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 undergraduate 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, ACM, IEI, 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)

Mandatory Courses: These courses are intended for students to gain general knowledge, learn a new skill or develop personal interests. These courses may be offered in any semester of the program.

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	Computer Programming-I	4-0-2	5
2	Introduction to Web Technologies	3-0-2	4
3	Calculus and Statistical Analysis	4-1-0	5
4	Modern and Computational Physics	3-0-0	3
5	Modern and Computational Physics Lab	0-0-2	1

6	Environmental Sciences	2-0-0	2
	Total	**23**	**20**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Computer Programming-II	4-0-2	5
2	Introduction to Linux	3-0-2	4
3	Operating System	3-0-0	3
4	Differential Equations and Transformations	4-1-0	5
5	Basics of Electronics Engineering	3-0-0	3
6	Basics of Electronics Engineering Lab	0-0-2	1
7	Human Values and Professional Ethics	1-0-0	0
8	English-I	0-0-2	1
		27	**22**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Database Management Concepts	3-0-0	3
2	Database Management Concepts Lab	0-0-2	1
3	Principles of Computer Networks	3-0-0	3
4	Principles of Computer Networks Lab	0-0-2	1
5	Problem Solving Using C	3-0-0	3
6	Problem Solving Using C Lab	0-0-2	1
7	Advanced Web Technology	3-0-0	3
8	Advanced Web Technology Lab	0-0-2	1
9	Engineering Exploration	2-0-0	2
10	Discrete Structures	4-0-0	4
		26	**22**

Semester-4			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Design & Analysis of Algorithms	3-0-2	4
2	Web Programming and Source Code Management	3-0-2	4
3	Data Structure	3-0-2	4
4	Theory of Computation	3-1-0	4
5	Integrated Project-I	0-0-4	2
6	Spanish / German / Japanese	0-0-4	2
7	Cyber Security	2-0-0	0
		29	**20**

Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	OOPS and IT Design Concepts	4-0-0	4
2	Advanced Data Structures	3-0-2	4
3	Front End Development	2-0-4	4
4	Back End Development	2-0-4	4
5	Algorithm Design & Implementation	0-0-4	2

6	Introduction to Cloud Computing	4-0-0	4
7	Disaster Management	2-0-0	0
		31	**22**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Professional Practices -System Design	4-0-0	4
2	React Native	2-0-4	4
3	Software Engineering & Quality Assurance	4-0-0	4
4	Integrated Project-II	0-0-4	2
5	Professional Elective - I	**	
6	Professional Elective – II	**	8#
7	Open Elective-I	**	3
		28**	**25#**

Semester-7			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Open Elective-II	3-0-0	3
2	Open Elective-III	3-0-0	3
3	Open Elective-IV	3-0-0	3
4	Open Elective-V	3-0-0	3
5	Advanced Operating Systems	4-0-0	4
6	Cryptography & Network Security	4-0-0	4
7	Artificial Intelligence and Expert System	4-0-0	4
		24	**24**

Semester-8			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	---	12
2	Professional Electives-III	**	
3	Professional Electives-IV		8#
		---	**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's choice-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					
Evaluation Component	Weightage (%)	Evaluation Component	Weightage (%)	Evaluation 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 Departmentmay 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	
Evaluation 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	
Evaluation 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	
Evaluation 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.

Evaluation for Mandatory Courses: There is only End term Examination for these courses with 100% weightage.

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:

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

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 applpy 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	5	17	4	85	16	15	42	**184**

- In addition to these courses, a student must takethreemandatorycourses
- 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)			**5**
CL102/103/ 104	Spanish / German / Japanese	0-0-4	2
CL101	English-I	0-0-2	1
ES101	Environmental Sciences	2-0-0	2
Basic Science Courses (BSC)			**17**
AM121	Calculus and Statistical Analysis	4-0-0	4
AM122	Differential Equations and Transformations	4-1-0	5
AM103	Discrete Structures	4-0-0	4
PH121	Modern and Computational Physics	3-0-0	3
PH111	Modern and Computational Physics Lab	0-0-2	1
Engineering Science Courses (ESC)			**4**
EC101	Basics of Electronics Engineering	3-0-0	3
EC102	Basics of Electronics Engineering Lab	0-0-2	1
Professional Core Courses (PC)			**85**
CST101	Database Management Concepts	3-0-0	3
CSP101	Database Management Concepts Lab	0-0-2	1
CST102	Principles of Computer Networks	3-0-0	3
CSP102	Principles of Computer Network Lab	0-0-2	1
CS111	Introduction to Web Technologies	3-0-2	4
CS114	Data Structures	3-0-2	4
CST107	Advanced Web Technology	3-0-0	3
CS115	Operating System	3-0-0	3
CSP107	Advanced Web Technology Lab	0-0-2	1
CST109	Problem Solving Using C	3-0-0	3

CSP109	Problem Solving Using C Lab	0-0-2	1
CS122	Design & Analysis of Algorithms	3-0-2	4
CSL2202	Web Programming and Source Code Management	3-0-2	4
CSL4305	Theory of Computation	3-1-0	4
CS184	OOPS and IT Design Concepts	4-0-0	4
CS2023	Advanced Data Structures	3-0-2	4
CS126	Algorithm Design & Implementation	0-0-4	2
CS151	Introduction to Cloud Computing	4-0-0	4
CS254H	Professional Practices -System Design	4-0-0	4
CS145	Front End Development	2-0-4	4
CS159	Back End Development	2-0-4	4
CS228	Software Engineering & Quality Assurance	4-0-0	4
CS913	Advanced Operating Systems	4-0-0	4
CS903	Cryptography & Network Security	4-0-0	4
CS123	Artificial Intelligence and Expert System	4-0-0	4
CS246	React Native	2-0-4	4

Professional Electives (PE)			**8**
a) Data Science			
CS108	Python Basics	2-0-4	4
CS133	Data Visualization and Query Language	2-0-4	4
CS134	Business Analytics	2-0-4	4
CS254J	Professional Practices- Dashboard Designing	2-0-0	2
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
CS254I	Professional Practices- Unreal Basis	2-0-0	2
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	SearchEngineMarketing(SEO&PPC),WebAnalysisandEmailMarketing&Management	2-0-4	4
CS143	SocialMediaMarketing&OptimizationandDigitalMarketingStrategy&LeadGeneration	2-0-4	4

Open Elective (OE) Courses			**3**
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)			**42**
a) Project			**40**
CS203	Integrated Project - I	0-0-4	2
CS187	Integrated Project - II	0-0-4	2
CS251	Co-op project at Industry (Module-1)	-	12
CS253	Industry Oriented Hands-on Experience	-	12
CS252	Co-op project at Industry (Module-2)	-	12
lCS248	Research Project Dissertation	- - -	
b) Engineering Exploration			2

Mandatory Courses			
HR101	Human Values and Professional Ethics	2-0-0	0
DM101	Disaster Management	2-0-0	0
CS501	Cyber Security	2-0-0	0

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

Course Code	Course Name	L-T-P	Credits
CL101	English	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply grammatical structures in presenting contextual ideas clearly to aid communication.

CLO.2 Elucidate vocabulary progressively and effectively use as per the social condition.

CLO.3 Exhibit the language functionally in real-life situations and social settings, evolving skills to make them competent to deal with industries scenarios.

CLO.4 Determine and demonstrate the usage of the language effectively in both academic and professional setups.

CLO.5 Apply knowledge to new situations to solve problems using required knowledge or skills.

Course Outline:

English in your country, job hunting, world of sport, discussing experiences, planning a trip, wedding bells, telephoning, catching up, around town, Dos and Don'ts, customer care, people are different, facts and figures, the workplace, Medicare.

Recommended Book(s):

1. Cunningham, S. & Moor, P. (2003). Cutting Edge Advanced New Edition Students (Vol. 1st). Pearson Longman.
2. Lawrence J. Zwier. (2021). English for everyday Activities. New Readers Pr.
3. Richard, J. C. (2005). Person to Person—Communicative Speaking and Listening Skills. Oxford University Press.
4. Shapira, N., & Adelson-Goldstein, J. (1999). The Oxford Picture Dictionary: English-Edition. Oxford University Press.

Course Code	Course Name	L-T-P	Credits
CL102	Spanish	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Exhibit basic structures and vocabulary progressively and effectively to understand the nuances of the Spanish language.

CLO.2 Apply the structures and vocabulary introduced in day-to-day conversation primarily focusing on enhancement of oral skills and then the latter three skills of reading, writing and listening.

CLO.3 Develop communicative competence towards its practical implementation in real daily conversations which will enhance their spoken skill properly and effectively during the semester.

CLO.4 Understand the main idea and some detailed aspects of complex or unfamiliar texts and identify, analyze some of the aesthetic functions of language and of literary styles.

CLO.5 Recognize the significance of cultural knowledge in comprehending a written text.

Course Outline:

learn how to present ourselves, to ask questions, the things in the class, greetings and farewell. Communicative resources, Vocabulary in the reception, personal details as if we were famous people, favorite words, ask for personal details in context, to write personal details of your classmates. The names in Spanish, The use of the verbs: *hablar, comprender y vivir*plus the verb *querer,* how to show preferences for social activities such as to dance salsa *bailar salsa,* reminder of the Spanish distinction in the gender, use of the adverbs and how they work in Spanish, interesting places of the Hispanic world, preferences to be done in this course, to learn the meaning of some words and their influence in other languages. Some cities with the name *Santiago* in Spain and other Hispanic countries, cultural aspects, to talk about the format of a blog in Spanish, to learn vocabulary to describe the weather, grammatical differences of *qué, cuál,* The life of some animals in Spain, demographic information about Argentina, to learn vocabulary to do shopping in the Spanish city of Málaga, do some shopping in a Spanish website, the use of the Spanish pronouns such in the expression *esta o esta,* numbers from 0 to 1000.0000.0000. demonstratives, the define article plus adjectives, the expression *qué + sustantivo + cuál/cuáles*. to use the vocabulary to describe pictures, to relate information of some famous people "celebrities in Spain" to their images, to describe the activities done by a person during her weekend. to talk about physical appearance, changes in the mood, the verb *gustar,* to give information about the members of one's family, to talk about the own mood and personality, to describe the likes according to an activity such as a festival, to use vocabulary to refer to the first hours in the week, the days of the week, to use the vocabulary related to our own hygiene, the reading of one of the most famous comic in Spanish. to learn the hours in Spanish, to describe a regular day in your life, to make and organize the activities in a schedule, to use the vocabulary learned when doing the bed. to talk about the Christmas day (Three Kings Day) to use the verbs:*vestirse, acostarse, despertarse y salir,* more vocabulary of the days of the week, the time, to localize the day, to recognize a sequence in a period of time, the irregular verbs. to use vocabulary about the physical condition, the use and discrimination of *primero, después, y luego,* a contest about some awards for some students in the class. The use of statistics in a graph and their specific vocabulary, general summary of all the aspect such as grammatical points, lexical items, the use of the verbs of the unit.

Recommended Book(s):

1. Saavedra, M. de C. (2014). El Quijote para estudiantes de español. Libro de lectura.: The Quixote for Spanish learners. Reading Book Level A2. Read It!
2. Warhol, A. (1989). Madrigal's Magic Key to Spanish: A Creative and Proven Approach. Crown Reissue.
3. Collins. (2018). Easy Learning Spanish Grammar. Collins.
4. Lobato,Jesus Sanchez. (2017). Nuevo Espanol Sin Fronteras ESF1. Goyal Publisher.

Course Code	Course Name	L-T-P	Credits
CL103	German	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the everyday expressions in German Language.
CLO.2 know about German culture.
CLO.3 Understand very simple communication in German.
CLO.4 Converse about basic topics in German.
CLO.5 Apply the structures and vocabulary introduced in day-to-day conversation primarily focusing on enhancement of oral skills and then the latter three skills of reading, writing and listening.

Course Outline:

Ice Breaker, Self-Introduction, Alphabets, Begrüßungen, Basic Phrases, Pronouns, Fragewort, Wochentage, Monate, Introduction of Prepositions (Präpositionen), Articles, Unregelmäβige verben, Vornamen, Nachnames, Marital Status (Familienstand), Counting (Zahlen) till 100 (bis 100), Landeskunde, Culture (Kultur), Sightseeing (Sehenswürdigkeiten), Food (Essen) and Drinks (Getränke), Wohnen, Countries and their Capitals (Länder und Hauptstädte), Introduction of Question Words (Fragewörter), Listening Activities (Hörübungen), Unofficial Time (Privat Uhrzeit), Offcial Time (OffizieleUhrzeit), Conjugation (Konjugation) of Regular verbs (Regelmäβige verben), Fruits and Vegetable (Obst und Gemüse), German Song (Deutsches Lied), Means of Transport (Verkehrsmittel), Hobbies (Hobbys), Sport (Sportarten), Skype Session or Interactive Session with a Native German Profession (Beruf), German Movie (Deutsche Filme), Activities: Quiz and Worksheet.

Recommended Book(s):

1. Friederike, Jin. (2017). Grammatik aktivÜben, Hören, Sprechen A1-B1: MitPagePlayer. FRAUS;
2. Pawel Karnowsk. (2016). Deutsch intensivHören&Sprechen B2 Buch. Klett.
3. Silke Hilpert,& Anne Robert. (2017). Schritte international—Deutsch alsFremdsprache, Bd.6, Kursbuch.
4. Silke,Demme. (2005). Studio d: Kurs- und Arbeitsbuch A1. Cornelsen Verlag GmbH & Co.

Course Code	Course Name	L-T-P	Credits
CL104	Japanese	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the everyday expressions, Idioms, phrases with Japanese Culture.

CLO.2 Understand Japanese Scripts (Hiragana, Katakana).

CLO.3 Help the students to speak, listening and writing.

CLO.4 Exhibit the language functionally in real-life situations and social settings, evolving skills to make them competent to deal with industries scenarios.

CLO.5 Determine and demonstrate the usage of the language effectively in both academic and professional setups.

Course Outline:

Orientation of Japanese language, Ice- breaking, Introduction of Scripts, Greetings, self-Introduction, Tense, Counting, Months name, Days of the week, Dates of the months, Addition, Subtraction, Division, Multiplication, Percentage, This/That, What, Particle no, ka + Home Assignments, Here/There, where, who, which, Countries + Home Assignments, Fruits name, Vegetables name, Colours name, Sports in Japanese, Suki, kirai with Particle ga, How much + Home Assignments, Japanese Song, Time, minutes, Particle ni, kara ~made, Expression of directions- (go, come, come back), Family chart, particle- de, e, when, Transitive verbs, shall i?, Particle wo, Give/Receive, Adjectives, Has/Have, Japan work culture, Comprehension Practice, Paragraph Writing, Discussion about Japanese- India places in Japanese through Comprehension, Jumbles sentence assignment, Students will make sentences through the picture, Assignment will do, how to crack Japanese Interview, Group discussion about culture, Positive, Negative, Students will record their skit, Discussion about Prepared Skit.

Recommended Book(s):

1. Stout,Timothy G. (2011). Japanese Hiragana & Katakana for Beginners: First Steps to Mastering the Japanese Writing System. Tuttle Publishing.
2. Stout,Timothy G. (2017). Japanese Kanji for Beginners. Tuttle Publishing.
3. Chieko Kano. (2015). BASIC KANJI BOOK. Bonjinsha.
4. Jpinsiders. (2018). Learn Japanese Book for Beginners: Learn Practical & Conversational Japanese. Yuto Kanazawa.
5. Kakuko Shoji, Common Japanese Collocations: A Learner's Guide to Frequent Word Pairings, Kodansha International, Bilingual edition

Course Code	Course Name	L-T-P	Credits
CSL254	Professional Practices	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify a new technology that will solve a problem in an organization
CLO.2 Gain skillset to examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G technologies
CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field
CLO.4 Understand, and contrast supervised and un-supervised learning algorithms.
CLO.5 Understand the context of information security with respect to social engineering and cyber security.
CLO.6 Recognize the importance of ethical practices with new technologies
CLO.7 Understand and review current literature on the selection, implementation, and evaluation of new and emerging technologies and their impacts

Course Outline:

Skillsets and traits for the future, 5G a revolution for communication services providers and consumers, social engineering in cyber security, machine learning and artificial intelligence, leading through crisis, future of technology, building scalable Android apps, impact vs actions, future trends of databases, impact of Covid – evolving skills, career and life, technical and HR skills for future readiness, demystifying AI/ML, data 4.0 journey, self-awareness for professional success, agile workforce.

Recommended Book(s):

1. Pramod Kumar, Anuradha Tomar, R. Sharmila, Emerging Technologies in Computing Theory, Practice, and Advances, Chapman and Hall/CRC
2. Kevin Kelly, The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future, Penguin; 1st edition
3. Klaus Schwab, The Fourth Industrial Revolution, Portfolio Penguin
4. Gerald C. Kane, Anh Nguyen Phillips, Jonathan R. Copulsky, Garth R.
5. Andrus, The Technology Fallacy: How People Are the Real Key to Digital Transformation (Management on the Cutting Edge), The MIT Press

Course Code	Course Name	L-T-P	Credits
ES101	Environmental Sciences	2-0-0	0

Course Learning Outcomes:

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. Bharucha, E. (2004). Textbook of Environmental Studies for Undergraduate Courses, First Edition, University Grants Commission, Universities Press (India) Private Limited.
2. Randhawa, M. (2014). The Basics of Environmental Sciences, Chitkara University publications, First edition
3. Rajagopalan, R. (2016). Environment And Ecology – A Complete Guide. Lexis Nexis, First edition.
4. Wright. Richard T. and Bourse. Dorothy F. (2016). Environmental Science: Toward A Sustainable Future, Benjamin-Cummings Pub Co, 13th edition.
5. Keen, M., Brown, Valerie A., Dyball, R. (2005). Social Learning in Environmental Management: Towards a Sustainable Future, Routledge, 1st edition.
6. Cunningham, William P. and Cunningham, Mary A. (2012). Principles of Environmental Science, McGraw-Hill Science Engineering, 7th edition.

Course Code	Course Name	L-T-P	Credits
AM121	Calculus and Statistical Analysis	4-0-0	4

Course Learning Outcomes:

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 textbook 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	4-1-0	5

Course Learning Outcomes:

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, ChitkaraUniversity Publication, Vol. II, First Edition
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:

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, ThirdEdition.
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	3-0-0	3

Course Learning Outcomes:

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, stimulated absorption, 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 superparamagnetic 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.gLavitation Effect, SQUID,Quantum Mechanics, Introduction to Quantum Mechanics, Group velocity and phase velocity, de-Broglie waves, Uncertainty principle, Wave function and its significance, Normalised wave function, 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 DhrubesBiswas, "Semiconductor Physics and devices", , Mc Graw Hill, Second Edition

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

Course Learning Outcomes:

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, Eng. Physics Theory and Practicals, Wiley (1 January 2015)
3. Donald A Neamen and DhrubesBiswas, "Semiconductor Physics and devices",Mc Graw Hill, Second Edition
4. Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K. SRudramba, Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K.S Rudramba, Eng. PhysicsPractical, 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:

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.

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 Able to 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).

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:

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,Third Edition,
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, Fifth Edition

Course Code	Course Name	L-T-P	Credits
EC106	Digital Electronics and Logic Design Lab	0-0-2	1

Course Learning Outcomes:

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 Implementation 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

Course Code	Course Name	L-T-P	Credits
CST101	Database Management Concepts	3-0-0	3

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
CSP101	Database Management Concepts Lab	0-0-4	2

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Apply the basic concepts of Database Systems and Applications.
CLO.2 Use the basics of SQL and construct queries using SQL in database creation and interaction.
CLO.3 Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
CLO.4 Analyze and Select storage and recovery techniques of database system.
CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills

Course Outline:

Introduction to SQL and architecture of database (tool to be used), Using DDL, DML, DCL commands, Exploring select clause and its single row functions, group functions, Implement nested and co-related queries, Table Creation and alteration, Insert, Update and delete, Views

Suggested Books:

1. Silberscatz, Abraham & Korth, Henry F. (2011). Database System Concepts. (2nd ed). McGraw-Hill.
2. Date, C.J. (2011). An Introduction to Database Systems (4th ed). O'Reilly Media.
3. Desai, Bipin.C.(2013). An Introduction to Database Systems (8th ed). West Group Division.
4. Elmasri, Ramez Z.& Navathe, Shamkant B. (2013). Database Systems. (7th ed). Pearson Education.
5. Elmasri, Ramez Z.& Navathe, Shamkant B. (2014). Fundamentals of Database Design. (7th ed). Pearson Education

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

Course Code	Course Name	L-T-P	Credits
CSP102	Principles of Computer Networking 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. (2nded), 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
CST125	Fundamentals of Web Technology	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the semantic web vision and technologies.
CLO.2 Apply the multimedia content, client-side programming and transformation of web content.
CLO.3 Employ modern tools and technologies for the development of web pages.
CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.
CLO.5 Examine the adaptability of scripting languages in web development.
CLO.6 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, Fourth Edition
2. Thomas Powell," The Complete Reference HTML & XHTML", Tata McGraw-Hill Company Limited, Fifth Edition,
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, Seventh edition,
5. NiederstRobbins," Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics", Oreilly Publication, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CSP125	Fundamentals of Web Technology Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Applying the semantic web vision and technologies.
CLO.2 Implementation of client-side programming and transformation of web content.
CLO.3 Experimentation on modern tools and technologies for the development of web pages.
CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.
CLO.5 Apply the adaptability of scripting languages in web development.
CLO.6 Develop web-portals independently or in teams.

Course Outline:

This course is designed to equip students with practical skills and an understanding of the underlying advanced principles of programming the World Wide Web. Major topics include advanced concepts of Internet and Web server, advanced implementations of Client-side programming using HTML5, Cascading Style Sheets, and JavaScript Server-side programming using PHP and setting up a business website

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CST106	Data Structures With C++	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Summarize different categories of Data Structures
CLO.2 Identify different parameters to analyze the performance of an algorithm.
CLO.3 Explain the significance of dynamic memory management Techniques
CLO.4 Design algorithms to perform operations with Linear and Nonlinear data structures
CLO.5 Illustrate various technique to for searching, Sorting and hashing
CLO.6 Choose appropriate data structures to solve real world problems efficiently.

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, Anita Huray, "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
CST107	Advanced Web Technology	3-0-0	3

CourseLearningOutcomes:

Students will be able to:

CLO.1 Manipulateelementsonawebpageandrespondingtouserinteractions

CLO.2 Developweb,desktop,andmobileapplications 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, BScarousel, bootstrap grids, angular js, databinding, controllers, scopes, filters, forms &validations,filestructures.

Recommended Book(s):

1. Robbins, Niederst (2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics (4thed). 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. (5thed). Tata McGraw-Hill.
4. Laura, Janan Lemay &Rafe, Coburn (2017). Mastering HTML, CSS &JAVAScript. (7th ed) SAMS publication.

Course Code	Course Name	L-T-P	Credits
CS105	Computer Programming-II	4-0-2	5

Course Learning Outcomes:

Students will be able to:

CLO1 Formulate problem solutions by incorporating advanced C programming constructs.

CLO2 Choose the appropriate searching and sorting technique.

CLO3 Demonstrate the advantages and disadvantages of specific techniques to be used.

CLO4 Develop programs using basic data structures like stack and queue

CLO5 Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outline:

Introduction, basics of C programming, functions, arrays, variables, datatypes, expressions, statements, loops, Time and space complexity, Memory model, storage classes, pointers, function pointers, recursion, stack, sorting , structure and queues.

Recommended Book(s):

1. Balagurusamy, E. (2016). Programming In Ansi C.
2. Kernighan, B. W., & Ritchie, D. M. (2002). The C programming language.
3. R3: Thareja R. (2018). Programming in C.
4. R4: Kanetkar, Y. (2018). Let us C. BPB publications.
5. R5: Mittal, A. (2010). Programming in C: A Practical Approach. Pearson Education India.

Course Code	Course Name	L-T-P	Credits
CS104	Computer Programming-I	4-0-2	5

Course Learning Outcomes:

Students will be able to:

CLO1 Analyze the problem statement.

CLO2 Choose the appropriate C programming constructs to solve the problems.

CLO3 Demonstrate the advantages and disadvantages of specific techniques to be used.

CLO4 Differentiate between efficient and inefficient way of programming

CLO5 Determine and demonstrate bugs in a program and recognize needed basic operations.

CLO6: Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outline:

Introduction, to C programming, functions, arrays, variables, datatypes, expressions, statements,loops.

Recommended Book(s):

1. The C Programming Language' by Dennis Ritchie and Brian. W. Kernighan, 2nd edition, Prentice Hall
2. Programming in C:A practical Approach' by Ajay Mittal, 1st edition, Pearson Publication
3. Introduction to Programming in C' by Reema Thereja, 2nd edition, Pearson Publication
4. C: The Complete Reference 'by Herbert Schildt, 4th edition, McGraw-Hill Education

Course Code	Course Name	L-T-P	Credits
CS110	Introduction to Linux	3-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO1: To Understand and work in Linux command line interface with various tools.

CLO2: To Create shell scripts for various administrative purpose.

CLO3: Apply various tools and techniques for User Management, Permission Management and File System Management.

CLO4: To learn C programming using GCC Compiler

CLO5: Apply this course knowledge for Real time Linux Server management being used in Industry (RHEL/CentOS etc.)

Course Outline: Introduction to linux, OS, Hstory of linux, linux architecture, dual booting, GRUB, mounting, unmounting, Linux file system, Basic commands in linux, root, regular expressions, file types.

Recommended Book(s):

1. Red Hat 9 Linux Administration: Pablo Eranzo, Scott Maccarty, Packt publishing 2022.
2. Your Unix - The Ultimate Guide' by Sumitabha Das, 4th Edition, Tata McGraw-Hill.
3. A Practical Guide to Linux' by Mark G. Sobell , 2ndEdition, Pearson Education.
4. 'Unix Shell programming' by Yashwant kanetkar, 1st Edition, BPB Publications.
5. Linux the Complete Reference, John Purcell, 6th edition, Walnut Creek.

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

Course Learning Outcomes:

Students will be able to:

CLO1: Students will be able to identify different types of Operating System and their components.
CLO2: Design and implementation of new system calls for any open source operating system.
CLO3: Implementation of existing resource management algorithms in Linux operating system.
CLO4: Students will be able to identify various system security and protection issues.
CLO5: Students will be able to completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.

Course Outline: An introduction to the operating system along with different concepts like memory management, security, types of operating systems, etc. are covered in this subject., The system programs, operating system generations, OS services, system calls, etc. are covered in this subject. The concepts of process, process control block, scheduling queues in a process, multithreaded programming, and related concepts are covered in this subject. Characterization of deadlock, system deadlock, preventing deadlock, and related concepts are covered in this subject.

Recommended Book(s):

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (ASIA) Pvt. Ltd, 9th Edition
2. D.M. Dhamdhere, "Systems Programming and Operating Systems", Tata McGraw Hill Publishing Company Limited, 2nd Revised Edition
3. Andrew S. Tanenbaum, "Modern Operating System", Prentice-Hall, 2nd Edition
4. W Stallings, Operating System, MacMillan Publishing Company, 5th Edition
5. Naresh Chauhan, Principles of Operating Systems, Oxford University Press,1st Edition

Course Code	Course Name	L-T-P	Credits
CS111	Introduction to Web Technologies	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO1: Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.

CLO2: Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.

CLO3: Use JavaScript to manipulate elements in the DOM to change appearance and visibility.

CLO4: Describe how intended website design features will specifically benefit a target user group content strategy.

CLO5: Demonstrate and develop web-portals independently or in teams.

Course Outline:

Create web pages using XHTML and Cascading Style Sheets. Build dynamic web pages using JavaScript (Client side programming). Create XML documents and Schemas.

Recommended Book(s):

1. R1: H. B. Covers CSS3. Javascript, XML, XHTML, Ajax, PHP and Jquery..
2. R2: Duckett, B. J. (2008). Beginning Web Programming with HTML. XHTML, and CSS, 2nd
3. Edition, Wrox.
4. R3: Meloni, J. C., & Kyrnin, J. (2018). HTML, CSS, and JavaScript All in One, Sams Teach
5. Yourself. Sams Publishing.
6. R4: Humphrey, B. (2016). Get Coding! Learn HTML, CSS & JavaScript & Build a Website, App &
7. Game. The School Librarian, 64(3), 189.

Course Code	Course Name	L-T-P	Credits
CSP107	Advanced Web Technology Lab	0-0-2	1

CourseLearningOutcomes:

Students will be able to:

CLO.1 Develop webpageswhich can respondtouserinteractions

CLO.2 Implement web,desktop,andmobileapplications skills

CLO.3 Apply Angular JS to develop cross-platform applications

CLO.4 Apply and experiment on core jQuery features which would help in designing GUI.

CLO.5 Apply 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, BScarousel, bootstrap grids, angular js, databinding, controllers, scopes, filters, forms &validations,filestructures.

Recommended Book(s):

1. Robbins, Niederst (2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics (4thed). 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. (5thed). Tata McGraw-Hill.
4. Laura, Janan Lemay &Rafe, Coburn (2017). Mastering HTML, CSS &JAVAScript. (7th ed) SAMS publication.

Course Code	Course Name	L-T-P	Credits
CSP106	Data Structures With C++ Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Ability to implement linear and non-linear data structure operations.
CLO.2 Identify appropriate data structure operations for solving a given problem.
CLO.3 Apply appropriate use of linear / non-linear data structure operations for a given problem.
CLO.4 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval
CLO.5 Apply the searching and sorting algorithms for problem solving.

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, Anita Huray, "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
CST109	Problem Solving Using C	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Describe the basics of digital computer and programming languages.
CLO.2 Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem.
CLO.3 Design and Implement C program using Control Statements and Functions.
CLO.4 Design and Implement C program using Pointers and File operations.
CLO.5 Identify the need for embedded C in real-time applications.

Course Outline:

This course is aimed at enabling the students to formulate simple algorithms for arithmetic and logical problems, Translate the algorithms to programs (in C language), Test and execute the programs and correct syntax and logical errors, Implement conditional branching, iteration and recursion, Decompose a problem into functions and synthesize a complete program using divide and conquer approach, Use arrays, pointers and structures to formulate algorithms and programs, Apply programming to solve matrix addition and multiplication problems and searching and sorting problems, Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

Recommended Book(s):

1. Jeyapoovan T, “Fundamentals of Computing and Programming in C”, Vikas Publishing house, 2015.
2. 2. Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014

Course Code	Course Name	L-T-P	Credits
CSP109	Problem Solving Using C Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Write high quality code.
CLO.2 Understand the concept of scalability, security and extensible code for software applications.
CLO.3 Learn debugging issues and end to end testing.
CLO.4 Learn skills to deliver features in an agile development environment.
CLO.5 Solve problems iteratively and recursively and design both structured and object-oriented program.

Course Outline:

C++ Fundamentals, arrays, pointers, strings, dynamic memory management, recursion, classes and objects, constructors and destructors, operator overloading, inheritance, virtual base class, overriding, virtual functions, polymorphism, exception handling, templates and generic programming, containers, iterators, vectors, lists, maps, project.

Recommended Book(s):

1. E Balagurusamy," Object Oriented Programming with C++", Tata McGraw-Hill, second Edition
2. Robert Lafore," Object Oriented Programming in Turbo C++", The WAITE Group Press, Fourth Edition
3. Herbert Schlitz," Compete Reference C++", TMH, Fourth Edition
4. Yashavant Kanetkar and Aditya Kanetkar," Let Us C", BPB, Publication, Second Edition

Course Code	Course Name	L-T-P	Credits
CS122	Design & Analysis of Algorithm	3-0-2	4

Course Learning Outcomes:

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, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications, Second Edition,
2. Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein, "Introduction to Algorithms", Prentice-Hall India, Third edition
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
CSL2202	Web Programming and Source Code Management	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop a dynamic webpage by the use of java script and DHTML.
CLO.2 Write a well-formed / valid XML document.
CLO.3 Connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.
CLO.4 Write a server-side java application called Servlet to catch form data sent from client, process it and store it on database.
CLO.5 Write a server-side java application called JSP to catch form data sent from client and store it on database

Course Outline:

This course is aimed at enabling the students to the concepts of web programming. This course is designed to start you on a path toward future studies in web development and design, no matter how little experience or technical knowledge you currently have. Source code management is the add up learning module of this course where students will be exploring GitHub for source code management.

Recommended Book(s):

1. Jon Duckett "Beginning Web Programming" WROX.
2. Marty Hall and Larry Brown "Core Servlets and Java Server pages Vol. 1: Core Technologies", Pearson.

Course Code	Course Name	L-T-P	Credits
CSL4206	Database Management System	3-0-2	4

Course Learning Outcomes:

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):

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

Course Code	Course Name	L-T-P	Credits
CSL4305	Theory of Computation	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Familiar with skills of basic automata theory of computer system.

CLO.2 Understand the working and data flow in computer components.

CLO.3 Understand the challenges for Theoretical Computer Science and its contribution to other sciences such as biology, economics, physics, and many other fields.

CLO.4 Deal with the problems efficiently on a model of computation using an algorithm.

CLO.5 Describe unrecognizable languages and undecidable problems.

Course Outline:

Mathematical notations and techniques, mathematical foundation of theory of computation basic mathematical objects – sets, logic, functions, relations, languages, non-determinism and Kleene's theorem, regular and nonregular languages, context free languages and pushdown automata, non-context-free languages, introduction to Turing machines, unsolvable problems, restricted Turing machines, programming techniques for Turing machines, undecidability, problems about Turing machines, intractable problems, NP complete problems, complements of languages in NP.

Recommended Book(s):

1. KLP Mishra, "Theory of Computer Science", PHI, Third Edition,
2. Hopcroft & Ullman, Addison, "Introduction to Automata Theory, Languages and Computation", Wesley'2007, Second edition.
3. James Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill, India, Second edition.
4. Mahesh, Kavi, "Theory Of computation: problem-solving approach", Wiley, Second edition.
5. Shukla, Rajesh, "Theory of Computation", Cengage Learning, First edition.

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 Understand the Need of Version Control Systems, Type of Repositories → Centralized Vs Distributed, Branches, Check in, Checkout. Conflict, Merge, Tags, Reverting changes, Basics of Branching strategy, Features of Maven, Objectives' of Maven , maven life cycle

CLO.2 Providing guidelines for best practices development. JDK, JRE, JVM, Memory (Heap, Stack) Object, Class, Inheritance, Polymorphic, Abstraction, Encapsulation, Difference between Abstract and Interface Constructor rules in inheritance, Access modifiers in the inheritance chain.

CLO.3 Understanding annotation and creating custom annotationskills

CLO.4 Usage of Generics

CLO.5 Understanding of Logging and working with Log4J

CLO.6 Understanding of XML elements and Schema, Working with files and Serialization

CLO.7 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
CS2023	Advanced Data Structures	3-0-2	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Learn the various data structures used.
CLO.2 Understand the data visualization and analytical skills.
CLO.3 Advance Data Structure analysis and creation
CLO.4 Optimizing complexity using different data structures

Course Outline:

Introduction to Data Structures: Basic Terminology, Classification of data structures, operations on data structures, Abstract Data Types, Time and Space Complexity, Asymptotic Notations. Linear Data Structures: Array, Linked List, Stack and Queue. Trees: Introduction to trees, Binary Trees, Binary Search Trees, AVL Trees, Red-Black Trees, B Trees and B+ Trees. Heaps: Heaps, Binary Heaps, Binomial Heaps, Fibonacci Heaps, Comparison of Binary, Binomial, and Fibonacci Heaps, Applications of Heaps. Graphs: Graph Terminology, Directed Graphs, Bi-connected Components, Representation of Graphs, Graph Traversal Algorithms. Advance Topics in Data Structures: Introduction to Searching, Interpolation Search, Jump Search, Introduction to Sorting, Merge Sort, Quick Sort, Radix Sort, Heap Sort, Hashing and Collision, Memory Management in Data Structures.

Recommended Book(s):

1. Data Structures by Schaums' Outlines Indian Adapted Edition 2006 by Seymour Lipschutz, Published by Tata McGraw-Hill Edition
2. Tanenbaum, Augenstein, & Langsam, Data Structures using C and C++, Prentice Hall of India, Second edition
3. Data structure Theory Problem in Algorithm by R.S Salaria, by Salaria Publisher
4. Data Structures in C by ReemaThareja , Oxford Publication, 3rd Edition
5. Fundamentals of Algorithm by Sahni and Horowitz 2nd Edition
6. Introduction to Algorithms by Coremen 3rd Edition

Course Code	Course Name	L-T-P	Credits
CS126	Algorithm Design & Implementation	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Well versed with Object Oriented Concepts and Java skills.
CLO.2 Have good idea of graph traversal algorithms and hashing techniques.
CLO.3 Write program in Java to solve graph-based problems.
CLO.4 Apply graph searching algorithms to real life problems.
CLO.5 Simulate real world problems to Java based software solutions.

Course Outline:

Java basics, classes & objects, data types & operators, methods & classes, introduction for generation of random numbers, inheritance, packages & interfaces, using I/O, generics, autoboxing, static import & annotations, graph primitives, DFS, BFS, connected components, directed and undirected graphs, balanced search trees and its applications, hash tables.

Recommended Book(s):

1. HerbertSchildt, “The Complete Reference Java”, McGraw Hill Education India, Fifth Edition
2. Data Structures by Schaum’s Outline Seymour Lipschutz,” Tata McGraw-Hill, Second Edition.
3. Kathy Sierra,” Head First Java”,Pearson, Second Edition.
4. Edward G. Finegan,”OCA Java SE8 Programmer I Study Guide”,Oracle Press, Third Edition
5. Norton, Ivor,"Beginning Java 2" Dreamtech Publication, Fifth Editon.

Course Code	Course Name	L-T-P	Credits
CS151	Introduction to Cloud Computing	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CLO.2 Explain the core issues of cloud computing such as security, privacy, and interoperability.
CLO.3 Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
CLO.4 Provide the appropriate cloud computing solutions and recommendations according to the applications used.
CLO.5 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, Fist edition
4. Rajkumar Buyya, Cloud Computing Principles and Paradigms, Wiley, 1st edition

Course Code	Course Name	L-T-P	Credits
CS254H	Professional Practices-System Design	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections.
CLO.2 Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.
CLO.3 Design and implement file management system.
CLO.4 Construct the SQL queries for given specifications.
CLO.5 Explain the functions of the different layer of the OSI Protocol. Skilled to handled different databases.

Course Outline:

Process Management, Process Control Blocks, Process States. Process Control Block (PCB), Process Scheduling Queues. Schedulers, Threading, Memory management (types, fragmentation, paging, segmentation).Scheduling Algorithms pre-emptive and non-pre-emptive.Virtual memory, Demand Paging, page replacement algorithms. Swapping, Thrashing. File System(Types of file system, File system structure). Allocation methods, directory implementation file system vs DBMS. HLD (Decision Tables, Decision Trees, Flow Diagrams, Flow Charts, Data Dictionary), LLD. Case Studies, Scaling (Vertical and Horizontal Scaling) OSI Layers (physical layer). Data link layer, network layer. Transport layer, session layer, presentation layer, application layer. IP addressing. Types of IP address, Classes. SQL Commands, NoSQL (graph, Document, Column family) Practice Queries.Normalization, Indexing Tabular vs Columnar Data.

Recommended Book(s) and References:

1. System Analysis and Design, 7th edition, Julie E Kendall and Kenneth E Kendal, 2009.
2. Systems Analysis and Design, 9th edition, Gary Shelly, Harry J. Rosenblatt, 2011.
3. System Analysis And Design, 5th edition, Wixom & Roth, 2012.
4. Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, 2010.
5. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill, 2007.
6. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition, 2013.

Course Code	Course Name	L-T-P	Credits
CS145	Front-end Development	2-0-4	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 Learning skills to 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 Understand the role and functions of Web servers and server frameworks.

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	2-0-4	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
CS228	Software Engineering& Quality Assurance	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 Editon
2. Ian Sommerville," Software Engineering", Adison- Wesley Pub. Co, Sixth Editon
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
CS913	Advanced Operating System	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Identify different types of Operating System and their components.

CLO.2 Design and implementation advance system calls for any open source operating system.

CLO.3 Implementation of advance resource management algorithms in Linux operating system.

CLO.4 Identify various system security skills and protection issues.

CLO.5 Completely administer the system skills 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.

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 Editon

Course Code	Course Name	L-T-P	Credits
CS903	Cryptography &Network Security	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 Gain skills to critically evaluate the risks and threats to networked computers.
CLO.4 Demonstrate detailed knowledge of the role of encryption to protect data.
CLO.5 Analyze security issues arising from the use of certain types of technologies.
CLO.6 Identify the appropriate procedures required to secure networks.

Course Outline:

Introduction to network security, security attacks, authentication and authorization, overview of computer networking, basics of cryptography, symmetric and asymmetric cryptography, public key crypto system, hash function, MAC, SHA, HMAC, MD5, digital signatures, web security, secure socket layer, firewalls.

Recommended Book(s):

1. William Stallings, 'Cryptography and Network Security- Principles and Practices', 8th Edition,
2. William Stallings, 'Computer Security- Principles and Practice', Ist Edition, Pearson Education
3. William Stallings, 'Network Security Essentials', 4th Edition, Pearson Publication
4. Bruce Schneier, 'Applied Cryptography', Edition 2001, Wiley & Sons Inc
5. Bernard Menezes, 'Network security and Cryptography', Ist Edition, Cengage Learning Publication, Prentice Hall Publication

Course Code	Course Name	L-T-P	Credits
CS123	Artificial Intelligence and Expert System	4-0-0	4

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
CS246	React Native	2-0-4	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 State the fundamental building blocks of mobile apps.
CLO.2 Select various modules for designing React Native components to build powerful and stylish mobile applications.
CLO.3 Use stylesheets, APIs and cross-platform native modules in React Native apps.
CLO.4 Organize React Native components skills and examine the parameter passing mechanism among them.
CLO.5 Debug and use developer Tools to build native mobile applications inn React Native

Course Outline:

React Native - Advantages of React Native- Working with React Native- React Native WorkRendering Lifecycle- Creating Components in React Native- Working with Views- Using

JSX- Styling Native Components- Host Platform APIs. - Building Your First Application:

Setting Up Your Environment - Creating a New Application- Exploring the Sample Code - Building a Weather App.

Components for Mobile - Analogies Between HTML Elements and Native Components -The Text Component- The Image Component- Working with Touch and Gestures- UsingTouchable Highlight- The Gesture Responder System- Pan Responder- Working withOrganizational Components - Using List View- Using Navigators- Other OrganizationalComponents - Platform-Specific Components. Styles: - Declaring and Manipulating StylesOrganization and Inheritance-Positioning and Designing Layouts.

Platform APIs: Using Geolocation- Accessing the User's Images and Camera- StoringPersistent Data with AsyncStore- TheSmarter Weather Application. Modules: InstallingJavaScript Libraries with npm- Native Modules for iOS- Native Modules for Android- CrossPlatform Native Modules.

Debugging and Developer Tools: JavaScript Debugging Practices, Translated- React Native

Debugging Tools - Debugging Beyond JavaScript- Testing Your Code- Putting It AllTogether: The Flashcard Application- Modeling and Storing Data - Using the Navigator- ALook at Third-Party Dependencies - Responsive Design and Font Sizes.

Deploying to the iOS App Store: Preparing Your Xcode Project- Uploading YourApplication-Beta Testing with TestFlight- Submitting the Application for Review -Semester Course Code Title of the Course Hours Credits

Deploying Android Applications: Setting Application Icon- Building the APK for Release - Distributing via Email or Other Links - Submitting Your Application to the Play Store.

Recommended Book(s):

1. JakobIversen, Michael Eierman, "Learning Mobile App Development -A Hands-on Guide to Building Apps with iOS and Android", Addison-Wesley, USA, 2014.
2. Nader Dabit, "React Native in Action"- Developing iOS and Android apps with JavaScript, Manning Publications Co. USA, 2019
   Dotan Nahum, "Programming React Native",Leanpub, Canada, 2016.

Course Code	Course Name	L-T-P	Credits
CS108	Python Basics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Designing real life scenario problems, identifying and analysing solutions for it.
CLO.2 Accurately and efficiently designing the solutions in python.
CLO.3 Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.
CLO.4 Use indexing and slicing to access data in Python programs.
CLO.5 Design loops and decision statements in Python.

Course Outline:

Introduction to objects & Python's math library, strings, lists, dictionary, understanding dictionary specific methods, keys, values, items, copy, update, pop, using * & ** during calling time & receiving time, modules, using Python GUI.

Recommended Book(s):

1. Lutz, Mark, "Learning python", O'Reilly Media, Inc.", Fifth Editon.
2. Zed A.Shaw, Learn python the hard way, Pearson publications, Third Edition
3. Dierbach, Charles, "Python, A Computational Problem-Solving Focus", Wiley,Third Editon
4. Ljubomir,"Introduction to programming using python: An application development focus. Percovic", Wiley, Third Editon

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, 2021 Edition

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
CS254J	Professional Practices-Dashboard Designing	2-0-0	2

Course Learning Outcomes:
Students will be able to:

CLO.1 Learn Design thinkingSKILLS
CLO.2 Convert information into actionable outcomes.
CLO.3 Prototyping data models.
CLO.4 Create dashboards using PowerBI
CLO.5 Learn basic and advanced fundamentals of Excel.

Course Outline:

Introduction What is design thinking? How (Design thinking process), Empathize, Define, Ideate, Prototype, Test, Implement Why is it important? The history of Design thinking the phase of design thinking Clustering ideas and reveal insights: Affinity diagrams. Creating your POV (Point of view) of the problem statement Importance of questioning.Mapping stakeholders in the project. Deciding and presenting most important information needed. Consolidation and Arrangement on a single screen.Definition and importance of Ideation. Discussing around brainstorming techniques, SCAMPER method etc. Selecting the best idea at the end of the session. Definition of prototyping Benefits of prototyping. Test: Evaluate the prototype by asking real users to use it. Implement: Put the vision into effect and ensure that it meets to original objectives. Understand your end goal. Know your purpose and audience Leverage the most-viewed spot. Optimal size of the display / Dashboard / Report Adding interactivity to encourage exploration.Advanced data cleaning and processing REPT, SUBSTITUTE, REPLACE, TEXTJOIN, CONCAT, TEXT, TRIM, CLEAN. Advanced Find and Replace Sorting | Filtering. Sorting data, Advance Sorting Hide/ Unhide data. Filter / Advance Filter Data Validation Sorting | Filtering. Sorting data, Advance Sorting Hide/ Unhide data.Filter / Advance Filter Data Validation. Handling dates Fixing incorrect dates DATE, DAY, MONTH, YEAR LOOKUPs. Understand how to use Vlookup, Hlookup, Index, Match, and Offset functions Understand how to use the SUMIFS function. Designing Interactive Dashboards with MS-Excel Visualization Concepts Tables. Basic Charts (Including custom formatting) Pivot table Pivot Chart Slicer, Timeline Conditional Formatting. Interactive Control Concepts Scrollbar Radio button Checkbox Dropdown list.How to create Form Controls. Create dynamic Interactive Charts in Excel with Form Controls Learn Excel techniques by creating dashboards Creating your own Dashboard – HandsOn Case Studies and HnadsOn Practice Aligning with Design principles. Applying right statistics angle Applying AI insights Comparing content types. Applying styles and layouts: content sizing and layout Web URL Add Logo.AI based intelligent Summary Mobile layout Dashboard and BI Apps. Incorporating Design concepts Dashboard Considerations Choosing right chart type Choosing relevant control Optimal chart Formats Data Modelling Choosing the relevant data for the analysis Type conversions Choosing the right types of relationship between data Schedule Refresh of Data (pro version) Frequency in a given duration Configuring the refresh cycle Using row-level security (RLS) - Role Based Navigation in reports and Dashboards Buttons and actions Drill through Extending report Interactions Using and building report filters Sync Slicer Report level filters Page Level Filterz Hands on Practice Case Studies Dashboard Design Deploy and sharing Publishing dashboards to the web.

Recommended Book(s):

1. The Big book of Dashboards, Steve Wexler, Wiley, 2017.
2. Story telling with data, Cole Knaflic, Wiley, 2015.
3. MICROSOFT EXCEL 2019: DATA ANALYSIS &BUSINESS MODEL, PHI Learning Pvt. Ltd, 2019.

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

Course Learning Outcomes (CLO):

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 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 Editon
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 Editon.
4. Jiawei Han and Micheline Kamber, 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 Gain risk assessmentskills
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 Editon
2. J Brooks," Cybersecurity Essentials", Wiley, Second Editon
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 Editon
2. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing, First Editon
3. Marjie T Britz, “Cyber Forensics and Cyber Crime An Introduction”Pearson, Second Editon
4. Cengage, “Hands on Ethical Hacking and Network Defence”, pearson, Second Editon

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 Editon
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, , First Edition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders, New Riders, First Edition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, First Edition
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, , First Edition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders, New Riders, First Edition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, First Edition
4. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", Papeback,CRC Press, First edition.

Course Code	Course Name	L-T-P	Credits
CS254I	Professional Practices-Unreal Basis	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstration of asymptotic notations of gamesskills.
CLO.2 Compare and contrast the operation and complexity of various level design and game play.
CLO.3 Analyse the fundamental concepts of complexity of level design and game play.
CLO.4 Create suitable solutions to solve complex game level puzzles.
CLO.5 Create Solutions for problems related to real world gaming.

Course Outline:

Getting Started in Unreal Engine, A Tour of the new Unreal Engine Learning Portal, Introduction about Unreal editor, Comprehending Projects and File Structure, Unreal Editor Fundamentals - Editor Introduction, Animation Kickstart, Materials Kickstar, Blueprint Kickstart, Lighting Essential Concepts and Effects, Introducing Global Illumination, Rendering Kickstart, Introducing the Principles of Real-time, An In-Depth look at Real-Time Rendering, Real-Time Rendering Fundamentals, VFX and Particle Systems with Unreal Engine, Sequencer, Unreal motion graphics, Real-Time Compositing Basics, Post Processing Essentials.

Recommended Book(s):

1. Game development and simulation with unreal technology by Tavakkoli, Alireza
2. Learning Unreal Engine game development: a step-by-step guide that paves the way for developing fantastic games with Unreal Engine 4 by Lee, Joanna
3. Unreal Engine 4 Game Development Essentials by Satheesh.

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 skills 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 Editon
2. Venakataramana Rolla, "Digital Marketing Practice Guide for SMBs: SEO,SEM and SMM Practice Guide",Wiley, Second Editon
3. Damian Ryan," Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogan page, Fourth Editon
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 Editon.

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 skills and 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 & Internet Technologies.

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 Editon.
2. Adam Clarke,”Search engine optimization 2016: Learn SEO with smart internet marketing strategies”, Pearson, Second Editon
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 Editon
4. Mike Moran and Bill Hunt, “Search Traffic to Your Company's Website”, (IBM Press), Third Editon

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 skills 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 Editon
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, First Edition

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 skills 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 entrepreneurshipskills 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 &Thompson Publications, 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”, Thompson Publications ,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 &Market Research for Entrepreneurs	2-0-4	4

Course Learning Outcomes:

Students will be able 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, The Entrepreneur Mind, 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
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understanding of the key skills 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 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 & Internet Technologies.

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 Editon.
2. Adam Clarke,”Search engine optimization 2016: Learn SEO with smart internet marketing strategies”, Pearson, Second Editon
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 Editon
4. Mike Moran and Bill Hunt, “Search Traffic to Your Company's Website”, (IBM Press), Third Editon

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 (CLO):

Students will be able to:

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

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

CLO.3 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 Editon
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, First Edition

Course Code	Course Name	L-T-P	Credits
CS121	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 skills of 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
CS147	Android Application Development	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Install and configure Android application development tools.
CLO.2 Design and develop user interfaces for the Android platform.
CLO.3 Save state information across important operating system events.
CLO.4 Apply Java programming skills and concepts to Android application development.
CLO.5 Design the structure of Android apps, understand layout files and the conversion to view objects.

Course Outline:

Introduction to Android and its environment, write a simple program to output a message, write a program to implement the usage of layouts and widgets, write a program that explains the usage of activity and intends, implementation of list view, create a framework for user interfaces, database connectivity with the developed user interface, implementation of JSON parsing.

Recommended Book(s):

1. Reto Meier, Android Application Development, Createspace Independent Publisher, 2nd edition
2. Lee, Wei-Meng, Beginning android 4 application development, Wrox, 1st edition
3. Barry Burd, Android Application Development All-In-One for Dummies, For Dummies, 2nd edition
4. John Horton, Android Programming with Kotlin for Beginners, Packt Publishing, 1st edition

Course Code	Course Name	L-T-P	Credits
CS148	iOS Programming	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstrate the skill of understanding of the fundamentals of Swift, building modern mobile apps, iOS, Xcode, and other tools in the Xcode development environment.

CLO.2 Demonstrate and understanding of how to handle and store data using clearly defined types.

CLO.3 Write code that makes decisions about what lines of code should be executed.

CLO.4 Create a basic iOS app to get familiar using Xcode.

CLO.5 Test and debug apps in a Mac, using the Simulator from Xcode.

Course Outline:

Basic introduction of ios, xcode, basic intro of Objective C open xcode, files, learning Objective C methods, basic introduction to create simple UI in iphone, UI Features, Create UI label programmatically, create UIButton programmatically, UI Webview, UIScrollview, UISwitch, activity IndicatorView, create login &registration view, local validations, evaluation, UITableVIew, UITableview delegate methods, UITableview data source methods, UIPickerview, UIPickerview delegate methods, UIDatepicker.

Recommended Book(s):

1. Ahmad Sahar, “iOS 13 programming for beginners”, Packt, Fourth edition,
2. Mark Wahlbeck, “iOS 13 and Swift 5 programming”,Devslopes, Second edition
3. Matt Neuburg, “iOS 13 programming fundamentals with Swift”, O'Reilly Media, Inc,third editon
4. Jon Hoffman, Mastering Swift 5: Deep dive into the latest edition of the Swift programming language, Packt Publishing Limited, 5th Edition

Course Code	Course Name	L-T-P	Credits
CS149	Internet of Things	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the architectural overview of the IoT applications.
CLO.2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.
CLO.3 Apply communication protocols for IoT application development.
CLO.4 Possess an ability to push the data onto the cloud services.
CLO.5 Analyze the sensor data and take necessary action associated with it.

Course Outline:

Introduction to Internet of Things (IoT), components of IoT, acquiring data, sensing and actuation, sensor networks, machine-to-machine communication, utilizing data, implementing IoT, IoT analytics, case studies.

Recommended Book(s):

1. Arshdeep Bahga and VijayMadisetti, “Internet of Things: A Hands-on Approach”, Universities Press,first editon
2. Oliver Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, Wiley Edition, Third Editon
3. Jacob Millman, Christos Halkias and Chethan D. Parikh, Integrated Electronics: Analog and Digital Circuits and Systems”,Tata McGraw-Hill Education, Second Editon India, 2010.
4. Morris Mano and Michael D. Cilette, “Digital Design” Pearson, Fifth Editon.

Course Code	Course Name	L-T-P	Credits
CS150	Mobile Ad-hoc and Sensor Networks	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Gain skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid

CLO.2 Study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.

CLO.3 Identify the issues and challenges in providing QoS

CLO.4 Explain about the energy management in ad-hoc networks

CLO.5 Demonstrate various types of mesh networksskills.

Course Outline:

Introduction, characteristics of MANET, application of MANET, challenges, data transmission, TCP over ad-hoc networks, basics of wireless sensor networks, data retrieval in sensor networks, security in ad-hoc wireless networks, sensor networks platforms and tools, TinyOS, TOSSIM.

Recommended Book(s):

1. Siva Ram Murthy and B.S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Pearson Education, Third Editon.
2. C.K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems, Pearson Education, First edition.
3. Fei Hu, Xiaojun Cao,”Wireless Sensor Networks — Principles and Practice”, Press, Taylor & Francis Group, First Editon.
4. Shih-Liri Wu, Yu-Chee Tseng, “Wireless Ad hoc Networking”, Auerbach Publications, Taylor & Francis Group, First Edition.

Course Code	Course Name	L-T-P	Credits
CS152	Advanced Computer Architecture	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the classes of computers, and new trends and developments in computer architecture.
CLO.2 Understand pipelining, instruction set architectures, memory addressing.
CLO.3 Understand multithreading by using ILP and supporting thread- level parallelism (TLP).
CLO.4 Build skills to understand the performance and efficiency in advanced multiple- issue processors.
CLO.5 Build skills to understand the performance of multi-core processors using SPEC benchmarks.
CLO.6 Understand storage systems, RAID, I/O performance, and reliability measures.

Course Outline:

Fundamental of computer design, pipelining, memory hierarchy, instruction level parallelism, multithreading, vector processing, multiprocessors, advanced memory hierarchy design, storage system.

Recommended Book(s):

1. Forouzan, “Data Communications and Networking”,McGraw-Hill Fifth edition.
2. Andrew S, “Computer Networks by Andrew”, Pearson Education, Fourth Edition.
3. William Stallings, “Data and computer Communications”, Pearson, Eighth Edition.
4. Todd Lammle, “CCNA Cisco Certified Network Associate Study Guide”, Wiley, Second Edition.

Course Code	Course Name	L-T-P	Credits
CS153	Digital Image Processing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand fundamental steps of digital image processing
CLO.2 Examine various types of images, intensity transformations and spatial filtering.
CLO.3 Gain skill to understand and compare various image enhancement techniques
CLO.4 Gain skillto understand and implement basic image segmentation techniques
CLO.5 Gain skillto understand and implement and compare various image restoration techniques

Course Outline:

Introduction, image fundamentals, image enhancement in spatial domain, image enhancement in frequency domain, image restoration, color image processing, image segmentation.

Recommended Book(s):

1. Rafael C. Gonzalez & Richard E. Woods, “Digital Image Processing”, Pearson Education, Third Editon
2. W.K. Pratt, “Digital Image Processing,“McGraw Hill, Second Editon
3. R.C. Gonzalez and R. E. Woods, “Digital Image Processing”,:Addison Wesley/ Pearson Education, Second Editon
4. Gonzalez, “Digital Image Processing”, Pearson International Edition, Third Editon

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 Editon
2. Schaum’s outline,” Computer Graphics”, McGraw-Hill India, First Editon
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
CS203	Integrated Project-I	0-0-4	2
CS187	Integrated Project - II	0-0-4	2
CS251	Co-op project at Industry (Module-1)	-	12
CS252	Co-op project at Industry (Module-2)	-	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.

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

Course Learning Outcomes:

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 skills 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 and children and Institutions for implementation of Human Rights at international and national level

Recommended Book(s):

1. S. Dinesh Babu,"Professional Ethics and Human Values", Firewall Media, First Editon
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 Chandpublishing , Fourth edition

Course Code	Course Name	L-T-P	Credits
DM101	Disaster Management	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.1 To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences

CLO.2 To increase the knowledge and understanding of the International Strategy for Disaster Reduction (UN- ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy

CLO.3 To ensure skills and abilities to analyse potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects

CLO.4 Learn the role of institutions and alsoanalyze the inter-relationship between disasters and developmental projects and their vulnerabilities.

CLO.5 Gain skills required for the safety of lives during the occurrence of disasters.

Course Outline:

Disasters, Classification, Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc. Differential impacts- in terms of caste, class, gender, age, location, disability), Principles of disaster management, Approaches to Disaster Risk reduction, Disaster cycle, Phases, Culture of safety, prevention, mitigation and preparedness, Community based DRR, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health, Structural and non-structural measures, Hazard Profile (India), Disaster Risk Management in India, Hazard and Vulnerability profile of India, Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation), Role of Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders, Disaster and Development, Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc., urban disasters, Waste Management. Global trends in disasters & Adaptation, Pandemics Climate change and Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

Recommended Book(s):

1. Alexander, D,"Natural Disasters", ULC press Ltd, London, First Edition
2. Carter, W. N. Disaster Management,"A Disaster Management Handbook", Asian Development Bank, Bangkok, 1991, First edition.
3. Alexander David, "Introduction in 'Confronting Catastrophe'', Oxford University Press, Second edition
4. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007, First edition.

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

Course Learning Outcomes:

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, Fourth Edition
5. Bruce Schneier, "Applied Cryptography", Wiley& Sons Inc, Second Edition
6. Network security and Cryptography' by Bernard Menezes, First Edition, Cengage LearningPublication.
7. C K Shyamala, N Harini, Dr T R Padmanabhan, "Cryptography and Network Security:",Wiley India,First Edition
8. Forouzan Mukhopadhyay," Cryptography and Network Security", MC Graw Hill, Second Edition.
9. Mark Stamp,"Information Security, Principles and Practice", Wiley India, First Edition

Appendix A: Mapping of Programme Outcomes (Pos) with Course Outcomes (Cos)

Course Code	Course Name	Course Learning Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CL101	English	CLO1: Students will be able to apply grammatical structures in presenting contextual ideas clearly to aid communication.										H		
		CLO2: Students will be able to elucidate vocabulary progressively and effectively use as per the social condition.									H	H		
		CLO3: Students will be able to exhibit the language functionally in real-life situations and social settings, evolving skills to make them competent to deal with industries scenarios.								H	M	H	M	
		CLO4: Students will be able to determine and demonstrate the usage of the language effectively in both academic and professional setups.								M		H		H
		CLO5: To apply knowledge to new situations to solve problems using required knowledge or skills.								H	M	M		H
CL102	Spanish	CLO1: Students will be able to exhibit basic structures and vocabulary progressively and effectively to understand the nuances of the Spanish language.									H	H		
		CLO2: Students will be able to apply the structures and vocabulary introduced in day-to-day conversation primarily focusing on enhancement of oral skills and then the latter three skills of reading, writing and listening.										H		M
		CLO3: Students will be able to develop communicative competence towards its practical implementation in real daily conversations which will enhance their spoken skill properly and effectively during the semester.									M	H		

		CLO4: Students will able to understand the main idea and some detailed aspects of complex or unfamiliar texts and identify, analyze some of the aesthetic functions of language and of literary styles.												M	H
		CLO5: Students will able to recognize the significance of cultural knowledge in comprehending a written text.									M			H	
CL103	German	CLO1: The students will be able to understand the everyday expressions in German Language.										H			
		CLO2: The Students will get to know about German culture.										H			
		CLO3: The course will be able to understand very simple communication in German.									M	H			
		CLO4: The course will be able to converse about basic topics in German.									H	H			
		CLO5: Students will be able to apply the structures and vocabulary introduced in day-to-day conversation primarily focusing on enhancement of oral skills and then the latter three skills of reading, writing and listening.										H			M
CL104	Japanese	CLO1: The students will be able to understand the everyday expressions, Idioms, phrases with Japanese Culture.										H			
		CLO2: Students will be able to understand Japanese Scripts (Hiragana, Katakana).										H			
		CLO3: The course will help the students to speak, listening and writing.									M	H			
		CLO4: Students will be able to exhibit the language functionally in real-life situations and social settings, evolving skills to make them competent to deal with industries scenarios.									H			M	
		CLO5: Students will be able to determine and demonstrate the usage of the language							M		H				

		effectively in both academic and professional setups.												
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	H							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).								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.										M		
		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.			H	H		H						
		CLO:5 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.			H	H								
AM121	Calculus and Statistical Analysis	CLO1: Students will be able to 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								
		CLO2: Students will be able to 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.	H	H										

		CLO3: Students will be able to apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.	H		M									H
		CLO4: Students will be able to 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
		CLO5: To 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	CLO1: Students will be able to 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	
		CLO2: Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.	H	H		M								
		CLO3: 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										
		CLO4: Student will be able to 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	H	H		H								

		processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.													
		CLO5: To develop skills required to find the appropriate differential equations that can be used as mathematical models.		H		H									
AM103	Discrete Structures	CLO1: 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											
		CLO2: Students will be able to solve real life problems using combinatorics.	H	H											
		CLO3: Students will be able to understand and apply the theory and techniques of Lattice, Logic and Boolean algebra		H	M										
		CLO4: 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										
		CLO5: 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	CLO1: Students will be able to 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						
		CLO2: Should differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and	H		H										

		solve related problems and their application in engineering domain.												
		CLO3: Should differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.	H		M									
		CLO4: 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.	H	H										
		CLO5: 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									

EC101	Basics of Electronics Engineering	CLO1: Students will be able to understand the basic concepts of semiconductor devices for use in electronic circuits.		M	H										
		CLO2: Students will be able to 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										
		CLO3: Students will be able to acquire the knowledge of digital logic gates for implementing basic digital circuits.	H		H										
		CLO4: Students will be able to recognize the primary functions of integrated circuits such as timer and voltage regulator.		H			M								
		CLO5: Students will be able to familiarize with generic IoT device and applications using case studies.		M			H							H	
EC102	Basics of Electronics Engineering Lab	CLO1: Students would know the basics of electronics elements, their functionality and applications.		M	H										
		CLO2: Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.			H										
		CLO3: They would be able to analyze and characterize the electronic circuits and have basic understanding for their implementation.	H		M										
		CLO4: Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.					M							H	
		CLO5: Students will be able to 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 Recognize 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 Realize 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 Realize the concept of memories and Programmable Logic Devices and their classification.		M	M								M	
EC106	Digital Electronics and Logic Design Lab	CLO1: To understand the digital logic and create various systems by using these logics	H											
		CLO2: To develop an understanding of design and simulation of digital logic circuits		H	M									
		CLO3: To get a basic understanding of layout of electronic circuits			H								M	
		CLO4: Practical implementation of design methodologies skills for implementing combinational and sequential circuits.		M	H									
		CLO5: Implementation of the concept of memories and Programmable Logic Devices and their classification.			H								M	
		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.	H											

CST101	Database Management Concepts	CLO:2 Describe relational algebra expression and tuple relation expression from queries.		H	M									
		CLO:3 Implement the concept of normalization and functional dependency while designing the databases.			H								M	
		CLO:4 Apply the concept of transaction, concurrency control, security and recovery in database.		M	H									
		CLO:5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.			H								M	
		CLO:6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.	H											
CSP101	Database Management Concepts Lab	CLO:1 Apply the basic concepts of Database Systems and Applications.		H	M									
		CLO:2 Use the basics of SQL and construct queries using SQL in database creation and interaction.			H								M	
		CLO:3 Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.		M	H									
		CLO:4 Analyze and Select storage and recovery techniques of database system.			H								M	
		CLO:5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills			H	M								
		CLO:1 CLO1: Students will be able to describe and analyze the hardware, software, components of a network and the interrelations.		H	H									

CST102	Principals of Computer Networking	CLO:2 CLO2: Explain networking protocols and their hierarchical relationship hardware and software.		M			H						H	
		CLO:3 CLO3: Compare protocol models and select appropriate protocols for a particular design.		H	M								M	
		CLO:4 CLO4: Manage multiple operating systems, systems software, network services and security.					H							
		CLO:5 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	
		CLO:6 CLO6: Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure					M			H				
		CLO:7 CLO7: Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.								M				
		CLO:8 CLO8: Effectively communicate technical information verbally, in writing, and in presentations.										M		
CSP102	Principals of Computer Networking Lab	CLO.1 Understand the practical approach to network communication protocols.	H	H										
		CLO.2 Understand network layers, structure/format and role of each network layer.		H	H							H	H	
		CLO.3 Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.		H	H									

		CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.			H	H							H	H
		CLO.5 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure			H	H								
CST125	Fundamentals of Web Technology	CLO.1 Students will be able tounderstand the semantic web vision and technologies.		H		H								
		CLO.2 Students will be able toapply the multimedia content, client-side programming and transformation of web content.			H	H								
		CLO.3 Students will be able toemploy modern tools and technologies for the development of web pages.	H		H									
		CLO.4 Students will be able toexperiment the web programming concepts to modify the design and layouts of web pages.	H	H		H						H		
		CLO.5 Students will be able toexamine the adaptability of scripting languages in web development.		H		H						H	M	
		CLO.6 Students will be able todemonstrate and develop web-portals independently or in teams.	H	H		H						H		
CSP125	Fundamentals of Web Technology Lab	CLO.1 Students will be able toapplying the semantic web vision and technologies.			H		H							
		CLO.2 Students will be able toimplementation of client-side programming and transformation of web content.				H	H							
		CLO.3 Students will be able toexperimentation on modern tools and technologies for the development of web pages.		H		H								
		CLO.4 Students will be able toexperiment the web programming concepts to modify the design and layouts of web pages.		H	H		H						H	

		CLO.5 Students will be able toapply the adaptability of scripting languages in web development.			H		H						H	M
		CLO.6 Students will be able todevelop web-portals independently or in teams.		H	H		H						H	
CST106	Data Structures With C++	CLO.1 Students will be able tosummarize different categories of Data Structures		H	H									
		CLO.2 Students will be able toidentify different parameters to analyze the performance of an algorithm.		H	H									H
		CLO.3 Students will be able toexplain the significance of dynamic memory management Techniques		H	H		H						H	
		CLO.4 Students will be able todesign algorithms to perform operations with Linear and Nonlinear data structures		H									H	
		CLO.5 Illustrate various technique to for searching, Sorting and hashing				M	H							
CST107	Advance Web Technology	CLO.1 Manipulateelementsonawebpageand respondingtouserinteractions		H	H		M							
		CLO.2 Developweb,desktop,andmobileapp lications skills		H	H	M								
		CLO.3 Use Angular JS to develop cross-platform applications			H									M
		CLO.4 Explore core jQuery features which would help in designing GUI.		H	H						M			
		CLO.5 Use Angular JS to develop cross-platform applications		H	H						M		H	M

CSP107	Advanced Web Technology Lab	CLO.1 Develop webpageswhich can respondtouserinteractions	H	H		M								
		CLO.2 Implement web,desktop,andmobileapplications skills	H	H	M									
		CLO.3 Apply Angular JS to develop cross-platform applications		H									M	
		CLO.4 Apply and experiment on core jQuery features which would help in designing GUI.	H	H						M				
		CLO.5 Apply Angular JS to develop cross-platform applications	H	H						M		H	M	
CST108	Operating System With Linux	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	
CSP106	Data Structures With C++ Lab	CLO.1 Ability to implement linear and non-linear data structure operations.		H	H									
		CLO.2 Identify appropriate data structure operations for solving a given problem.		M			H						H	

		CLO.3 Apply appropriate use of linear / non-linear data structure operations for a given problem.		H	M								M	
		CLO.4 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval					H							
		CLO.5 Apply the searching and sorting algorithms for problem solving.	M	H	M		M						M	
CS117	Computer Networks	CLO.1 Describe and analyze the hardware, software, components of a network and the interrelations.		M										
		CLO.2 Explain networking protocols and their hierarchical relationship hardware and software.		H										
		CLO.3 Compare protocol models and select appropriate protocols for a particular design.			H		H						H	H
		CLO.4 Manage multiple operating systems, systems software, network services and security.	H		H		H							
		CLO.5 Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.		H	H									
CST109	Problem Solving Using C	CLO.1 Describe the basics of digital computer and programming languages.			H									
		CLO.2 Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem.			H		H							
		CLO.3 Design and Implement C program using Control Statements and Functions.			H		H						H	

		CLO.4 Design and Implement C program using Pointers and File operations.			H									
		CLO.5 Identify the need for embedded C in real-time applications.					H							
CSP109	Problem Solving Using C Lab	CLO.1 Write high quality code.		H		H								
		CLO.2 Understand the concept of scalability, security and extensible code for software applications.		H	M	H								
		CLO.3 Learn debugging issues and end to end testing.	M	H	M									
		CLO.4 Learn skills to deliver features in an agile development environment.		H		H								
		CLO.5 Solve problems iteratively and recursively and design both structured and object-oriented program.					H							
CS122	Design & Analysis of Algorithm	CLO.1 Analyze algorithms and algorithm correctness.		H	H	H								
		CLO.2 Analyze time complexities of algorithms using asymptotic analysis.			H		H						H	
		CLO.3 Summarize searching and sorting techniques.			H									
		CLO.4 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.			H	H	H							
		CLO.5 Explain the major graph and tree algorithms and their analysis skills. Employ graphs to model engineering problems.					H						H	
CSL2202	Web Programming and Source Code	CLO.1 Develop a dynamic webpage by the use of java script and DHTML.		M	H								H	
		CLO.2 Write a well-formed / valid XML document.		M	H	M								

	Management	CLO.3 Connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.		M	M									
		CLO.4 Write a server-side java application called Servlet to catch form data sent from client, process it and store it on database.			H		H							
		CLO.5 Write a server-side java application called JSP to catch form data sent from client and store it on database		M	H								H	
		CLO.6 Develop a dynamic webpage by the use of java script and DHTML.	H		H		H						H	
CSL4206	Database Management System	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.		M										M
		CLO.2 Describe relational algebra expression and tuple relation expression from queries.		M	H									
		CLO.3 Implement the concept of normalization and functional dependency while designing the databases.		M	H		H							
		CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.			M	H	H							
		CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.			M	H	H							
CSL4305	Theory of Computation	CLO.1 Familiar with skills of basic automata theory of computer system.			H									
		CLO.2 Understand the working and data flow in computer components.			H								H	
		CLO.3 Understand the challenges for Theoretical Computer Science and its contribution to other sciences such as biology, economics, physics, and many other fields.		H		H								M

		CLO.4 Deal with the problems efficiently on a model of computation using an algorithm.			H								H	
		CLO.5 Describe unrecognizable languages and undecidable problems.		H		H								M
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									
CS2023	Advanced Data Structures	CLO.1 Design and analyze programming problem statements.				H	M							
		CLO.2 choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.		M	H		H							
		CLO.3 understand the necessary mathematical abstraction to solve problems.			H	H								M
		CLO.4 come up with analysis of efficiency and proofs of correctness		M	H		H							M
		CLO.5 comprehend and select algorithm design approaches in a problem specific manner.		M			H							M
CS126	Algorithm Design & Implementation	CLO.1 Well versed with Object Oriented Concepts and Java skills.		H	H									
		CLO.2 Have good idea of graph traversal	M	H	M		M						M	

		algorithms and hashing techniques.												
		CLO.3 Write program in Java to solve graph-based problems.		M										
		CLO.4 Apply graph searching algorithms to real life problems.		H										
		CLO.5 Simulate real world problems to Java based software solutions.			H		H						H	H
CS151	Introduction to Cloud Computing	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		
CS254H	Professional Practices-System Design	Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections		H		H								M
		Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.		H	H									
		Design and implement file management system.	M	H	M		M						M	

		Construct the SQL queries for given specifications.		M										
		Explain the functions of the different layer of the OSI Protocol. Skilled to handled different databases.		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							
CS228	Software Engineering& Quality Assurance	Acquire 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						H	H
		Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.								M				
		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.		M										
		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.	M									L		
		Learn and understand various object oriented concepts along with their applicability contexts	M						L					
CS913	Advanced Operating Systems	CLO.1: Create Cloud using multiple operating systems simultaneously.					M							
		CLO.2: Detailed case study on Linux family.					M							H

		CLO.3: Live experiments on concurrency, threads and deadlocks.		H										
		CLO.4: Administer the system using various Operating systems skills for managing its resources to create your own operating system.			H				L					
CS903	Cryptography & Network Security	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					
CS123	Artificial Intelligence and Expert System	Learning the basic concepts and skills of Artificial Intelligence.		H		H								M
		Represent Knowledge using propositional calculus and predicate calculus.			H								H	
		Use inference rules to produce predicate calculus expression.		H		H								M
		Demonstrate awareness of informed search and uninformed search techniques.						H		H				

		Explain about AI techniques for planning, knowledge representation and management.		H	H									H
		Outline the process involved in Expert systems and in building such systems.			L								M	
CS246	React Native	State the fundamental building blocks of mobile apps		M										
		Select various modules for designing React Native components to build powerful and stylish mobile applications.	M									L		
		Use stylesheets, APIs and cross-platform native modules in React Native apps	M						L					
		Organize React Native components skills and examine the parameter passing mechanism among them	M									L		
		Debug and use developer Tools to build native mobile applications inn React Native		H		H								M
CS108	Python Basics	CLO1: Designing real life scenario problems, identifying and analysing solutions for it.		M	H	H								
		CLO2: Accurately and efficiently designing the solutions in python.		H			H							
		CLO3: Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.		M	H	H								
		CLO4: Use indexing and slicing to access data in Python programs.			H		H	H						
		CLO5: Design loops and decision statements in Python.			H		H	H						

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							
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				
CS254J	Professional Practices-Dashboard Designing	Learn Design thinking Skills		M	H	H								
		Convert information into actionable outcomes.			H		H	H						
		Prototyping data models.			H		H	H						
		Create dashboards using PowerBI						H		H				

		Learn basic and advanced fundamentals of Excel.		H	H									H
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 editing, recovery of files, password cracking, etc.		H			H							
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 apply static 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 investigation is taking place and/or revealing their identity.	H	H		H								
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	
CS254I	Professional Practices-Unreal Basis	Demonstration of asymptotic notations of games skills.		H	H									
		Compare and contrast the operation and complexity of various level design and game play.		H		H	H							
		Analyse the fundamental concepts of complexity of level design and game play.		M	H	H							H	
		Create suitable solutions to solve complex game level puzzles.		H		H	H							

		Create Solutions for problems related to real world gaming.		M	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 &				H	H				H		H	

		Internet Technologies for entrepreneurs.												
		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 Optimization Techniques useful for entrepreneurs.				H	H				H		H	
CS144	Affiliate Marketing and Online	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		

	Reputation Management (ORM)	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			H		H							

		and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.												
EP102	Consumer & Market Research for 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 resources control, and thus satisfy all specific needs within the market, at the right time.		H	H			H					H	
		CLO5: Satisfy customer's specific needs through a required product or service.			H		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		
CS147	Android Application Development	CLO.1 Install and configure Android application development tools.		H		H								
		CLO.2 Design and develop user interfaces for the Android platform.		H		H								
		CLO.3 Save state information across important operating system events.		H									H	
		CLO.4 Apply Java programming skills and concepts to Android application development.			H	H							H	
		CLO.5 Design the structure of Android apps, understand layout files and the conversion to view objects.			H	H	H							
CS148	iOS Programming	CLO.1 Demonstrate the skill of understanding of the fundamentals of Swift, building modern mobile apps, iOS, Xcode, and other tools in the Xcode development environment.	H	M	M									
		CLO.2 Demonstrate and understanding of how to handle and store data using clearly defined types.		M	M									
		CLO.3 Write code that makes decisions about what lines of code should be executed.		M	H	H								
		CLO.4 Create a basic iOS app to get familiar using Xcode.	H		H	M	H							

		CLO.5 Test and debug apps in a Mac, using the Simulator from Xcode.		M	H	M								H
CS149	Internet of Things	CLO.1 Know the architectural overview of the IoT applications.	H	M										
		CLO.2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.			H									
		CLO.3 Apply communication protocols for IoT application development.			H	H								
		CLO.4 Possess an ability to push the data onto the cloud services.		M	H	H	M							
		CLO.5 Analyze the sensor data and take necessary action associated with it.	H				M							
CS150	Mobile Ad-hoc and Sensor Networks	CLO.1 Gain skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid	H	M	H								M	
		CLO.2 Study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.	H	M	M								M	
		CLO.3 Identify the issues and challenges in providing QoS	H	H		M								
		CLO.4 Explain about the energy management in ad-hoc networks	M	M		M								
		CLO.5 Demonstrate various types of mesh networks.	M	M	H									
CS152	Advanced Computer Architecture	CLO.1 Know the classes of computers, and new trends and developments in computer architecture.						H	M	H				

		CLO.2 Understand pipelining, instruction set architectures, memory addressing.								H	M	M		
		CLO.3 Understand multithreading by using ILP and supporting thread- level parallelism (TLP).						H				M		
		CLO.4 Build skills to understand the performance and efficiency in advanced multiple- issue processors.								H	M	M		
		CLO.5 Build skills to understand the performance of multi-core processors using SPEC benchmarks.					H							
		CLO.6 Understand storage systems, RAID, I/O performance, and reliability measures.						H				M		
CS153	Digital Image Processing	Understand fundamental steps of digital image processing						H			H			
		Examine various types of images, intensity transformations and spatial filtering.						M	H		H			
		Skill to understand and compare various image enhancement techniques						H	M					
		Skill to understand and implement basic image segmentation techniques						M	H		H			
		Skill to understand and implement and compare various image restoration techniques						H	M					
CS154	Computer Graphics	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								

		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						
		Students will be able to interpret the mathematical foundation of the concepts of computer graphic skills.		M		H		M						
		Students will be able to describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.			H		H	M						
		Students will be able to identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.					M							
		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						
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	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-1)	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-2)	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students	H	H	M		M				H		H	

		employable.												
		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
HR101	Human Values and Professional Ethics	CLO.1 Get awareness on human values and professional ethics										M	H	
		CLO.2 Understand the core values that shape their ethical behaviour.		H						H	M	M		
		CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.		M							M	M		
		CLO.4 Gain thorough knowledge in the field of human rights and this will add to the academic qualification									M	H		
		CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.											M	M
DM101	Disaster Management	CLO.1 To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences											M	H
		CLO.2 To increase the knowledge and understanding of the International Strategy for Disaster Reduction (UN- ISDR) and to increase				H						H	M	M

		skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy												
		CLO.3 To ensure skills and abilities to analyse potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects				M							M	M
		CLO.4 Learn the role of institutions and also analyze the inter-relationship between disasters and developmental projects and their vulnerabilities.											M	H
		CLO.5 Gain skills required for the safety of lives during the occurrence of disasters.		H										
CS501	Cyber Security	CLO.1 Acquire Information and risk models including confidentiality, integrity and availability				H						H	M	M
		CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities				M							M	M
		CLO.3 To gain knowledge on Cyber security architecture and operations											M	H
		CLO.4 Understand how Cyber security is conceptualized and carried out		M										
		CLO.5 Articulate informed opinion about issues related to cyber security					M	M						

CS104	Computer Programming-I	CLO1: Analyze the problem statement.	H										M	
		CLO2: Choose the appropriate C programming constructs to solve the problems			H									
		CLO3: Demonstrate the advantages and	H	M										

		disadvantages of specific techniques to be used.												
		CLO4: Differentiate between efficient and inefficient way of programming.	H		H									
		CLO5: Determine and demonstrate bugs in a program and recognize needed basic operations.			H		H							
		CLO6: Formulate new solutions for programming problems or improve existing code to program effectively.	H		H									
CS110	Introduction to Linux	CLO1: To Understand and work in Linux command line interface with various tools.	H	H	H			M						
		CLO2: To Create shell scripts for various administrative purpose.		H	H									H
		CLO3: Apply various tools and techniques for User Management, Permission Management and File System Management.		H	H		H						H	
		CLO4: To learn C programming using GCC Compiler		H									H	
		CLO5: Apply this course knowledge for Real time Linux Server management being used in Industry (RHEL/CentOS etc.)				M	H							
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		
CS105	Computer Programming-II	CLO1: Formulate problem solutions by incorporating advanced C programming constructs.	H	H	H	H	L	L	-	-	-	L	L	-
		CLO2: Choose the appropriate searching and sorting technique	H	M	M	M	L	L	-	-	-	-	-	-
		CLO3: Demonstrate the advantages and disadvantages of specific techniques to be used.	H	H	H	H	L	L	-	-	-	-	-	-
		CLO4: Develop programs using basic data structures like stack and queue	H	H	H	H	H	L	-	-	-	-	-	-
		CLO5: Formulate new solutions for programming problems or improve existing code to program effectively.	M	H	H	M	M	M	-	-	-	-	-	L
CS111	Introduction to	CLO1: Identify the basis of designing a Web			H									

	Web Technologies	site; create Web pages, links, images, tables and pages layouts in HTML.												
		CLO2: 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							
		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.			H									
		CLO5: Demonstrate and develop web-portals independently or in teams.					H							