Gain conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.
CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization
CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques for entrepreneurs.

Course Outline:

Social media marketing, Facebook marketing, invite potential followers, group monetization, Facebook ads and promotions, LinkedIn marketing, Twitter marketing, Instagram marketing, Pinterest marketing, introduction to affiliate marketing, mobile marketing, online reputation management.

Recommended Book(s):

1. Michael Richards, "Social Media: Dominating Strategies for Social Media Marketing with Twitter, Facebook, Youtube, LinkedIn, and Instagram", Paperback, First edition.
2. Andrew Macarthy, "500 Social Media Marketing Tips: Essential Advice, Hints and Strategy for Business: Facebook, Twitter, Pinterest, Google+, YouTube, Instagram, LinkedIn, and More", Wiley, First Edition
3. J. Wolf, "Social Media: Master, Manipulate, And Dominate Social Media Marketing Facebook, Twitter, YouTube, Instagram And LinkedIn",Paperback, Second edition.
4. Daniel Rowles, "Mobile Marketing: How Mobile Technology is Revolutionizing Marketing, Communications and Advertising, Kogan Page, First Edition.
5. Rachel Pasqua, Mobile Marketing: An Hour a Day by Rachel Pasqua and Noah Elkin, Sybex, FirstEdition

Course Code	Course Name	L-T-P	Credits
CS144	Affiliate Marketing and Online Reputation Management (ORM)	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Gain conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.
CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization.
CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques useful for entrepreneurs.

Course Outline:

Introduction to affiliate marketing, adding paid sponsoring placement, getting the most from what you are delivering, forums, websites, conference, message boards, generating revenue through a membership site or list building, search engine techniques, online reputation management, tools for monitoring online reputation.

Recommended Book(s):

1. Rachael Aprill Phillips, “Affiliate Marketing for Women”, Lulu.com, Second edition.
2. New Thrive Learning Institute, Affiliate Marketing - the Complete Affiliate Marketing Handbook, Lulu.com, First edition.
3. A Anderson,”Affiliate Marketing: How to Make Money and Create an Income”, Createspace Independent Publishing Platform,First edition
4. Lori Randall Stradtman, “Online Reputation Management for Dummies”, John Wiley & Sons, Third edition.
5. Keith Fugate, “Affiliate Marketing”, Paperback, First edition.

Course Code	Course Name	L-T-P	Credits
EP101	Entrepreneurship and Opportunity	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Sell themselves and their ideas and become entrepreneurs.
CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.
CLO.3 Find problems worth solving.
CLO.4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.
CLO.5 Increase their awareness and deliberately practice the entrepreneurship skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.

Course Outline:

What is entrepreneurship, key aspects, entrepreneurship fundamentals, self-discovery, effectuation, case study, team formation, identify problems worth solving, design thinking, look for solutions, customers and markets, identify your costumer segment and niche, craft your value proposition, present your value proposition, basics of business model and lean approach, sketch the lean canvas, risks and assumptions, gap analysis, common observation methods.

Recommended Book(s):

1. Bart Clarysse and Sabrina Kiefer, “The Smart Entrepreneur: How To Build For A Successful Business”, Elliott &ThompsonPublications, First edition.
2. Eric Ryes, “The Lean Startup: How Constant Innovation Creates Radically Successful Businesses, Penguin UK, Second edition.
3. Katy Milkman, **“**How to Change: The Science of Getting From Where You Are to Where You Want to Be”, ThompsonPublications ,First edition,
4. Peter G. Peterson, “The Education of an American Dreamer”, Twelve, First edition.

Course Code	Course Name	L-T-P	Credits
EP102	Consumer&MarketResearchfor Entrepreneurs	2-0-4	4

Course Learning Outcomes:

Students willbeable to:

CLO.1 Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.

CLO.2 Understand the process that enables entrepreneurs with limited resources.

CLO.3 Understand and apply fundamental aspects as a means of personal empowerment.

CLO.4 Help a company or business development, through proper planning, organization, and both human and material resources control, and thus satisfy all specific needs within the market, at the right time.

CLO.5 Satisfy customer's specific needs through a required product or service.

Course Outline:

Blue Ocean Strategy to refine your value proposition, Applying the Four Actions Framework, Build Solution Demo, Problem-Solution Fit, Identify Your MVP and Build It, Conduct MVP Interviews, Prototyping and MVP, Present your MVP, Money, Team, Marketing & Sales, Support, Pitch your Idea

Recommended Book(s):

1. Kevin D Johnson, TheEntrepreneurMind, Jaico Publishing House, 1st Edition
2. Pankaj Goyal, Before You Start Up: How to Prepare to Make Your Startup Dream a Reality, Fingerprint! Publishing
3. Peter F Drucker, The Entrepreneurial Innovator; Harper Business, Reprint Edition
4. Arvind Kumar Bhatt, INNOVATION AND ENTREPRENEURSHIP, Laxmi Publications Pvt. Ltd., First Edition

Course Code	Course Name	L-T-P	Credits
CS168	UX Design and Digitalization	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand what interaction design is, the importance of user-centred design and methods of user information gathering.

CLO.2 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.

CLO.3 Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.

CLO.4 Analyse and critique the design of interactive products.

CLO.5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.

Course Outline:

Understand the evolution of UX design, learning about UX industry experts, UX design process and methodologies, user centred design, 5S model, job roles and responsibilities in the UX industry, UX industry trends, deep-dive in UX methodologies, case studies in UX design, heuristic evaluation, understanding product UX lifecycle, BFSI, manufacturing, retail, automotive, media, FMCG, logistics, oil & gas, understand industry specific problems, digitalization for the bottom of the pyramid, localization of experience, project.

Recommended Book(s):

1. Dave and Tom Kelly Tom Kelley, David Kelley , Creative Confidence: Unleashing the Creative Potential Within Us, Currency, Illustrated Edition
2. Don Norman, The Design of Everyday Things, Basic Books, 2nd Edition
3. Nir Eyal, Hooked: How to Build Habit-Forming Products, Portfolio Penguin; Latest Edition
4. Kim Goodwin, Designing for the Digital Age: How to Create Human-Centered Products and Services, Wiley, 1st Edition

Course Code	Course Name	L-T-P	Credits
CS169	User Interface Design	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Construct navigation that enables users to easily accomplish tasks.
CLO.2 Determine which data to display in order to meet user needs.
CLO.3 Enable users make social connections through their mobile devices.
CLO.4 Focus on patterns that bring clarity.
CLO.5 Learn the skills of design strategy development that provides solutions to meet business and user goals.

Course Outline:

Elements of design, pronciples of design, tools of visual design, introduction to the operating systems and digital devices, visual design principles, contrast ratio, colour psychology, laws in UI design, consistency and legibility, creating digital guidelines considering factors of UX colour, typography, iconography, grid, document and portfolio guidelines.

Recommended Book(s):

1. Everett N McKay, UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, Morgan Kaufmann, Illustrated edition
2. Jeff Johnson, Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines, Morgan Kaufmann, 2nd edition
3. Chris Nodder, Evil by Design: Interaction Design to Lead Us into Temptation, Wiley, 1st Edition
4. Golden Krishna, The Best Interface Is No Interface: The simple path to brilliant technology, New Riders

Course Code	Course Name	L-T-P	Credits
CS170	Empathy & its Tools	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Use empathy to change behaviour and build better relationshipskills.

CLO.2 Develop empathy through role-play activities.

CLO.3 Explain what it means to have different perspectives.

CLO.4 Empathy prepares students to be leaders in their community.

CLO.5 Understand the key difference(s) between empathy and sympathy.

Course Outline:

Learn how to understand user, techniques to empathize with users, identify key user problems, learn how to gain insights from empathy, empathy tools, emotional mapping, emotional observation, understand the user's interaction with the environment, understand the people and culture, understand the UX and societies, user scenarios, understanding research problems, perform field study to understand people design, project.

Recommended Book(s):

1. Daniel J Siegel, Mindsight: Transform your Brain with the new Science of Empathy, Pan Macmillan India
2. Frans De Waal, The Age of Empathy: Nature's Lessons for a Kinder Society, Broadway Books, Illustrated edition
3. Jon Kolko, Well-Designed: How to use Empathy to Create Products People Love, Harvard Business
4. Dev Patnaik, Wired to Care: How Companies Prosper when They Create Widespread Empathy, FT Press; 1st edition

Course Code	Course Name	L-T-P	Credits
CS122	Business Intelligence and Data Warehousing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Speculate various models and algorithms in data warehousing.

CLO.2 Analyze various database problems and to find out the relevant information out of big data.

CLO.3 Implement major algorithms that generates frequent itemset.

CLO.4 Differentiate between OLAP AND OLTP.

CLO.5 Use clustering techniques for maintaining database integrity.

CLO.6 Model an application's data requirements using conceptual model tools skills like BI tools and strategies

Course Outline:

Data warehouse design and management, business analytics and data warehousing, OLAP, cube, data mining for BI, knowledge management, KM strategies.

Recommended Book(s):

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufman Publishers, Third edition,.
2. R.N. Prasad and Seema Acharya, "Fundamentals of Business Analytics", Wiley India Publishers, First edition.
3. Christian Bauer,Gavin King,Gary Gregory, Linda Demichiel, "Java Persistence with Hibernate", Dreamtech Press,Second edition
4. Jason Bell, "Machine Learning for Big Data: Hands-On for Developers and Technical Professionals", Wiley, Second edition.

Course Code	Course Name	L-T-P	Credits
CS181	Software Quality Assurance and Testing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand software testing and quality assurance as a fundamental component of software life cycle

CLO.2 Infer various software models concepts and skills for making the software.

CLO.3 Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.

CLO.4 Make sure that the result meets the business and user requirements Software testing plays an instrumental role.

CLO.5 Satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.

Course Outline:

Software quality, role of testing, verification and validation, unit testing, control flow testing, system integration testing, regression tests, documentation, system test design, system test planning and automation, monitoring test execution, acceptance criteria, software quality, ISO 9126` quality characteristics, ISO 9000:2000 software quality standard.

Recommended Book(s):

1. Sagar Naik, Piyu Tripathy, Software Testing and Quality Assurance: Theory and Practice, , University of Waterloo, Wiley, 2008.
2. Naresh Chauhan, Software Testing: Principles and Practices , 2012, Oxford Univesity Press.
3. J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, Glenford.
4. Ron Patton, Software Testing, 2nd Edition, 2005

Course Code	Course Name	L-T-P	Credits
CS245	Big Data Analytics	2-0-2	3

Course Outcomes:

Students will be able to:

CLO.1 Speculate various models and algorithms in Big Data Analytics.

CLO.2 Analyze various database problems and to find out the relevant information out of big data.

CLO.3 Implement major algorithms that generates frequent itemset.

CLO.4 Use clustering techniques for maintaining database integrity.

CLO.5 Model an application's data requirements using conceptual model tools skills like BI tools and strategies

Course Outline:

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Recommended Book(s):

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. •
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013) •
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.

Course Code	Course Name	L-T-P	Credits
CS162	Full Stack Development	0-0-6	3

Course Outcomes:

Students will be able to:

CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet
CLO.2 Apply basic design principles to present ideas, information, products, and services on websites
CLO.3 Apply basic programming principles to the construction of websites
CLO.4 Effectively manage website projects using available resources
CLO.5 Demonstrate communication skills, service management skills, and presentation skills

Course Outline:

SDLC overview, agile, object-oriented design & programming, UML diagrams, use case, package, state cart diagram, RDBMS fundamentals, normal forms, Oracle DB design, single row functions, multiple rows and group functions, join, sub queries and set operators, DDL, DCL, DML, TCL, other schemas, index and synonyms, Java fundamentals, Java API, string, inherritance, polymorphism, exception handling, IO streams, collections, generics, multi-threading, JSP, JSTL, servlets, HTML5, CSS3, responsive, spring, beans, JDBC, hibernate, session mapping, XML, Java blue rpint patterns, unit testing with Junit5, negative-positive test cases.

Recommended Book(s):

1. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress, 1st ed. edition
2. Shama Hoque, Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, Packt Publishing Limited, 2nd edition
3. Frank Zammetti, Modern Full-Stack Development:Using TypeScript, React, Node.js, Webpack, and Docker, Apress, 1st edition
4. Sebastian Grebe, Hands-On Full-Stack Web Development with GraphQL and React: Build scalable full-stack applications while learning to solve complex problems with GraphQL, Packt Publishing Limited

Course Code	Course Name	L-T-P	Credits
CS154	Computer Graphics	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.
CLO.2 Apply the concepts of colour models, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering.
CLO.3 Interpret the mathematical foundation of the concepts of computer graphic skills.
CLO.4 Describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.
CLO.5 Identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.
CLO.6 Create effective programs to solve graphics programming issues, including 3D transformation, objects modelling, colour modelling, lighting, textures, and ray tracing.

Course Outline:

History of computer graphics, graphics architecture and software, vision and imaging, color models, geometric transformations, three-dimensional graphics, ray tracing, illumination, shading, rasterization, compositing.

Recommended Book(s):

1. Donald Hearn and Pauline Baker, “Computer Graphics” Pearson Education, Second Edition
2. Schaum’s outline,” Computer Graphics”, McGraw-Hill India, First Edition
3. David Rogers,”Mathematical Elements of Computer Graphics” McGraw-Hill, Second edition
4. John F. Hughes,”Computer Graphics: Principles and Practice”, Pearson Publication, Third Edition

Course Code	Course Name	L-T-P	Credits
CS4003	Network Security	3-0-0	3

Course Outcomes:

Students will be able to:

CLO.1 Explain about the OSI Security architecture and various Crytographic techniques.
CLO.2 Describe about the data encryption standard, block ciphers and block ciphers mode of operation.
CLO.3 Describe the principles of various public key cryptosystems
CLO.4 Explain the need for authentication and various authentication system methods.
CLO.5 Illustrate the different types of threats and attacks in data networks and explain about Internet and Mobile security

Course Outline:

Services, Mechanisms and Attacks-The OSI Security Architecture – Network Security Model – Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography. Block Ciphers- Simplified Data Encryption Standard -Data Encryption Standard– Block cipher principlesblock cipher modes of operation – Triple DES-Simplified Advanced Encryption Standard Advanced Encryption Standard (AES).

Recommended Book(s):

1. Behrouz A Ferouzan, Cryptography & Network Security, Tata McGraw Hill-2007
2. Man Young Rhee, Internet Security: Cryptographic Principles", "Algorithms and Protocols, Wiley Publications-2003
3. Charles Pfleeger, Security in Computing, Prentice Hall of India -2006
4. Ulysess Black, Internet Security Protocols, Pearson Education Asia -2000

Course Code	Course Name	L-T-P	Credits
CS203	Integrated Project-I	0-0-4	2
CS205	Integrated Project – II	0-0-4	2
CS251	Co-op project at Industry Module-I	-	12
CS252	Co-op project at Industry Module-II	-	12
CS248	Research Project Dissertation	-	12

Course Learning Outcomes:

Students will be able to:

CLO.1 Acquire presentation and communication skills
CLO.2 Undertake problem identification, formulation and solution to make students employable.
CLO.3 Design engineering solutions to complex problems utilizing a systems approach
CLO.4 Implement learning in real life problem for skill development
CLO.5 Propose multiple solution to any given problem and find best out of those.

Appendix A: Mapping of Programme Outcomes (POs) with Course Outcomes (COs)

Course Code	Course Name	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
ES101	Environmental Sciences	CLO:1 Understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.						H	M					
		CLO:2 Identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming).		M				H	H					
		CLO:3 Understand and hone skills to the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs.						H	H	M				
		CLO:4 Knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and also to students to real-world issues.						M	H		M	M		
		CLO:5 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.							H		M			
CS501	Cyber Security	CLO.1 Acquire Information and risk models including confidentiality, integrity and availability					M				M	H		
		CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities	H	H	M		M				H		H	
		CLO.3 Gain knowledge on Cyber security architecture and operations		M	H	H	H				H		H	M

		CLO.4 Understand how Cyber security is conceptualized and carried out	H	H	M		M				H		H	
		CLO.5 Articulate informed opinion about issues related to cyber security		M	H	H	H				H		H	M
HR101	Human Values and Professional Ethics	CLO.1 Get awareness on human values and professional ethics					M				M	H		
		CLO.2 Understand the core values that shape their ethical behaviour.	H	H	M		M				H		H	
		CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.		M	H	H	H				H		H	M
		CLO.4 Gain thorough knowledge in the field of human rights and this will add to the academic qualification	H	H	M		M				H		H	
		CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.		M	H	H	H				H		H	M
AM121	Calculus and Statistical Analysis	CLO:1 Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.	H	H		H								
		CLO:2 Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange	H	H										

		multipliers and solve related application problems.													
		CLO:3 Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.	H		M										H
		CLO:4 Interpret statistical inference skills with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ appropriate regression models in determining statistical relationships.	H	H											M
		CLO:5 Equip with the skills to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.	H		H										M
AM122	Differential Equations and Transformations	CLO:1 Analyse and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).	H	H										H	
		CLO:2 Use ordinary differential equations student will be able to solve various practical problems in Science and Engineering.	H	H		M									
		CLO:3 Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.	H	H											
		CLO:4 Analyse functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces ability to recognize and find families of solutions for most real physical processes	H	H		H									

		such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.												
		CLO:5 Develop skills required to find the appropriate differential equations that can be used as mathematical models.		H		H								
AM103	Discrete Structures	CLO:1 Students will be able to apply the knowledge obtained to investigate and solve a variety of live problems related to Sets, Relations and Functions.	H	H										
		CLO:2 Students will be able to solve real life problems using combinatorics.	H	H										
		CLO:3 Students will be able to understand and apply the theory and techniques of Lattice, Logic and Boolean algebra		H	M									
		CLO:4 Students will be able to comprehend Graph Theory and its relevance within the context of computer science and finding solutions of live problems related to shortest path etc.	H	M	H									
		CLO:5 Students will be able to able to develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms	H		H									
PH121	Modern and Computational Physics	CLO:1 Analyse and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.	H	H					H					
		CLO:2 Differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.	H		H									

		CLO:3 Differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.	H		M									
		CLO:4 Describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.	H	H										
		CLO:5 Develop skills for critical thinking and problem solving involving the various concepts of physics.		H	M									
PH111	Modern and Computational Physics Lab	CLO:1 Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.		H	M									
		CLO:2 Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.				M								
		CLO:3 Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.		H										
		CLO:4 Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.		H	M									
		CLO:5 Possess an ability to evaluate and analyze scientific measurement and error analysis.				M								
		CLO:6 Apply the fundamental conceptsof physics to related engineering problems.			M									

EC101	Basics of Electronics Engineering	CLO:1 Understand the basic concepts of semiconductor devices for use in electronic circuits.		M	H									
		CLO:2 Gain skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.		H	M									
		CLO:3 Acquire the knowledge of digital logic gates for implementing basic digital circuits.	H		H									
		CLO:4 Recognize the primary functions of integrated circuits such as timer and voltage regulator.		H			M							
		CLO:5 Familiarize with generic IoT device and applications using case studies.		M			H						H	
EC102	Basics of Electronics Engineering Lab	CLO:1 Know the basics of electronics elements, their functionality and applications.		M	H									
		CLO:2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.			H									
		CLO:3 Analyze and characterize the electronic circuits and have basic understanding for their implementation.	H		M									
		CLO:4 Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.					M						H	
		CLO:5 Gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.						M					H	
EC105	Digital Electronics and Logic Design	CLO:1 Understand the underlying differences between analog and digital systems, and interconversion between the two.	H		M									

		CLO:2 Understand and apply mathematical skills to solve digital design problems involving Boolean logic.	M	M	H									
		CLO:3 Understand the underlying differences between combinational and sequential circuits.		M										
		CLO:4 Understand and apply the design methodologies skills for implementing combinational and sequential circuits.	H		M									
		CLO:5 Understand the concept of memories and Programmable Logic Devices and their classification.			M								M	
		CLO:6 Understand the concept of memories and Programmable Logic Devices and their classification.		M									M	
EC106	Digital Electronics and Logic Design Lab	CLO:1 Understand the digital logic and create various systems by using these logics	H											
		CLO:2 Develop an understanding of design and simulation of digital logic circuits		H	M									
		CLO:3 Get a basic understanding of layout of electronic circuits			H								M	
		CLO:4 Gain skill of practical implementation of design methodologies skills for implementing combinational and sequential circuits.		M	H									
		CLO:5 Implement the concept of memories and Programmable Logic Devices and their classification.			H								M	
EE101	Basics of Electrical Engineering	CLO:1 Understand and analyse the concepts of DC circuits	H	H										
		CLO:2 Understand AC circuits and their power measurements		H	H									
		CLO:3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.		H	M					H				

		CLO:4 Understand the basic knowledge of transducers and measuring instruments	H	H						M				
		CLO:5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices		H	H									
EE102	Basics of Electrical Engineering Lab	CLO:1 Know the basics components of electrical elements, equipment and their functionality with applications	H											
		CLO:2 Possess an ability to analyze and characterize the electrical equipment's and instruments basics for their implementation	H	H										
		CLO:3 Measure power and power factor of ac circuits and understand three-phase star and delta connections with and without applying loads to calculate 3-phase power	H	M					H					
		CLO:4 Possess an ability to perceive the concept of Fuse/MCB characteristics for different fault currents	H						M					
		CLO:5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices	H	H										
CS104	Computer Programming-I	CLO:1 Analyse the problem statement.	H											
		CLO:2 Choose the appropriate C programming constructs to solve the problems.	H	H										
		CLO:3 Demonstrate the advantages and disadvantages of specific techniques to be used.	H	M					H					
		CLO:4 Differentiate between efficient and inefficient way of programming skills.	H						M					
		CLO:5 Determine and demonstrate bugs in a program and recognize needed basic operations.					M							
		CLO:6 Formulate new solutions for programming problems or improve existing	H	H										

		code to programeffectively.												
CS106	Object Oriented Programming	CLO:1 Implement the concept of object-oriented techniques and methodologies using Java			H		H							
		CLO:2 Use Exception Handling concepts and skills for a Robust Application in Java.				H	H							
		CLO:3 Demonstrate an understanding of Java Input and Output		H		H								
		CLO:4 Develop applications using multithreading concept of Java.		H	H		H						H	
		CLO:5 Use and Implement several Data structures using Collection Framework			H		H						H	M
		CLO:6 Use database connectivity for a complete Java application.		H	H		H						H	
CS107	Object Oriented Software Engineering	CLO.1Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.			H		H							
		CLO.2Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.				H	H							
		CLO.3Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both		H		H								

		communication and negotiation management skill.												
		CLO.4Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.		H	H		H						H	
		CLO.5Learn and understand various object oriented concepts along with their applicability contexts			H		H						H	M
CS110	Introduction to Linux	CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, anddevelop shell scripts to perform more complex tasks.		H	H									
		CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.		H	H									H
		CLO.3 Monitor system performance and network activities.		H	H		H						H	
		CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.		H									H	

		CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.				M	H								
CS111	Introduction to Web Technologies	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.	H	H										H	
		CLO.2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.	H	H		H								H	
		CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.	H											H	
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.			M	H									
		CLO.5 Demonstrate and develop web-portals independently or in teams.						M							
CS112	Advanced Web Programming	CLO.1Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.	M												
		CLO.2 Implementform validation using regular expressions.	H	H										H	

		CLO.3Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.	H	H		H						H		
		CLO.4Use and Implement AJAX to fetch data from the server in JQuery and React.	H									H		
		CLO.5Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.									M			
CS114	Data Structures	CLO.1 Students will be able to analyse algorithms and algorithm correctness.		H	H		M							
		CLO.2 Students will be able to analyse time complexities of algorithms using asymptotic analysis.		H	H	M								
		CLO.3 Students will be able to summarize searching and sorting techniques.			H									M
		CLO.4 Students will be able to describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.		H	H						M			
		CLO.5Students will be able gain skills to explain the major graph and tree algorithms and their analyses.												

		CLO.6Employ graphs to model engineering problems, when appropriate.		H	H						M		H	M
CS115	Operating System	CLO1: Students will be able to identify different types of Operating System and their components.		H	M									
		CLO2: Design and implementation of new system calls for any open source operating system.		M	H									
		CLO3: Implementation of existing resource management algorithms in Linux operating system.			H		H						H	
		CLO4: Students will be able to identify various system security and protection issues.		H	H									M
		CLO5: Students will be able to completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.		H	H								H	
CS116	Database Management System	CLO.1Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.					H							
		CLO.2Describe relational algebra expression and tuple relation expression from queries.						M					H	

		CLO.3Implement the concept of normalization and functional dependency while designing the databases.			M										
		CLO.4Apply the concept of transaction, concurrency control, security and recovery in database.			M										
		CLO.5Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.				M			H						
		CLO.6Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.							H						
CS118	Computer System Architecture	CLO1: Ability to Understand Basic structure of computer		H	M										H
		CLO2: Ability to perform Computer's Arithmetic Operations		H	M										
		CLO3: Ability to understand control unit operations		H	M										
		CLO4: Ability to learn the design skills of memory organization that uses different word size operations		H	M		M								M
		CLO5: Ability to understand concept of cache memory technique.		H	M										

		CLO6: Ability to conceptualize instruction level parallelism.	M	H	M		H							H
CS122	Business Intelligence and Data Warehousing	CLO.1 Speculate various models and algorithms in data warehousing.		H	H									
		CLO.2 Analyze various database problems and to find out the relevant information out of big data.		H	H									
		CLO.3 Implement major algorithms that generates frequent itemset		M	H									
		CLO.4 Differentiate between OLAP AND OLTP.			H	H								
		CLO.5 Use clustering techniques for maintaining database integrity.					H							
		CLO.6 Model an application's data requirements using conceptual model tools skills like BI tools and strategies			H	H								
CS184	OOPS and IT design Concepts	CLO.1 Understanding annotation and creating custom annotation		H	M		M							M
		CLO.2 Understand the usage of Generics		H	M									
		CLO.3 Understanding of Logging and working with Log4J	M	H	M		H							H
		CLO.4 Understanding of XML elements and Schema, Working with files and Serialization		H	H									
		CLO.5 Understanding and usage of the Design patterns		H	H									

CS145	Front-end Development	CLO1:Identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.		H	H									
		CLO2:Learning skills to describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.		M	H	M	H							
		CLO3:Use Javascript to manipulate elements in the DOM to change appearance and visibility.			H	H								
		CLO4:Describe how intended website design features will specifically benefit a target user group content strategy.		M	H	M	H							
		CLO5: Design loops and decision statements in Python. Understand the role and functions of Web servers and server frameworks.			H	H								
CS159	Back-end Development	CLO1:Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.			H	H		M						
		CLO2:Understand the concept of full stack development and APIs.			H	H		M						
		CLO3:Learn debugging issues and end-to-end testing..		M	H		H							
		CLO4:Deliver features in an agile development environment.			H	H		M						

		CLO5:Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.		M	H		H							
CS185	Java Framework	CLO.1 Design the website.			M						L			
		CLO.2 Develop project usingSpring framework skill.									M			
		CLO.3 Maintain and enhance existing web platform.			M	M								
		CLO.4 Implement several Data structures using Collection Framework.				M						L		
		CLO.5 Use database connectivity for a complete Java application.										M		
CS186	Full Stack Database Integration	CLO.1: Understand the functionality of the various database systems.	M					L						
		CLO.2: Practice the codes and study about the case studies.										M		
		CLO.3: Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills	M					L						
		CLO.4: Learn the installation of the software.		M	L									
		CLO.5: Design a commercial relational database system, skilled in Oracle, MySQL.		M								L		

CST102	Principles of Computer Network	CLO1: Students will be able to describe and analyze the hardware, software, components of a network and the interrelations.		H	H									
		CLO2: Explain networking protocols and their hierarchical relationship hardware and software.		M			H						H	
		CLO3: Compare protocol models and select appropriate protocols for a particular design.		H	M								M	
		CLO4: Manage multiple operating systems, systems software, network services and security.					H							
		CLO5: Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.	M	H	M		M						M	
		CLO6: Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure					M			H				
		CLO7: Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.								M				

		CLO8: Effectively communicate technical information verbally, in writing, and in presentations.										M		
CSP102	Principles of Computer Networks Lab	CLO.1 Understand the practical approach to network communication protocols.	M					L						
		CLO.2 Understand network layers, structure/format and role of each network layer.		M	L									
		CLO.3 Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.		M								L		
		CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.		H	H									
		CLO.5 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure		M			H						H	
CS249	Cloud Computing and Applications	CLO.1 Students will be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.								M				
		CLO.2 Students will be able to explain the core issues of cloud computing such as security, privacy, and interoperability.		M										
		CLO.3 Students will be able to identify problems, and explain, analyze, and evaluate various cloud computing solutions.	M									L		

		CLO.4 Students will be able to provide the appropriate cloud computing solutions and recommendations according to the applications used.	M						L					
		CLO.5 Students will be able to build skills to generate new ideas and innovations in cloud computing.	M									L		
CS256	Ethical Hacking	CLO.1: Identify common network security vulnerabilities/attacks.			L								M	
		CLO.2: Explain the foundations of Cryptography and network security.				L							M	
		CLO.3: Critically evaluate the risks and threats to networked computers.					M							
		CLO.4: Demonstrate detailed knowledge of the role of encryption to protect data. Analyze security issues arising from the use of certain types of technologies.						L						
		CLO.5: Identify the appropriate procedures required to secure networks.							M					
	Artificial Intelligence and Machine Learning	CLO:1 Learning the basic concepts and skills of Artificial Intelligence.		H		H								M
		CLO:2 Represent Knowledge using propositional calculus and predicate calculus.			H								H	
		CLO:3 Use inference rules to produce predicate calculus expression.		H		H								M
		CLO:4 Demonstrate awareness of informed search and uninformed search techniques.						H		H				

CS243		CLO:5 Explain about AI techniques for planning, knowledge representation and management.		H	H									H
		CLO:6 Outline the process involved in Expert systems and in building such systems.			L								M	
CS257	Agile Methodology	CLO:1 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.		H		H								
		CLO:2 Understand the concept of full stack development and APIs.			H									
		CLO:3 Learn debugging issues and end-to-end testing.		H		H								
		CLO:4 Deliver features in an agile development environment.						H						
		CLO:5 Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.		H	H									
		CLO:6 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.			L									
CS108	Python Basics	CLO1:Run basic python programs		M	H	H								
		CLO2:Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.		H			H							
		CLO3:Logic building using looping and decision statements.		M	H	H								
		CLO4:Develop problem solving abilities using Python.			H		H	H						

		CLO5:Learn building packages and modules for reusability.			H		H	H						
CS135	Advanced Java	CLO1: Students will be able to design the website			H									
		CLO2: Students can develop project using Spring framework skills			H								H	
		CLO3: Students can maintain and enhance existing web platform		H		H								M
		CLO4: Use and Implement several Data structures using Collection Framework.			H								H	
		CLO5: Use database connectivity for a complete Java application.		H		H								M
CS133	Data Visualization and Query Language	CLO1:Infer skills for various performance measures and benchmarking progress towards business goals.						H		H				
		CLO2:Analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.		H	H									H
		CLO3:Create database and work on complex queries.			H	H								
		CLO4:Differentiate various mapping tools.			H		H							
		CLO5:Learn web mapping services requirements.			H		H							

CS134	Business Analytics	CLO1:Understand and critically apply the concepts and methods of business analytics		M	M									
		CLO2:Use basic functions and packages in Python.			H	H								
		CLO3:Understand statistical concepts, skills and different hypothesis tests.		M	H	H		M		H	M			
		CLO4:Learn how to prepare data using Python.					H	M		M				
CS138	Machine Learning	CLO1:Understand and implement classical models and algorithms in machine learning as well as python programming concepts.		M	H									
		CLO2:Analyze the data, identify the problems.		M	H									
		CLO3:Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.			H		H							
		CLO4:Understand the comparative study of the related approaches.			M		H							
		CLO5:Able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.	H	H		H								
CS129	Introduction to Cyber Security	CLO1:Review and practice computer and network etiquette and ethics found in working environments			H									

		CLO2:Perform risk assessment	H	M	H	H							H	
		CLO3:Install, configure, use and manage anti malware software on a working network	H	M	H		H						H	
		CLO4:Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems	H	M	H	H							H	
		CLO5:Articulate informed opinion about issues related to cyber security	H	M	H		H						H	
CS130	Cyber Security for Forensics & Investigation	CLO1:Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.		H	H									
		CLO2:Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).		H	H	H							H	
		CLO3:Use tools for faithful preservation of data on disks for analysis.		H			H							
		CLO4:Find data that are hidden on a computer disk.		H	H	H							H	
		CLO5:Learn the skills to use of computer forensics tools used in data analysis, such as searching, absolute disk sector viewing and		H			H							

		editing, recovery of files, password cracking, etc.												
CS131	Malware and Reverse Engineering-I	CLO1: Student will be able to apply malware analysis methodology and technology		M	H									
		CLO2: Student will be able to applystatic malware analysis skills.		M	H									
		CLO3: Able to identify basic and some malware functionality			H		H							
		CLO4: Identify known anti-reverse engineering techniques			M		H							
		CLO5: Student will be able to conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.		H		H								
CS132	Malware and Reverse Engineering-II	CLO1: Student will be able to apply malware analysis methodology and technology skills.		M	H									
		CLO2: Student will be able to apply advanced static malware analysis.		M	H									
		CLO3: Able to identify basic and some advanced malware functionality			H		H							
		CLO4: Identify known anti-reverse engineering techniques			M		H							
		CLO5: Student will be able to conduct an analysis without revealing that the	H	H		H								

		investigation is taking place and/or revealing their identity.												
GPP101	Fundamentals of Game Programming	CLO1: Students will develop the skill to be able to program for a game.			H									
		CLO2: Students can develop their own games.	H	M	H	H							H	
		CLO3: Students can perform their games on multiple platforms.	H	M	H		H						H	
		CLO4: Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.	H	M	H	H							H	
		CLO5: Seek new knowledge of games development through self-directed study.	H	M	H		H						H	
GPP103	Graphics Programming	CLO1: Students will be able to program computer graphics renderers.		H	H									
		CLO2: Students will learn the skills to develop OpenGL applications.		H	H	H							H	
		CLO3: Students can perform transformations on objects in graphics application.		H			H							
		CLO4: Analyze, synthesize, and utilize design processes and strategy from concept to delivery to creatively solve communication problems.		H	H	H							H	

		CLO5: Create and develop skill in communication solutions that address audiences and contexts, by recognizing the human factors that determine design decisions.		H			H								
GPL104	Game Design – BG	CLO1: Generate the skill of innovative ideas, and go beyond the obvious and predefined.		H	H										
		CLO2: Listen to, evaluate, and respond critically to the ideas of others.		H		H	H								
		CLO3: Identify steps, develop and manage a successful professional workflow.		M	H	H								H	
		CLO4: Synthesize trends, theories, and movements in the development of new ideas		H		H	H								
		CLO5: Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work		M	H	H								H	
GPL102	Game Design – 2D & 3D	CLO1: Generate the skill of innovative ideas, and go beyond the obvious and predefined.		H	H										
		CLO2: Listen to, evaluate, and respond critically to the ideas of others.		H		H	H								
		CLO3: Identify steps, develop and manage a successful professional workflow.		M	H	H								H	

		CLO4: Generate innovative ideas, and go beyond the obvious and predefined.		H		H	H							
		CLO5: Synthesize trends, theories, and movements in the development of new ideas.		M	H	H							H	
GPP107	Unity Game Development	CLO1: Development of 2D & 3D games using the learned skills.			H	H	H						H	
		CLO2: Development of Special effects and Multiplayer games			H	M								
		CLO3: Apply mathematical and game programming knowledge and skills to solve development tasks.				M	M							
		CLO4: Build familiarity and appreciation of the programmatic components of an industry standard game development engine.								H			H	
		CLO5: Seek new knowledge and skill development of games development through self-directed study.			H	H	H						H	
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	CLO1: Understanding of the key concepts, skills and trends associated with Digital Marketing & Internet Technologies for becoming entrepreneurs.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H		

		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.				H	H				H		H	
		CLO4: Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.					H	M		H	M	H		
		CLO5: Interpret for skill development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.				H	H				H		H	
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & InternetTechnologies for entrepreneurs.				H	H				H		H	

		CLO4: Analyze the confluence of marketing, operations, and human resources in real-time delivery.					H	M		H	M	H		
		CLO5: Demonstrate cognitive knowledge of the skills required in CLO6: conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities				H	H				H		H	
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies for entrepreneurs.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.				H	H				H		H	
		CLO4: Find out the significance of Search Engine Marketing and Social Media Optimization					H	M		H	M	H		
		CLO5: Analyze various ranking factors of online applications with Search Engine				H	H				H		H	

		Optimization Techniques useful for entrepreneurs.													
CS144	Affiliate Marketing and Online Reputation Management (ORM)	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M			
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H			
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.	H			H	H				H		H		
		CLO4: Find out the significance of Search Engine Marketing and Social Media Optimization useful for entrepreneurship					H	M		H	M	H			
		CLO5: Analyze various ranking factors of online applications with Search Engine Optimization Techniques useful for entrepreneurs.	H			H	H				H		H		
EP101	Entrepreneurship and Opportunity	CLO1:Sell themselves and their ideas and become entrepreneurs.		H			H								
		CLO2:Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.	H	H	H	H									

		CLO3:Find problems worth solving.	H	H		H								
		CLO4:Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.			H		H							
		CLO5:Increase their awareness and deliberately practice the entrepreneurship skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.			H		H							
EP102	Consumer&MarketResearchfor Entrepreneurs	CLO1:Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.												
		CLO2:Understand the process that enables entrepreneurs with limited resources.		H	H									
		CLO3:Understand and apply fundamental aspects as a means of personal empowerment.			H	H								
		CLO4:Help a company or business development, through proper planning, organization, and both human and material		H	H			H					H	

		resources control, and thus satisfy all specific needs within the market, at the right time.												
		CLO5:Satisfy customer's specific needs through a required product or service.			H		H						H	
CS168	UX Design and Digitization	CLO1:Understand what interaction design is, the importance of user-centred design and methods of user information gathering.		H	H									
		CLO2:Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.		H	M									
		CLO3:Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.		M	H	H								
		CLO4: Differentiate between OLAP AND OLTP. Analyse and critique the design of interactive products.				H								
		CLO5:Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.		M						M			H	
CS169	User Interface Design	CLO1:Construct navigation that enables users to easily accomplish tasks.	H											
		CLO2:Determine which data to display in order to meet user needs.		H										

		CLO3:Enable users make social connections through their mobile devices.		H	H									
		CLO4:Focus on patterns that bring clarity.			H	H								
		CLO5:Learn the skills of design strategy development that provides solutions to meet business and user goals.		H	H	H	H							
CS170	Empathy and its Tools	CLO1:Use empathy to change behaviour and build better relationship skills.		H	H									
		CLO2:Develop empathy through role-play activities.		M	H									
		CLO3:Explain what it means to have different perspectives.			H	H								
		CLO4:Empathy prepares students to be leaders in their community.	H	H	H	H								
		CLO5:Understand the key difference(s) between empathy and sympathy.	H	H		H								
CS122	Business Intelligence and Data Warehousing	CLO.1 Speculate various models and algorithms in data warehousing.		H	H									
		CLO.2 Analyze various database problems and to find out the relevant information out of big data.		H	H									
		CLO.3 Implement major algorithms that generates frequent itemset		M	H									

		CLO.4 Differentiate between OLAP AND OLTP.			H	H								
CS121	Software Quality Assurance and Testing	CLO.1 Understand software testing and quality assurance as a fundamental component of software life cycle						H		H	H			
		CLO.2 Infer various software models concepts and skills for making the software.									H	H		
		CLO.3 Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.			H			H		H				
		CLO.4 Make sure that the result meets the business and user requirements Software testing plays an instrumental role.		M	H			M						M
		CLO.5 Satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.		M			H				H	H		
CS245	Big Data Analytics	Speculate various models and algorithms in Big Data Analytics.					M				M	H		
		Analyze various database problems and to find out the relevant information out of big data.	H	H	M		M				H		H	

		Implement major algorithms that generates frequent itemset.		M	H	H	H				H		H	M
		Use clustering techniques for maintaining database integrity.	H	H	M		M				H		H	
		Model an application's data requirements using conceptual model tools skills like BI tools and strategies								H				
CS162	Full Stack Development	CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet					M				M	H		
		CLO.2 Apply basic design principles to present ideas, information, products, and services on websites	H	H	M		M				H		H	
		CLO.3 Apply basic programming principles to the construction of websites		M	H	H	H				H		H	M
		CLO.4 Effectively manage website projects using available resources	H	H	M		M				H		H	
		CLO.5 Demonstrate communication skills, service management skills, and presentation skills		M	H	H	H				H		H	M
CS154	Computer Graphics	CLO.1 Students will be able to explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.		M	H	M								

		CLO.2 Students will be able to apply the concepts of colour models, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering.			H		H	M						
		CLO.3 Students will be able to interpret the mathematical foundation of the concepts of computer graphic skills.		M		H		M						
		CLO.4 Students will be able to describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.			H		H	M						
		CLO.5 Students will be able to identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.					M							
		CLO.6 Students will be able to create effective programs to solve graphics programming issues, including 3D transformation, objects modelling, colour modelling, lighting, textures, and ray tracing.		M		H		M						
CS4003	Network Security	Explain about the OSI Security architecture and various Crytographic techniques.	H	M	H								M	
		Describe about the data encryption standard, block ciphers and block ciphers mode of operation.	H	M	M								M	
		Describe the principles of various public key cryptosystems	H	H		M								
		Explain the need for authentication and various authentication system methods.	M	M		M								

		Illustrate the different types of threats and attacks in data networks and explain about Internet and Mobile security	M	M	H									
CS204	Lab Oriented Project	CLO.1 To acquire presentation and communication skills						H				M		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.						H			H			
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach						M	H		H			
		CLO.4 To implement learning in real life problem for skill development						H	M					
		CLO.5 Satisfy customer's specific needs through a required product or service.						M	H		H			
CS244	Professional Practices-Coding	CLO1 Formulate problem solutions by incorporating advanced programming skills.						H	M					
		CLO2 Choose the appropriate searching and sorting technique.		M	H	M								
		CLO 3 Demonstrate the advantages and disadvantages of specific techniques to be used.			H		H	M						
		CLO4 Develop programs using basic data structures like stack and queue.		M		H		M						

		CLO 5 Formulate new solutions for programming problems or improve existing code to program effectively.			H		H	M						
CS203	Integrated Project-I	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 Satisfy customer's specific needs through a required product or service.								H				
CS187	Integrated Project –II (Full Stack Development)	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M

		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 Satisfy customer's specific needs through a required product or service.								H				
CS251	Co-op project at Industry Module-I	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS252	Co-op project at Industry Module-II	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M

		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M