Academic Programme Guide
of
Bachelor of Engineering
(Computer Science and Engineering)

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

w.e.f.
Academic Year: 2018-19

Approved by the 21st Academic Council dated 30-06-2018, vide agenda item 21.6

CHITKARA UNIVERSITY
HIMACHAL PRADESH - NAAC Accredited

INDEX

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 four-year B.E. (Computer Science and Engineering) 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 provide the solution for the complex engineering problems by using the concepts of Computer Science and Engineering.

PEO 2. To work independently and efficiently in multi-disciplinary teams by communicating effectively.

PEO 3. To acquire the additional knowledge and skills through enduring edification.

PEO 4. To contribute effectively towards sustainable solution for environment and society.

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. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and multidisciplinary settings.
PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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 B.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. This programme also offers "Engineering Projects in Community Services" (EPICS) course to the students where they learn to serve the community by organising various activities for their benefit and deepen their knowledge and perspectives. 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 B.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 B.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 BE program is four years - divided into 8 semesters. University conducts end term examination at the end of each semester, except in the case of Industry Oriented Hands-on Experience (IOHE) or Internship at Industry, which is evaluated by a jury appointed by the University.

The maximum duration of completion of the degree is 6 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 Courses (BSC)
c) Engineering Science Courses (ESC)
d) Professional Core Courses (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. Students have to pass these

courses; however, no credits will be added for these courses. These courses may be offered in any semester of the program.

Special Courses (SC):

a) Projects and Industry Oriented Hands-on Experience (IOHE): 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) or Nanodegree courses.

c) Courses for Global Exposure: To provide global exposure to students, the short duration courses are offered by professors from Universities across the globe. The students may choose or may be offered these courses to earn additional credits. These courses are decided for each batch as per the expertise of the teaching faculty and will be informed to the students before offering in a semester.

Model Programme Structure

Semester-1			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Engineering Mathematics I	4-1-0	5
2	Basics of Electrical Engineering	3-1-2	5
3	Engineering Graphics	4-0-2	5
4	Languages	0-0-4	2
		21	**17**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Engineering Mathematics II	4-1-0	5
2	Basics of Electronics Engineering	3-1-2	5
3	Introduction to C Programming	0-0-10	5
4	Engineering Physics	3-1-2	5
5	Engineering Exploration	2-0-2	3
		31	**23**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Digital Electronics and Logic Design	3-0-2	4
2	Advanced C Programming	0-0-10	5
3	Introduction to Web Technologies	0-0-10	5
4	Introduction to Linux	0-0-6	3

5	Engineering Exploration	0-0-4	2
6	Manufacturing Practices	0-0-4	2
7	Global Engineering Week Courses	-	2##
8	Environmental Sciences	2-0-0	2
		41	**25**

Semester-4			
S.No	**Course Title`**	**L-T-P**	**Credits**
1	Discrete Structures	4-0-0	4
2	Core Java	2-0-6	5
3	Advanced Web Programming	2-0-4	4
4	Database Management System	3-0-0	3
5	Operating Systems	3-1-0	4
6	Engineering Exploration	0-0-4	2
7	Cyber Security	2-0-0	0
8	Disaster Management	2-0-0	0
		33	**22**

Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Computer System Architecture	3-1-0	4
2	Object Oriented Software Engineering	3-0-2	4
3	Data Structures	3-0-4	5
4	Computer Networks	3-0-4	5
5	Professional Elective-I	2-0-0	2
		25	**20**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Numerical Ability and Logical Reasoning	4-0-0	4
2	Integrated Project	0-0-8	4
3	Professional Elective-II	**	20#
4	Professional Elective-III	**	
5	Professional Elective-IV	**	
6	Professional Elective-V	**	
7	Professional Elective-VI	**	
		32#	**28#**

Semester-7			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Open Elective – I	**	9#
2	Open Elective – II	**	
3	Open Elective – III	**	
4	Lab Oriented Project	0-0-6	3
OR			
1	Co-opt Training Module-I	-	12
		15#	**12***

Semester-8			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	- - -	12
OR			
1	Co-opt Training Module-II	-	12
		-	**12 ***

*** Students can also earn these credits by opting co-op training in seventh and eighth semesters**
 # Credits may vary based on the specialization
Students will get extra credits for this course
**** 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 Department may decide the number of STs required for a specific course. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments' (if applicable else weightage is merged in STs) as decided by the course coordinator and Head of the Department and is announced separately for each course.

The evaluation components for Lab Courses have weightage for regular lab performances, internal viva-voce, conducted at the end of the academic semester. The

End Term Examination for lab courses includes the conduct of experiments and an oral examination (viva voce).

Lab Courses	
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 MOOC Courses: There is one evaluation at the end of the course. The certificate is issued by the host institute. Upon submission of the certificate, credits will be awarded to the student.

Evaluation for Global Exposure Courses: There is only 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
	AB		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:

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

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 GPA 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 the CGPA 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 the 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 the Department to drop the term. If such permission has not been requested or after a request, the permission has been denied, his/her name would be

struck off the rolls of the University and he would no longer be a student of the University. His/her case will be automatically processed and the file will be closed. However, if such a student, after his/her name has been struck off the rolls of the University, is permitted to come back, his/her case can be considered at the sole discretion of the competent authority of the University with the provision that all his/her previous records as a former student are revived under the current academic and administrative structure, regulations and schedule of fees.

10. Migration/Credit Transfer Policy

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

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

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

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

11. Eligibility to Award the Degree

To be eligible for award of B.E. degree in Computer Science and Engineering, a student must complete all the courses in which he/she has registered with minimum 150 credits and a minimum CGPA of 4.5.

12. Program Overview

Course type		HSM	BSC	ESC	PC	PE	OE	SC	Total
Credits	Co-op	8	19	21	52	22	-	37	159
	Other	8	19	21	52	22	9	28	159

- The number of courses may vary in a semester based on the choice of electives/specialization courses.
- Student may earn credits of the seventh and eighth semester by taking co-op training.

- Student can choose additional electives instead of co-op training in the seventh semester.

List of Courses:

Course Code	Course Name	L-T-P	Credits
Humanities, Social Science and Management Courses (HSM)			**8**
CL101/102/ 103/104	English-I / Spanish / German / French-I	0-0-4	2
GE101	Numerical Ability and Logical Reasoning	4-0-0	4
DM101	Disaster Management	2-0-0	0
CS501	Cyber Security	2-0-0	0
ES101	Environmental Sciences	2-0-0	2

Basic Science Courses (BSC)			**19**
AM101	Engineering Mathematics I	4-1-0	5
AM102	Engineering Mathematics II	4-1-0	5
AM103	Discrete Structures	4-0-0	4
PH101	Engineering Physics	3-1-0	4
PH103	Engineering Physics Lab	0-0-2	1

Engineering Science Courses (ESC)			**21**
EC101	Basics of Electronics Engineering	3-1-0	4
EC102	Basics of Electronics Engineering Lab	0-0-2	1
EE101	Basics of Electrical Engineering	3-1-0	4
EE102	Basics of Electrical Engineering Lab	0-0-2	1
ME102	Engineering Graphics	4-0-0	4
ME153	Engineering Graphics Lab	0-0-2	1
EC105	Digital Electronics and Logic Design	3-0-0	3
EC106	Digital Electronics and Logic Design Lab	0-0-2	1
ME152	Manufacturing Practices	0-0-4	2

Professional Core Courses (PC)			**52**
CS101	Introduction to C Programming	0-0-10	5
CS103	Advanced C Programming	0-0-10	5
CS109	Core Java	2-0-6	5
CS107	Object Oriented Software Engineering	3-0-2	4
CS110	Introduction to Linux	0-0-6	3
CS111	Introduction to Web Technologies	0-0-10	5
CS112	Advanced Web Programming	2-0-4	4
CS114	Data Structures	3-0-4	5
CS115	Operating Systems	3-1-0	4
CS116	Database Management System	3-0-0	3
CS117	Computer Networks	3-0-4	5

CS118	Computer System Architecture	3-1-0	4

Professional Electives (PE) *(Elective-I to VI)			
A. Specialization Tracks			
a) Full-Stack			
CS254A	Full Stack Java Web Programming	2-0-0	2
CS113	Advanced Programming Concepts	2-0-4	4
CS126	Algorithm Design & Implementation	2-0-4	4
CS145	Front-end Development	2-0-4	4
CS146	Web Application Development	2-0-4	4
CS159	Back-end Development	2-0-4	4
b) 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
CS138	Machine Learning	2-0-4	4
CS174	Applications of Data Science	2-0-4	4
c) 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
CS135	Advanced Java	2-0-4	4
d) 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
CS176	Immersive Reality	2-0-4	4
e) 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
CS177	Advance Affiliate Marketing, Drop Shipping and online Customer Support	2-0-4	4
f) Entrepreneurship Development Program			
EP101	Entrepreneurship and Opportunity	2-0-4	4
EP102	Consumer & Market Research for Entrepreneurs	2-0-4	4

EP103	New Venture Creation	2-0-4	4
EP104	The Entrepreneurial Innovator	2-0-4	4
CS178	Practice Venture Building	2-0-4	4
g) UI/UX Design			
CS168	UX Design & Digitization	2-0-4	4
CS169	User Interface Design	2-0-4	4
CS170	Empathy & Its Tools	2-0-4	4
CS171	User Research & Its Application	2-0-4	4
CS172	Design Thinking & Its Applications	2-0-4	4
CS175	Interaction Design and its Applications	2-0-4	4

B. Departmental Electives (DE)			
CS120	Theory of Computation	4-0-0	4
CS123	Artificial Intelligence and Expert System	4-0-0	4
CS124	Network Security	4-0-0	4
CS125	Compiler Design	4-0-0	4
CS128	Enterprise Application Development	2-0-4	4
CS136	Introduction to DevOps	2-0-4	4
CS139	Parallel and Distributed Computing	4-0-0	4
CS151	Introduction to Cloud Computing	4-0-0	4
CS160	Microprocessor and Assembly Language Programming	3-0-2	4

Open Elective Courses (OE) (any three)			**9**
CS181	Software Quality Assurance and Testing	3-0-0	3
CS182	Business Intelligence and Data Warehousing	3-0-0	3
CS147	Android Application Development	2-0-2	3
CS148	iOS Programming	2-0-2	3
CS149	Internet of Things	3-0-0	3
CS150	Mobile Ad-hoc and Sensor Networks	3-0-0	3
CS152	Advanced Computer Architecture	3-0-0	3
CS153	Digital Image Processing	3-0-0	3
CS154	Computer Graphics	3-0-0	3
CS161	Java Programming	0-0-6	3
CS162	Full Stack Development	0-0-6	3

Special Courses (SC)			
a) Project			
CS203	Integrated Project	0-0-8	4
CS183	Lab Oriented Project	0-0-6	3
CS251	Co-op project at Industry (Module-1)	-	12
CS252	Co-op project at Industry (Module-2)	-	12
CS253	Industry Oriented Hands-on Experience	-	12
b) Engineering Exploration			**7**
c) Value Addition Courses			

	Global Engineering Week Courses	-	2^{+}

Mandatory Courses:
A few courses as prescribed by the UGC are offered as mandatory courses.

*** Students have option to choose either a specialization track or four courses from open track**
 # Credits can vary according to students' choice-based credit system
+ Additional credits under Global Engineering Week

List of courses offered in Engineering Exploration

Offline/E-Learning Courses	Internet of Things
	Introduction to Internet of Things
	Machine Learning
	Engineering Projects in Community Services
	Intellectual Property Rights
	Data Visualization
	Ethical Hacking
	Digital Marketing
	Publishing Research
	Entrepreneurship
	Speech Recognition
	Design Thinking
Foreign Language Certification Courses	German
	Japanese
	Spanish
	Chinese Mandarin
MOOC	The joy of Computing using Python
	Ethical Hacking
	Introduction to Internet of Things
	Programming in Java
	Artificial Intelligence Search Methods for Problem Solving
	An Introduction to programming through C++
	Software Testing
	Introduction to Machine Learning
	Blockchain Architecture Design and Use Cases
	Discrete Mathematics
	Programming in C++
	E-Commerce Technologies

Course Outline

Course Code	Course Name	L-T-P	Credits
CL101	English-I	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. (2017). English for everyday Activities (Issue January). 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, Begrüβungen, 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 (Offiziele Uhrzeit), 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 aktiv Üben, Hören, Sprechen A1-B1: Mit PagePlayer. FRAUS;
2. Pawel Karnowsk. (2016). Deutsch intensiv Hören & Sprechen B2 Buch. Klett.
3. Silke Hilpert, & Anne Robert. (2017). Schritte international—Deutsch als Fremdsprache, 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	French-1	0-0-4	2

Course Learning Outcomes:

Students will be able to:

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

CLO.2 Understand French Scripts.

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 French 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 French, Suki, How much + Home Assignments, French Song, , French work culture, Comprehension Practice, Paragraph Writing, Discussion about French - India places in French through Comprehension,

Jumbles sentence assignment, Students will make sentences through the picture, Assignment will do, how to crack French Interview, Group discussion about culture, Positive, Negative, Students will record their skit, Discussion about Prepared Skit.

Recommended Book(s):

1. Stout,Timothy G. (2011). French for Beginners: First Steps to Mastering the French Writing System. Tuttle Publishing.
2. Stout,Timothy G. (2017). French Kanji for Beginners. Tuttle Publishing.
3. Jpinsiders. (2018). Learn French Book for Beginners: Learn Practical & Conversational French.

Course Code	Course Name	L-T-P	Credits
GE101	Numerical Ability and Logical Reasoning	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Improve answers during the aptitude test and develop an all-around personality with a mature outlook.

CLO.2 Enhance their logical thinking skills, verbal reasoning and numerical reasoning skills.

CLO.3 Enhance the employability skills among the students so that they will take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.

CLO.4 Enhance the problem solving skills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.

CLO.5 Enhance the Aptitude Round Clearing ability in interview process.

Course Outline:

Vedic module: Introduction with aptitude, Cube and cube root, Division, Addition and Subtraction, Algebraic formula base, Approximation, Number System, Ratio, Percentage, Simple Interest, Compound Interest, Profit and Loss, Discount, Work and Time, Permutation and Combination, Geometry, Coordinate Geometry, Reasoning, Distance and Direction, Blood Relation, Analogy and Venn diagram, Syllogism and Classification and Mathematical operation, Coding – Decoding, and Alphabet Test, Problem on Ages and dictionary, Series Cube and Dice and Missing number, Ranking, Clock, and Calendar, Inequalities and I/P and O/P, Puzzle, Sitting Arrangement, Statement –Argument, Statement- course of Action, Verbal Questions, Image-Based Questions, sequence questions, Mirror and Water Images, Odd One Out, Picture Series and Sequences, Paper Folding, Pattern Series and Sequences, shape construction.

Recommended Book(s):

1. Abhijit Guha. (2017). Quantitative Aptitude for Competitive Examination (2nd ed). MC Graw Hill.
2. Chowdhary,S.S. (2018). Test of Reasoning & Numerical Ability. Sahitya Bhawan.
3. Quantum Cat. (2017). Quantitative Aptitude & Verbal – Nonverbal Reasoning. Arihant Publication.
4. Subject, E. (2017). ESE/GATE/PSUs Numerical Ability, Logical Reasoning & Analytical Ability. ACE Engineering Publications.

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

Course Learning Outcomes:

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 also analyze 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. (2018). Natural disasters. Routledge.
2. Carter, W. N. (2008). Disaster management: A disaster manager's handbook.
3. Shaw, R., & Krishnamurthy, R. R. (Eds.). (2009). Disaster Management: Global challenges and local solutions. Universities Press.
4. Coppola, D. P. (2006). Introduction to international disaster management. Elsevier.

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

Course Learning Outcomes:

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. Merkow, M. S., & Breithaupt, J. (2014). Information security: Principles and practices. Pearson Education.
2. Ciampa, M., & Learning, C. (2005). Network security fundamentals. Thomson Course Technology, 1556-1561.
3. Johnson, R., & Easttom, C. (2017). Security policies and implementation issues. Jones & Bartlett Learning.
4. Stallings, W. (2018). Effective cybersecurity: a guide to using best practices and standards. Addison-Wesley Professional.
5. Bruce, S. (1996). Applied cryptography: protocols, algorithms, and source code in C.
6. Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security (Vol. 12). New York, NY, USA:: Mc Graw Hill Education (India) Private Limited.

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

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 also to students to 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. (2005). Textbook of environmental studies for undergraduate courses. Universities Press.
2. Sivashanmugam, P. (2007). Basics of environmental science and engineering. New India Publishing.
3. Miller, G. T., & Spoolman, S. (2015). Environmental science. Cengage Learning.
4. Wright, R. T., Boorse, D., & Boorse, D. T. (2005). Environmental science: toward a sustainable future (p. 682). Pearson/Prentice Hall.
5. Keen, M., Brown, V., & Dyball, R. (2005). Social learning in environmental management. London: Earthscan.
6. Cunningham, W., & Cunningham, M. A. (2010). Principles of environmental science. McGraw-Hill Higher Education.

Course Code	Course Name	L-T-P	Credits
AM101	Engineering Mathematics I	4-1-0	5

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. Zill, D. G. (2017). Advanced engineering mathematics. Jones & Bartlett Publishers.
2. Willie Jr, C. R. (1966). Advanced engineering mathematics (Vol. 151). New York, McGraw-Hill.
3. The Engineering Mathematics, Chitkara University Publication, Vol. I. Second Edition,
4. Ramana, B. V. (2006). Higher Engineering Mathematics. Tata McGraw-Hill Education.

5. Jain, R. K., & Iyengar, S. R. (2004). Advanced engineering mathematics. Alpha Science Int'l Ltd.
6. Grewal, B. S., & Grewal, J. S. (1996). Higher engineering mathematics. 2002, Khanna Publishers, New Delhi.
7. Bali, N. P., & Iyengar, N. C. N. (2004). A Textbook of Engineering Mathematics: For B. Sc.(Engg.). BE, B. Tech., ME and Equivalent Professional Exams. Laxmi publications.
8. Anderson, M. (2013). Independent vector analysis: Theory, algorithms, and applications. University of Maryland, Baltimore County.

Course Code	Course Name	L-T-P	Credits
AM102	Engineering Mathematics II	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 Use ordinary differential equations student will be able to solve various practical problems in Science and Engineering.

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

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

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

Course Outline:

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

Recommended Book(s):

1. The Engineering Mathematics , Chitkara University Publication, Vol. II, First Edition
2. Ramana, B. V. (2006). Higher Engineering Mathematics. Tata McGraw-Hill Education.
3. Taneja, H. C. (2008). Advanced Engineering Mathematics. IK International Pvt Ltd.
4. Jain, R. K., & Iyengar, S. R. (2004). Advanced engineering mathematics. Alpha Science Int'l Ltd..
5. Dass, H. K. (2008). Advanced engineering mathematics. S. Chand Publishing.

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 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. Coding Theory: Coding of binary information and error detection, decoding and error detection

Recommended Book(s):

1. Liu, C. L. (1977). Elements of discrete mathematics (No. 511.6 L5).
2. Ram, B. (2012). Discrete mathematics. Pearson Education India.
3. Grassmann, W. K., & Tremblay, J. P. (1996). Logic and discrete mathematics. Upper Saddle River, NM: Prentice Hall.
4. The Discrete Mathematics, Chitkara University Publication.

Course Code	Course Name	L-T-P	Credits
PH101	Engineering Physics	3-1-0	4

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 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 Differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.

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

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.g Lavitation Effect, SQUID,Quantum Mechanics, Introduction to Quantum Mechanics, Group velocity and phase velocity, de-Broglie waves, Uncertainty principle, Wave function and its significance, Normalised wave function, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equation.

Recommended Book(s):

1. Malik, H. K., & Singh, A. K. (2010). Engineering physics. McGraw-Hill Education.
2. Engineering Physics by Chitkara Publication 2nd Edition.
3. Neamen, D. A. (2003). Semiconductor physics and devices: basic principles. McGraw-hill.
4. Squires, G. L., & Squires, G. L. (2001). Practical physics. Cambridge university press.

Course Code	Course Name	L-T-P	Credits
PH103	Engineering 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, Engg.Physics Theory and Practicals, Wiley (1 January 2015)
3. Neamen, D. A. (2003). Semiconductor physics and devices: basic principles. McGraw-hill.
4. Malik, H. K., & Singh, A. K. (2010). Engineering physics. McGraw-Hill Education.

Course Code	Course Name	L-T-P	Credits
EC101	Basics of Electronics Engineering	3-1-0	4

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. Muthusubramanian, R., Salivahanan, R., & Muraleedharan, K. A. (2009). Basic Electrical & Electronics Engineering. Tata McGraw Hill Education Private Limited.
2. Kothari, D. P., & Nagrath, I. J. (2017). Basic Electrical and Electronics Engineering|. McGraw-Hill Education.
3. Bhattacharya, D. K., & Sharma, R. (2007). Solid State Electronic Devices (Vol. 85). Oxford University Press, USA.
4. Malvino, A. P., Bates, D. J., & Hoppe, P. E. (1993). Electronic principles. Glencoe.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the basics of electronics elements, their functionality and applications.
CLO.2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.

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

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

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

Course Outline:

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

Recommended Book(s):

1. Muthusubramanian, R., Salivahanan, R., & Muraleedharan, K. A. (2009). Basic Electrical & Electronics Engineering. Tata McGraw Hill Education Private Limited.
2. Kothari, D. P., & Nagrath, I. J. (2017). Basic Electrical and Electronics Engineering|. McGraw-Hill Education.
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
EE101	Basics of Electrical Engineering	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and analyse the concepts of DC circuits.

CLO.2 Understand AC circuits and their power measurements

CLO.3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.

CLO.4 Understand the basic knowledge of transducers and measuring instruments.

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

Course Outline:

Analysis of AC Circuits: Introduction to Alternating Voltage and Current—Waveform terms and Definitions. Root mean square, peak value, average value of A.C, phasor representation, and rectangular and polar forms of alternating quantities. Analysis of pure resistive, inductive and capacitive circuits. Analysis of series R-L, R-C and R-L-C circuits. AC power calculations for single phase. Analysis of parallel circuits, Power in AC circuits, Resonance in series circuit. Introduction to three phase systems-types of connections, relationship between line and phase values, AC power calculations for three phase systems. Magnetic Circuits: Definition of emf, mmf, flux and reluctance, Faraday's laws, self and mutual inductance, Energy in linear magnetic systems, coils connected in series, electromagnets. Electric Machines: DC Motors- Working principle, construction and applications of DC Motors. Three-phase and Single-phase induction motor- Principle, construction, working and applications. Measuring Instruments and Transducers: Classification of Instruments, Principle of Indicating Instruments, measurement errors. Transformer – Principle, construction, working, equivalent circuit, testing and efficiency. Classification of Transducers, Active and passive transducers, Displacement transducers- LVDT, Temperature Transducers- Resistance Temperature Detectors, thermocouples and Thermistors, Piezoelectric Transducers. Batteries: Types, construction, charging and maintenance of batteries. Electrical Protection and Safety: Basic Protection Devices – Types and Rating of fuses, MCB's, ELCB and MCCB. Electrical shock and precautions against shock, Concept of earthing and various types of earthing. Faraday's law of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced EMF's self and mutual inductance coefficient of coupling, energy stored in magnetic field

Recommended Book(s):

1. Muthusubramanian, R., Salivahanan, R., & Muraleedharan, K. A. (2009). Basic Electrical & Electronics Engineering. Tata McGraw Hill Education Private Limited.
2. Kothari, D. P., & Nagrath, I. J. (2017). Basic Electrical and Electronics Engineering|. McGraw-Hill Education.
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
EE102	Basics of Electrical Engineering Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1Know the basics components of electrical elements, equipment and their functionality with applications.

CLO.2 Possess an ability to analyze and characterize the electrical equipment's and instruments basics for their implementation.

CLO.3 Measure power and power factor of ac circuits and understand three-phase star and delta connections with and without applying loads to calculate 3-phase power.

CLO.4 Possess an ability to perceive the concept of Fuse/MCB characteristics for different fault currents.

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

Course Outline:

Practical Implementation of Theoretical Concepts.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
ME102	Engineering Graphics	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Improve the technical writing skills.
CLO.2 Improve the basic sketching and drawing.
CLO.3 Use engineering scale effectively.
CLO.4 Use dimensioning effectively.
CLO.5 Use development of surfaces.
CLO.6 Communicate through Engineering Graphics.

Course Outline:

Drawing Techniques: Various types of lines, principles of dimensioning, size and location dimensions, symbols, conventions, scales (plane and diagonal) and lettering as per IS code of practice (SP-46) for general Engineering Drawing. Practice of drawing various types of lines and dimensioning exercises. Drawing exercises pertaining to Symbols, Conventions and exercises on lettering techniques free hand printing of letters and numerals in 5 mm sizes, vertical and inclined.

Projection of Points and Lines: Concept of horizontal and vertical planes. First and third angle projections; projection of points and lines, true lengths of lines and their horizontal and vertical traces. Projection of Planes: projection of planes and their traces.

Projection of Solids: Projection of Right solids; solids of rotation and polyhedrons etc, Projection of solids with cases when (a) inclined to one ref plane and (b)inclined to both ref planes. Sectioning of solids. Principles of sectioning, types of sectioning, and their practice on projection of solids, sectioning by auxiliary planes. isometric projections and Orthographic projections- Concept of isometric views; isometric scale and exercises

on isometric views. Practice in orthographic projections.

Development of Surfaces: Development of surfaces of cylinders, cones, pyramids and prisms.

Recommended Book(s):

1. Wolff, D. (2018). OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++ 17. Packt Publishing Ltd.
2. Lengyel, E. (2016). Foundations of Game Engine Development: Volume 1: Mathematics. Terathon Software LLC.
3. Sellers, G., Wright Jr, R. S., & Haemel, N. (2013). OpenGL superBible: comprehensive tutorial and reference. Addison-Wesley.
4. Thorn, A., Doran, J. P., Zucconi, A., & Palacios, J. (2017). Complete Unity 2018 Game Development: Explore techniques to build 2D/3D applications using real-world

Course Code	Course Name	L-T-P	Credits
ME153	Engineering Graphics Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to

CLO.1 Improve the technical writing skills.
CLO.2 Improve the basic sketching and drawing.
CLO.3 Use engineering scale effectively.
CLO.4 Use dimensioning effectively.
CLO.5 Use development of surfaces.
CLO.6 Will be skilled to communicate through Engineering Graphics.

Course Outline:

Introduction of the CAD (computer aided drafting) software and its utilities in the engineering software. Study of the various toolbar options and exercises to familiarize all the drawing tools. Study the basic initial setting and viewing of the drafting software interfaces. Use of basic entities in 2D. Uses of various modify commands of the drafting software. Dimensioning in 2D and 3D entries. Study and implementation of coordinate systems.

Recommended Book(s):

1. Wolff, D. (2018). OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++ 17. Packt Publishing Ltd.
2. Lengyel, E. (2016). Foundations of Game Engine Development: Volume 1: Mathematics. Terathon Software LLC.
3. Sellers, G., Wright Jr, R. S., & Haemel, N. (2013). OpenGL superBible: comprehensive tutorial and reference. Addison-Wesley.
4. Thorn, A., Doran, J. P., Zucconi, A., & Palacios, J. (2017). Complete Unity 2018 Game Development: Explore techniques to build 2D/3D applications using real-world examples. Packt Publishing Ltd.

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. Understand 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 Understand the underlying differences between combinational and sequential circuits.
CLO.4 Understand and apply the design methodologies skills for implementing combinational and sequential circuits.
CLO.4 Understand the concept of memories and Programmable Logic Devices and their classification.
CLO.5 Understand 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. Kumar, A. A. (2016). Fundamentals of digital circuits. PHI Learning Pvt. Ltd.
2. Floyd, T. L. (2010). Digital Fundamentals, 10/e. Pearson Education India.
3. Mano, M. M. (1984). Digital Design, Prentice Hall. Inc., Englewood Cliffs, New Jersey, 7632, 119-125.
4. Leach, D. P., & Malvino, A. P. (1994). Digital principles and applications. Glencoe/McGraw-Hill.

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 Gain the skills of 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. Kumar, A. A. (2016). Fundamentals of digital circuits. PHI Learning Pvt. Ltd.
3. Floyd, T. L. (2010). Digital Fundamentals, 10/e. Pearson Education India.
4. Mano, M. M. (1984). Digital Design, Prentice Hall. Inc., Englewood Cliffs, New Jersey, 7632, 119-125.
5. Leach, D. P., & Malvino, A. P. (1994). Digital principles and applications. Glencoe/McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CS101	Introduction to C Programming	0-0-10	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand a functional hierarchical code organization.

CLO.2 Ability to define and manage data structures based on problem subject domain.

CLO.3 Ability to work with textual information, characters and strings.

CLO.4 Ability to work with arrays of complex objects.

CLO.5 Understand and develop the skills to a concept of object thinking within the framework of functional model.

Course Outline:

Introduction: Structure of a c program, Compilation, Linking & Execution, Comments in C,

Identifiers: Nomenclature of an Identifier, Variables, Constants, Reserved Keywords Pre-processor directives: #define, #include.

Data Types: Introduction Initialization and Declaration of Data Type, Expressions, Statements, Symbolic Constants, Type, Memory representation of integer, character and float data types., Conversion / Type Casting, Input Output in C: Introduction, scanf(), printf( )

Operators: Arithmetic, Relational, Logical, Assignment, Conditional, bitwise, sizeof, Precedence of operators and their associativity.

Control Statements: Selection control Statements: if, if – else, Switch. Iteration control Statements: while, do – while, for, Nested loops, Continue, break. Introduction to complexity analysis

Functions and Pointers: Functions - User defined functions, Built-in functions. Pointers: Introduction to pointer, Pointer expression and pointer Arithmetic, Assignment, Value finding (dereferencing), Taking a pointer address, Adding an integer to a pointer, null pointer, void pointer generic pointer. Function parameter passing mechanisms: call by value, call by reference. Recursion. Storage classes: auto, register, static, extern

Arrays: Types of Arrays, 1-D Arrays: Introduction, Need & Importance

Dynamic memory Allocation in c Initialization of arrays, inputting values, assigning Values Passing 1-D to Function Representing 1-D arrays as pointer Arrays of pointers, pointer to an array Function pointer in C Multi-Dimensional Arrays: Declaration of 2-D Array, Initialization of 2-D Array, passing 2-D array to function Representing 2-D arrays as pointer

Strings: Introduction, Reading and writing strings, String functions(Predefined) : isalpha(), isdigit(), isspace(),strcat(), strncat(),strcpy(),strncpy(),strlen(),strlwr(),strupr(),strchr(),strcmp(),strstr() Pointers and Strings Passing string to a function Array of Strings: Introduction, Reading and writing strings Pointers and Strings Passing string to a function.

String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Introduction to Pointers – Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.

Structure and Union: Structure – Declaring Structure, Accessing members of Structure, Copying Structure, Accessing Structure elements, Nested Structure, Array of structure, passing structure elements to a function individually, Passing entire structure to a function, Pointer to structure, Passing pointer of structure to function. Union. Bit Fields in c. Enum in c. typedef. Command line arguments. Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by ‘n’ devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character.

Recommended Book(s):

1. Thareja, R. (2011). Data structures using C. Oxford University Press, Inc..
2. Kernighan, B. W., & Ritchie, D. M. (1988). The C programming language. Pearson Educación.
3. Schildt, H. (2003). C++: The complete reference. New York: McGraw-Hill.
4. Kamthane, A. (2006). Programming with ANSI and Turbo C. Pearson Education India.

Course Code	Course Name	L-T-P	Credits
CS109	Core Java	2-0-6	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Implement the concept of object-oriented techniques and methodologies using Java

CLO.2 Use Exception Handling concepts for a Robust Application in Java.

CLO.3 Demonstrate an understanding of Java Input and Output

CLO.4 Develop application's skills of using multithreading concept of Java.

CLO.5 Use and Implement several Data structures using Collection Framework

CLO.6 Use database connectivity for a complete Java application.

Course Outline:

Introduction: History and goals of Java, Fundamentals of OOPs, Overview of JDK, JVM, Garbage Collection, Working with Java Data Types, Using Operators.Final keyword, Final variable, Final method, Final class. Super keyword, Calling of superclass instance variable, Superclass constructor ,Superclass method. The second section deals with This keyword, Calling of current class constructor, and method.

Looping Constructs & Arrays: Decision Constructs, Using Loop Constructs, Creating and Using Arrays (1D, 2D, Multidimensional) Jagged Arrays, Command Line Arguments. Practice Problems Strings: Introduction, Immutable String, Methods of String class, StringBuffer class &StringBuilder class, toString method, StringTokenizer class.Super Keyword, Calling of superclass instance variable, Superclass constructor, Superclass method.

Classes, objects and methods: defining a class, Access Control, Method overloading, constructors, constructor overloading, use of this and static.Working with Inheritance: Inheritance Basics & Types, using super, Method Overriding, Dynamic method dispatch, final keyword. Abstract: Methods & Classes, Packages & Interfaces.Abstraction in Java, Abstract Class, Abstract method, Interface in Java, Nested interface, rules, and example programs,

Exception Handling: Exception handling fundamentals, Exception types, try and catch, multiple catch clauses, nested try, throw, throws and finally, Creating custom Exception. Practice problems.

IO Streams: Stream Classes: Byte Streams, Character Streams, StreamTokenizer. Practice Problems Multithreading: Java thread model, main thread, creating thread by implementing Runnable and extending thread class, creating multiple threads, using isAlive() and join(),

thread priorities, Synchronization. Generics: Introduction, Generic Example, Generic Class, Generic Method, Generic Constructor and Generic Interfaces.

Collections Framework: Introduction, Collection Interfaces, Collection Classes, Iterator, Working with Maps: Map Interfaces & Classes, Comparators, Arrays, Vector, Stack, Dictionary, Hashtables.

JDBC Connectivity.

Recommended Book(s):

1. Schildt, H., & Coward, D. (2014). Java: the complete reference (p. 1312). New York: McGraw-Hill Education.
2. Bloch, J. (2008). Effective java (the java series). Prentice Hall PTR.
3. Cay, S. (2016). Core Java-Volume I: Fundamentals. Prentice Hall.
4. Eckel, B. (2003). Thinking in JAVA. Prentice Hall Professional.

Course Code	Course Name	L-T-P	Credits
CS103	Advanced C Programming	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the concept of advanced constructs, algorithms, and data structures in the C programming language.
CLO.2 Understand and apply mathematical skills to solve the problems using C programming language.
CLO.3 Understand the concepts of functions and arrays.
CLO.4 Understand and apply the design methodologies skills for implementing combinational and sequential circuits.
CLO.5 Understand the concept of , pointers, structures as well as sorting algorithms.
CLO.6 Understand the concept of linked lists, complex numbers, stacks, queues, hash tables, and binary trees.

Course Outline:

This course introduces advanced constructs, algorithms, and data structures in the C programming language. Emphasis is on problem solving and techniques useful to engineers. Topics include functions, array, pointers, structures as well as sorting algorithms, linked lists, complex numbers, stacks, queues, hash tables, and binary trees.

Recommended Book(s):

1. C: The Complete Reference, Fourth Edition, Herbert Schildt, Osborne/McGraw-Hill, 2000

Course Code	Course Name	L-T-P	Credits
CS107	Object Oriented Software Engineering	3-0-2	4

Course Learning Outcomes:

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 To 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, project organization & 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. Pressman, R. S. (2005). Software engineering: a practitioner's approach. Palgrave macmillan.
2. Sommerville, I. (2004). Software engineering. Pearson Education India.
3. Jalote, P. (2012). An integrated approach to software engineering. Springer Science & Business Media.
4. Bruegge, B., & Dutoit, A. H. (1999). Object-oriented software engineering. Using UML.

Course Code	Course Name	L-T-P	Credits
CS110	Introduction to Linux	0-0-6	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.

CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.

CLO.3 Monitor system performance and network activities.

CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.

CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.

Course Outline:

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

Recommended Book(s):

1. Purcell, J. (Ed.). (1999). Linux: The Complete Reference; The Advanced Reference. Walnut Creek CDROM.
2. Blum, R. (2008). Linux command line and shell scripting bible (Vol. 481). John Wiley & Sons.
3. Das, S. (2001). Your UNIX: The ultimate guide. McGraw-Hill Science, Engineering & Mathematics.
4. John Goerzen ,"Linux Programming Bible", IDG Books, New Delhi, Eight Edition
5. Sobell, M. G. (2013). A practical guide to Linux commands, editors, and shell programming. Prentice Hall.
6. Kanetkar, Y. P. (2003). UNIX Shell programming. BPB publications.

Course Code	Course Name	L-T-P	Credits
CS111	Introduction to Web Technologies	0-0-10	5

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. Batross, I. (2009). Web Enabled Commercial Application Development Using HTL, DHTML, Javascript, Peril CGI. Bpb Publications.
2. Powell, T. A. (2003). HTML & XHTML: the complete reference.
3. Mack, E. S., & Platt, J. (1997). HTML 4.0: no experience required. SYBEX Inc.
4. Laura Lemay, Rafe Coburn, Jennifer Kyrnin,"Mastering HTML, CSS & JAVAScript", SAMS publication, Seventh edition.
5. Robbins, J. N. (2012). Learning web design: A beginner's guide to HTML, CSS, JavaScript, and web graphics. " O'Reilly Media, Inc.".

Course Code	Course Name	L-T-P	Credits
CS112	Advanced Web Programming	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.

CLO.2 Implement form validation using regular expressions.

CLO.3 Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.

CLO.4 Use and Implement AJAX to fetch data from the server in JQuery and React.

CLO.5 Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.

Course Outline:

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

Recommended Book(s):

1. Geschwinde, E., & Schönig, H. J. (2002). PHP and PostgreSQL: Advanced Web Programming. Sams Publishing.
2. Bates, C. (2002). Web Programming Building Internet Applications. John Wiley & Sons.
3. Holden, S., & Beazley, D. M. (2002). Python Web Programming. Sams Publishing.
4. Sebesta, R. W. (2002). Programming the world wide web. Addison-Wesley Longman Publishing Co., Inc.

Course Code	Course Name	L-T-P	Credits
CS114	Data Structures	3-0-4	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Analyse algorithms and algorithm correctness.

CLO.2 Analyse time complexities of algorithms using asymptotic analysis.

CLO.3 Summarize searching and sorting techniques.

CLO.4 Describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.

CLO.5 Gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Course Outline:

Introduction, elementary data organization, asymptotic notations for complexity, array, linked list, Simple implementations, Binary Heap: Structure Property, Heap Order Property, Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations.

Binomial Queues: Binomial Queue Structure, Binomial Queue Operations, Implementation of Binomial Queue, Priority Queues in the Standard Library.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. Skewed binary tree, extended binary tree, Graph Data Structure, Representation of Graphs

Recommended Book(s):

1. Lipschutz, S., & Pai, G. A. (2008). Data Structures. Tata McGraw-Hill Publishing Company Limited.
2. Hubbard, J. R., & Huray, A. (2004). Data structures with Java. Prentice-Hall.
3. Gilberg, R. F., & Forouzan, B. A. (2001). Data structures: A pseudocode approach with C++. Brooks/Cole Publishing Co.
4. Karumanchi, N. (2011). Data structures and algorithms made easy: data structure and algorithmic puzzles. Narasimha Karumanchi.

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

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Introduction to operating system, computer system architecture, single processor and multiprocessor systems, OS structure, components of OS, process management, I/O management, storage management, protection and security, OS services, process and threads, CPU scheduling, process synchronization, semaphores, deadlock, memory management, paging and segmentation, virtual memory, file system, case studies.

Recommended Book(s):

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2006). Operating system principles. John Wiley & Sons.
2. Dhamdhere, D. M. (2006). Operating systems: a concept-based approach, 2E. Tata McGraw-Hill Education.
3. Tanenbaum, A. (2009). Modern operating systems. Pearson Education, Inc.,
4. Andrew, S. T. (2014). Modern operating systems Pearson.

Course Code	Course Name	L-T-P	Credits
CS116	Database Management System	3-0-0	3

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):

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2002). Database system concepts (Vol. 5). New York: McGraw-Hill.
2. Date, C. J. (2011). SQL and relational theory: how to write accurate SQL code. " O'Reilly Media, Inc.".
3. Desai Bipin.C.(2006), An Introduction to Database Systems, West Group Division, Eleventh Edition
4. Elmasri, R., Navathe, S. B., Elmasri, R., & Navathe, S. B. (2000). Fundamentals of Database Systems Wesley Publications, Seventh Edition.
5. Bayross I.(2005) ," Introduction to PL/SQL", BPB Publications, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CSP2206	Database Management System Lab	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Design and implement skills of database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities.
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.
CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.

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.Perform the following: Rename the table dept as department Add a new column PINCODE with not null constraints to the existing table DEPT. All constraints and views that reference the column are dropped automatically, along with the column. Rename the column DNAME to DEPT_NAME in dept table.

Recommended Book(s):

1. Elmasri, Ramez Z.& Navathe, Shamkant B. (2014). Fundamentals of Database Design. (7th ed). Pearson Education.
2. Silberscatz, Abraham& Korth, Henry F. (2016). Database System Concepts. (5th ed). McGraw-Hill.
3. Desai, Bipin.C.(2013). An Introduction to Database Systems (8th ed). West Group Division.

Course Code	Course Name	L-T-P	Credits
CS117	Computer Networks	3-0-4	5

Course Learning Outcomes:

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 Develop effective skills to 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, A. B. (2007). Data communications & networking (sie). Tata McGraw-Hill Education.
2. Tanenbaum, A. S. (2002). Computer networks. Pearson Education India.
3. Stallings, W. (2007). Data and computer communications. Pearson Education India.
4. Lammle, T. (2011). CCNA Cisco Certified Network Associate Study Guide. John Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS118	Computer System Architecture	3-1-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Evolution of computers, Von Neumann machine, Flynn's classification, basic computer organization, instruction codes, introduction to 8085 microprocessor, add, subtract, multiply algorithms, micro programmed control, central processing unit, input-output organization, DMA, IO interface, IOP, memory organization, virtual memory. Introduction to Parallel Processing: Pipelining, Characteristics of multiprocessors, Interconnection structures, Interprocessor arbitration, Interprocessor communication & synchronization.Register Transfer Language, Register transfer. Bus and Memory transfer Arithmetic Micro-operations. Logic Micro-operations Shift Micro-operations, Arithmetic Logic Shift Unit.

Recommended Book(s):

1. Mano, M. M. (2006). Computer systems architecture.
2. Hayes John P. (1998). Computer Architecture and Organization, Prentice Hall
3. Hennessy, J. L., & Patterson, D. A. (2011). Computer architecture: a quantitative approach. Elsevier.
4. Hayes J.P. (2003), "Computer System Architecture", Pearson Education Asia

Course Code	Course Name	L-T-P	Credits
CS113	Advanced Programming Concepts	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Versed with pointers and structures in C.
CLO.2 Apply linear data structure.
CLO.3 Choose the appropriate searching and sorting technique.
CLO.4 Demonstrate the advantages and disadvantages of specific techniques to be used.
CLO.5 Develop programs using basic data structures like stack and queue.

Course Outline:

Introduction: Structure of a C program, Compilation, Linking & Execution, Using comments, Identifiers- Nomenclature of an Identifier, Variables, Constants, Reserved Keywords.

Data Types: Introduction, Initialization, Declaration of Data Type, Expressions, Statements, Symbolic Constants, Type Conversion / Type Casting, Input Output in C- Introduction, scanf(), printf().

Operators: Arithmetic, Relational, Logical, Assignment, Conditional, size of, Precedence.

Decision Control Construct: Conditional Statements: if, if – else, Nested if –Else, switch, conditional operator, Looping- Types of Loops: while, do – while, for, Nested loops, Continue, break. Functions: User defined functions, Recursion, Storage classes.

Arrays: Introduction, Need & Importance, Types of Arrays: One Dimensional Arrays, Two Dimensional Arrays, Initialization of arrays, inputing values, assigning Values, Multi-Dimensional Arrays, Declaration of an Array, Initialization of an Array, passing 1d to Function, passing two- dimensional array to function, Sparse Matrix.

Strings:Reading and writing strings String functions Predefined), isalpah(), isdigit(), isspace(), strcat(), strncat(), strcpy(), strncpy(), strlen(), strncpy, Implementing user defined functions for Strcpy, strlen, strcmp, strlwr, strupr, strcat.

Pointers: Introduction to pointer: Pointer expression and pointer arithmetic Assignment, Value finding (dereferencing), Taking a pointer address, adding an integer to a pointer, incrementing a pointer, Pointers and strings Passing pointer to a function, Representing arrays as pointer, Arrays of pointers, Null pointers, Generic pointer, Dynamic Allocation of Arrays. Allocating block of memory, releasing the used block, alter the size of allocated memory, allocating memory to single dimensional array, Allocating memory to two dimensional arrays.

Structure: Declaring Structure Accessing members of Structure, Copying Structure Accessing Structure elements, Nested Structure Array of structure, passing structure elements to a function individually passing entire structure to a function. Union: Union Accessing member of Union Unions Inside structure, Pointer to structure, passing pointer of structure to function.

File Handling: File pointer, open file, close file Read data from file, fgetc(), fgets(), fscanf(), fprintf(), writing data from a file, fputc(), fputs(), fprintf(), fwrite() ,Difference between Text Mode, Binary Mode, Detecting End-of-file , Accepting command line arguments, Functions for

selecting record randomly fseek(), ftell(), rewind(),Difference between Text Mode, Binary Mode, Detecting End-of-file Accepting command line arguments ,Functions for selecting record randomly fseek(), ftell(), rewind(). Preprocessor Directives. Base64 encoding, Boolean Algebra.

Recommended Book(s):

1 Hubbard, AnitaHuray, (2011). Data Structures with Java, R. (2nd ed)., Prentice Hall of India.
2 Gilberg ,Richard & Behrouz, Forouzan, (2016). Data Structures. (2nd ed).McGraw-Hill.
3. Karumanchi, Narasimha. (2016). Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles. (3rd ed). Pearson publication.
4. Lipschutz, Seymour (2006). Data Structures: Outline Indian Adapted Edition. Tata McGraw-Hill Horowitz,Ellis .
5. (2008). Computer algorithms. University Press.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Well versed with Object Oriented Concepts and Java skills.
CLO.2 Have 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. Hubbard, AnitaHuray, (2011). Data Structures with Java, R. (2nd ed)., Prentice Hall of India.
2. HerbertSchildt. (2015). The Complete Reference Java. (5th ed). McGraw Hill Education India.
3. Kathy Sierra. (2014). Head First Java. (5th ed). Pearson.
4. Finegan, Edward G. (2016). OCA Java SE8 Programmer I Study Guide (3rd ed). Oracle Press.

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 Understanding the role and functions of Web
CLO.6 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. Banks, Alex & Porcello, Eve. (2017). Learning React: Functional Web Development with React and Redux. O'Reilly.
2. Francesco, Strazzullo & Framework, less. (2017). Front-End Development: Do You Control Your Dependencies Or Are They Controlling You?. Apress.
3. Duckett,Jon (2017). Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback. Wiley.
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
CS146	Web Application Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply the web application development skills to design the responsive website
CLO.2 Develop multi/ single page interactive website
CLO.3 Maintain and enhance existing web application
CLO.4 Perform the 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.

Course Outline:

Fundamental of modern web application design, web application frameworks, Ruby on Rails, managing data, middleware, user interface.

Recommended Book(s):

1. Brown, E. (2016). Learning JavaScript: JavaScript Essentials for Modern Application Development. " O'Reilly Media, Inc.".
2. Krug, S. (2000). Don't make me think!: a common sense approach to Web usability. Pearson Education India.
3. Lemay, L., Colburn, R., & Kyrnin, J. (2017). Sams teach yourself HTML, CSS and Javascript web publishing in one hour a day. Sams.
4. Robbins, J. N. (2012). Learning web design: A beginner's guide to HTML, CSS, JavaScript, and web graphics. " O'Reilly Media, Inc.".

Course Code	Course Name	L-T-P	Credits
CS159	Back-end Development	2-0-4	4

Course Outcomes:

CLO.1 Students will be able to gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.
CLO.2 Students will understand the concept of full stack development and APIs.
CLO.3 Student will 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):

1. Brown, E. (2017). Web development with node and express: leveraging the JavaScript stack. O'Reilly Media.
2. Duckett,Jon (2017). Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback. Wiley.
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
CS108	Python Basics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Design the 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. (2015). Learning python: Powerful object-oriented programming. (5th ed). O'Reilly Media, Inc.
2. Shaw, Zed A, (2013). Learn Python the hard way: A very simple introduction to the terrifyingly beautiful world of computers and code. (3rd ed). Addison-Wesley.
3. Charles, Dierbach. (2016). Introduction to computer science using python: A computational problem-solving focus. Wiley Publishing.
4. Mark, Luty, (2017), Programming Python, (5th ed). Shroff Publication.

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, and 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. Alexander, Michael. (2014). Microsoft Business Intelligence Tools for Excel Analysts. WILEY.
2. Murray, Daniel G. (2016). Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software. (2nd ed). Wiley.
3. Bayross, Ivan. (2014). Introduction to PL/SQL by Ivan Bayross. (3rd ed). BPB Publication.
4. Deshpande, P.S. (2011). SQL & PL / SQL for Oracle 11g Black Book. Dreamtech Press.

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.

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. Persson, Magnus Vilhelm & Martins Luiz Felipe. (2014). Mastering Python Data Analysis. (2nd ed). PACKT Publications.
2. Halterman , Richard L. Halterman. (2014). Learning to program with python. (2nd ed). Pearson publication,
3. Burkov, Andriy (2017). The Hundred-Page Machine Learning. Pearson publication.
4. Winston , Wayne L. (2017) Microsoft Excel Data Analysis and Business Modeling. (2nd ed). Microsoft Press.Persson, Magnus (2016). Mastering Python Data Analysis. Packt Publishing Limited.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and implement classical models and algorithms in machine learning as well as python programming concepts.
CLO.2 Analyze the data, identify the problems.
CLO.3 Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.
CLO.4 Understand the comparative study of the related approaches.
CLO.5 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. Michalski, R. S., Carbonell, J. G., & Mitchell, T. M. (Eds.). (2013). Machine learning: An artificial intelligence approach. Springer Science & Business Media.
2. Wickham, H., & Grolemund, G. (2016). R for data science: import, tidy, transform, visualize, and model data. " O'Reilly Media, Inc.".
3. Theobald, O. (2017). Machine learning for absolute beginners: a plain English introduction (Vol. 157). Scatterplot press.
4. Han, J., Kamber, M., & Pei, J. (2001). Data mining concepts and techniques, Morgan Kaufmann Publishers. San Francisco, CA, 335-391.

Course Code	Course Name	L-T-P	Credits
CS174	Applications of Data Science	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply quantitative modeling skills and data analysis techniques to the solution of real-world business problems, communicate findings, and effectively present results using data visualization techniques.
CLO.2 Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
CLO.3 Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.
CLO.4 Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
CLO.5 Apply principles of Data Science to the analysis of business problems.

Course Outline:

Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed.

Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm)

Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web. Feature Generation and Feature Selection (Extracting Meaning from Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset

Recommended Book(s):

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

2. VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. " O'Reilly Media, Inc.".

3. Peng, R. D. (2016). R programming for data science (pp. 86-181). Victoria, BC, Canada: Leanpub.

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

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Information security, basic networking & TCP/IP, introduction of malwares, attacks and offensive security, virtualization, Debian hands-on, Wireshark, Internet Information

Service (IIS), TCP headers, IP tables, SNORT, SDLC, security tools and sites, fingerprinting, cryptography, system vulnerability test, Metasploit, HTTP basics, CTF challenges. Digital Forensics, Network Security, Cloud Security, and Application Security, Risk Management: Why is it Important?, Critical Security Components

Recommended Book(s):

1. Wu, C. H. J., & Irwin, J. D. (2016). Introduction to computer networks and cybersecurity. CRC Press.
2. Brooks, C. J., Grow, C., Craig Jr, P. A., & Short, D. (2018). Cybersecurity essentials. John Wiley & Sons.
3. Engebretson, P. (2013). The basics of hacking and penetration testing: ethical hacking and penetration testing made easy. Elsevier.
4. Mitnick, K. (2017). 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. Little, Brown.

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, S., & Murugan, S. (2018). Cyber Forensics Book.
2. Parekh, P. H. (Ed.). (2010). Human Rights Year Book 2010. Universal Law Publishing.
3. Britz, M. (2009). Computer forensics and cyber crime: An introduction, 2/e. Pearson Education India.
4. Simpson, M. T., Backman, K., & Corley, J. (2010). Hands-on ethical hacking and network defense. Cengage Learning.

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 analysis skills.
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. Eilam, Eldad. (2013). Reversing: Secrets of Reverse Engineering. Wiley.
2. Sikorski, Michael & Honig, Andrew. (2012). Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software.
3. Erickson, Jon. (2014). Hacking: The Art of Exploitation. (2nd ed). Wiley.
4. Dang,Bruce. (2014). Practical Reverse Engineering. 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 technology skills.
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. Eilam, Eldad. (2013). Reversing: Secrets of Reverse Engineering. Wiley.
2. Sikorski, Michael & Honig, Andrew. (2012). Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software.
3. Erickson, Jon. (2014). Hacking: The Art of Exploitation. (2nd ed). Wiley.
4. Bruce Dang, “Practical Reverse Engineering”,John Wiley & Sons Inc, First edition.

Course Code	Course Name	L-T-P	Credits
CS135	Advanced Java	2-0-4	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. Schildl, Herbert. (2015). The Complete Reference Java. (8th ed). McGraw Hill Education India.
2. Lipschutz, Seymour. (2010). Schaum Data Structures Outline. (2nd ed). Tata McGraw-Hill.
3. Sierra, Kathy. (2009). Head First Java. (2nd ed).Pearson.
4. Finegan, Edward G.(2014).OCA Java SE8 Programmer I Study Guide. (3rd ed). Oracle Press.
5. Ivor,Norton. (2016).Beginning Java 2. (5th ed). Dreamtech Publication.

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 Have 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. Craig, Alan B.(2012). Understanding Augmented Reality, Concepts and Applications. Morgan Kaufmann Publishers Inc.
2. Lengyel, Eric. (2013). Foundations of Game Engine Development, Vol 1.Wiley.
3. Schell,Jesse. (2016). The Art of Game Design: A Book of Lenses. (3rd ed) CRC Press.

4. Rogers,Scott. (2015). Level Up! The Guide to Great Video Game Design. (2nd ed). Wiley.
5. Swink,Steve. (2017). Game Feel: A Game Designer's Guide to Virtual Sensation. CRC Press.

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. Wolf, David. (2018) OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++17. (3rd ed). Ingram.
2. Hearn, Donald & Baker, Pauline. (2015). Computer Graphics.(2nd ed). Pearson Education.
3. Xiang, Ziahng. (2002). Schaum's outline. Computer Graphics. McGraw-Hill India,
4. Rogers, David. (2016). Mathematical Elements of Computer Graphics. (2nd ed). McGraw-Hill,
5. Hughes, John F. (2011). Computer Graphics: Principles and Practice. (3rd ed). Pearson Publication.

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. Craig,Alan B. (2017). Understanding Augmented Reality, Concepts and Applications. Morgan Kaufmann Publishers.
2. Lengyel,Eric.(2016).Foundations of Game Engine Development, Vol 1: Mathematics. CRC Press.
3. Schell,Jesse (2016). The Art of Game Design: A Book of Lenses. (3rd ed) CRC Press.
4. Rogers,Scott. (2016).Level Up! The Guide to Great Video Game Design. (2nd ed). Wiley.
5. Swink, Steve (2015). Game Feel: A Game Designer's Guide to Virtual Sensation. CRC Press.
6. Chandler, Heather. (2010). Fundamentals of Game Development. Jones Barlett Press.
7. Ploor, Michael. (2013) Video Game design foundation. Goodheart willcoax Publisher.

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. Craig,Alan B. (2017). Understanding Augmented Reality, Concepts and Applications. Morgan Kaufmann Publishers.
2. Lengyel,Eric.(2016).Foundations of Game Engine Development, Vol 1: Mathematics. CRC Press.
3. Schell,Jesse (2016). The Art of Game Design: A Book of Lenses. (3rd ed) CRC Press.
4. Rogers,Scott. (2016).Level Up! The Guide to Great Video Game Design. (2nd ed). Wiley.

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 Development of 2D & 3D games using the learned skills.
CLO.2 Development of 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. Craig,Alan B. (2017). Understanding Augmented Reality, Concepts and Applications. Morgan Kaufmann Publishers.
2. Lengyel,Eric.(2016).Foundations of Game Engine Development, Vol 1: Mathematics. CRC Press.
3. Schell,Jesse (2016). The Art of Game Design: A Book of Lenses. (3rd ed) CRC Press.
4. Rogers,Scott. (2016).Level Up! The Guide to Great Video Game Design. (2nd ed). Wiley.
5. Swink, Steve (2015). Game Feel: A Game Designer's Guide to Virtual Sensation. CRC Press.
6. Chandler, Heather. (2010). Fundamentals of Game Development. Jones Barlett Press.

Course Code	Course Name	L-T-P	Credits
CS176	Immersive Reality	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Describe how VR systems work and list the applications of VR.

CLO.2 Understand the design and implementation of the hardware that enables VR systems to be built.

CLO.3 Understand the system of human vision and its implication on perception and rendering.
CLO.4 Explain the concepts of motion and tracking in VR systems.

CLO.5 Describe the importance of interaction and audio in VR systems.

Course Outline:

Introduction to Immersive Reality , Representing the Immersive World, The Geometry of Virtual Worlds &The Physiology of Human Vision, Visual Perception & Rendering, Motion & Tracking, Interaction & Audio,

Recommended Book(s):

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002

3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

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 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 Implement 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. Williams, Brad & Damstra, David. (2016). Professional WordPress: Design and Development. (3rd ed). Wrox.
2. Rolla, Venakataramana. (2013). Digital Marketing Practice Guide for SMBs: SEO,SEM and SMM Practice Guide (2nd ed).Wiley.
3. Ryan, Damian. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation. (4rth ed). Kogan page.
4. Karwal, Shivam. (2018). Digital Marketing Handbook: A Guide to Search Engine Optimization, Pay Per Click Marketing, Email Marketing, Social Media Marketing and Content Marketing. Reilly.

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 Have understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Perform 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. Grappone, Jennifer & Couzin, Gradiva. (2011). Search Engine Optimization (SEO): An Hour a Day, (2nd ed). Wiley..
2. Gradiva, Adam. (2016). Search engine optimization 2016: Learn SEO with smart internet marketing strategies. (2nd ed).Pearson.
3. McDonald ,Jason. (2014). SEO Fitness Workbook, 2016 Edition: The Seven Steps to Search Engine Optimization Success on Google by Search Engine Marketing, Inc.: Driving. Wiley.
4. Moran, Mike & Hunt, Bill. (2016). Search Traffic to Your Company's Website. (3rd ed). IBM Press.

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 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 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. Chaffey, D., & Smith, P. R. (2017). Digital marketing excellence: planning, optimizing and integrating online marketing. Routledge.
2. Hall, S. (2002). B2B digital marketing strategy: how to use new frameworks and models to achieve growth. Kogan Page Publishers.
3. Chaffey, D., & Ellis-Chadwick, F. (2012). Digital marketing: strategy, implementation & practice. Pearson uk.
4. Tuten, T. L. (2002). Social media marketing. Sage.

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 the key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Perform hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Apply 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. Phillips, Rachael Aprill. (2015). Affiliate Marketing for Women. (2nd ed). Lulu.com.
2. Brown, B. C. (2009). The complete guide to affiliate marketing on the Web: How to use and profit from affiliate marketing programs. Atlantic Publishing Company.
3. Dwivedi, Y. K., Rana, N. P., & Alryalat, M. A. A. (2017). Affiliate marketing: An overview and analysis of emerging literature. The Marketing Review, 17(1), 33-50.
4. Prussakov, E. (2011). Affiliate program management: An hour a day. John Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS177	Advance Affiliate Marketing, Drop Shipping and online Customer Support	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the key concepts and trends associated with Affiliate Marketing & Internet Technologies.
CLO.2 Perform hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Affiliate Marketing & Internet Technologies.
CLO.3 Apply 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:

Advanced concepts on affiliate marketing, Drop shipping , Customer Support services , 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. Phillips, Rachael Aprill. (2015). Affiliate Marketing for Women. (2nd ed). Lulu.com.
2. Brown, B. C. (2009). The complete guide to affiliate marketing on the Web: How to use and profit from affiliate marketing programs. Atlantic Publishing Company.
3. Dwivedi, Y. K., Rana, N. P., & Alryalat, M. A. A. (2017). Affiliate marketing: An overview and analysis of emerging literature. The Marketing Review, 17(1), 33-50.
4. Prussakov, E. (2011). Affiliate program management: An hour a day. John Wiley & Sons.

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 Enhance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.
CLO.5 Increase their awareness and deliberately practice the entrepreneurship skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.

Course Outline:

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

RecommendedBook(s):

1. Clarysse, Bart & Sabrina Kiefer. (2008).The Smart Entrepreneur: How To Build For A Successful Business. Elliott & Thompson Publications.
2. Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Currency.
3. Katy, Milkman. (2014). How to Change: The Science of Getting From Where You Are to Where You Want to Be. Thompson Publications.
4. Peterson, Peter G. (2009). The Education of an American Dreamer. Twelve Publishers.

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. Johnson, K. D. (2015). The Entrepreneur Mind. JAICO Publishing House.
2. Mullins, J. (2017). The New Business Road Test: What entrepreneurs and investors should do before launching a lean start-up. Pearson UK.
3. Young, T. E. (2012). The Everything Guide to Crowdfunding: Learn how to use social media for small-business funding. Simon and Schuster.
4. Love, H. (2016). The start-up J Curve: The six steps to entrepreneurial success. Greenleaf Book Group.

Course Code	Course Name	L-T-P	Credits
EP103	New Venture Creation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop critical thinking skills and work in a team used for entrepreneurs.
CLO.2 Transform a simple idea into a sustainable success.
CLO.3 Understand the market needs and apply fundamental aspects to position the developed product.
CLO.4 Understand the concept of entrepreneurship and skill sets of an entrepreneur.
CLO.5 Examine historical and theoretical perspective of entrepreneurship.
CLO.6 Enable recognition and shaping of various opportunities for new venture.

Course Outline:

Market Segmentation, Market segmentation analysis, Market Research, Market Information Sourcing, Advantages of Market Segmentation, Different Perspective on Personas, Product Positioning, Product Positioning components, Competition analysis, Competitor Map, Conduct Research, Market Feasibility study stages, Perform your market research, Customer survey, Survey promotion, Background and Methodology, Suggestions for improving customer service, Final pitch and report submission.

Recommended Book(s):

1. Pinson, L. (2008). Anatomy of a Business Plan: A Step-by-step Guide to Building the Business and Securing Your Company's Future. Aka associates.
2. Craig, C. S., & Douglas, S. P. (2005). International marketing research. Chichester: John Wiley & Sons.
3. Ward, D. B. (2009). A new brand of business: Charles Coolidge Parlin, Curtis Publishing Company, and the origins of market research. Philadelphia, PA: Temple University Press.
4. Ward, D. B. (1996). Tracking the culture of consumption: Curtis Publishing Company, Charles Coolidge Parlin, and the origins of market research, 1911-1930. University of Maryland, College Park.

Course Code	Course Name	L-T-P	Credits
EP104	The Entrepreneurial Innovator	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Establish goals, identify resources and determine the steps required to accomplish their goals.

CLO.2 Identify and interact with local entrepreneurs and business owners within their own communities.

CLO.3 Develop initial competitive landscape and future growth for potential viable business idea.

CLO.4 Have the ability to discern distinct entrepreneurial traits

CLO.5 Know the parameters to assess opportunities and constraints for new business ideas.

Course Outline:

Purpose of a business plan, Rationale of how an organization creates, 9 building blocks, Value Proposition, Cost Structure, Business Model canvas, Research three business plan models, Discuss the differences between fixed and variable expenses, Importance of return on investment, Levels of measurement, Calculate return on investment: ROI, Business Model Scalability, Business model scalability attributes, KSF of a Great Business Model, Other key success factors, Designing the Revenue Model, 7 step development plan, Validating the Revenue Model, The Role of Early Hires, Importance of hiring the right startup roles, Company Formation & Documentation, Pitch Perfect

Recommended Book(s):

1. Holt, D. H. (1992). Entrepreneurship: New venture creation.
2. Timmons, J. A., Spinelli, S., & Tan, Y. (2004). New venture creation: Entrepreneurship for the 21st century (Vol. 6). New York: McGraw-Hill/Irwin.
3. Hall, T., Christensen, C., Dillon, K., & Duncan, D. (2016). Competing Against Luck: The Story of Innovation and Customer Choice. EUA: HarperBusiness.

   Bhattacharya, D. (2018). Competing against Luck: The Story of Innovation and Customer Choice. Vikalpa, 43(2), 121-123.

Course Code	Course Name	L-T-P	Credits
CS178	Practice Venture Building	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Establish goals, identify resources and determine the steps required to accomplish their goals.

CLO.2 Identify and interact with local entrepreneurs and business owners within their own communities.

CLO.3 Develop initial competitive landscape and future growth for potential viable business idea.

CLO.4 Have the ability to discern distinct entrepreneurial traits

CLO.5 Know the parameters to assess opportunities and constraints for new business ideas.

Course Outline:

Introduction of Venture ,Mission, vision, entrepreneurial qualities – I,Mission, vision, entrepreneurial qualities – II, Competitive advantage , Marketing management 1 ,

Marketing management 2 , Government incentives for entrepreneurship, Human Resource management in startups, Dos & Donts in entrepreneurship , Business model scalability attributes, KSF of a Great Business Model, Other key success factors, Designing the Revenue Model, 7 step development plan, Validating the Revenue Model, The Role of Early Hires, Importance of hiring the right startup roles, Company Formation &

Recommended Book(s):

1. Effective Entrepreneurial Management: Strategy, Planning, RiskManagement, and Organization - Robert D. Hisrich VelandRamadani, Springer (2017)
2. Entrepreneurship- Theory, Process Practice –by Kuratko &Hodgetts, Thompson South-Western Publication Entrepreneurship –by Robert D. Hisrich (Edition-9)
3. Holt, D. H. (1992). Entrepreneurship: New venture creation.
4. Timmons, J. A., Spinelli, S., & Tan, Y. (2004). New venture creation: Entrepreneurship for the 21st century (Vol. 6). New York: McGraw-Hill/Irwin.

Course Code	Course Name	L-T-P	Credits
CS168	UX Design and Digitalization	2-0-4	4

Course Learning Outcomes:

Students will be able to:

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

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

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

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

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

Course Outline:

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

Recommended Book(s):

1. Chung, H. D. (2014). Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelley and David Kelley: New York, NY: Crown Business, 2013, 304 pp., $28, ISBN 978-0-3853-4936-9.
2. Rice, G. (2014). Book Review—Creating With Confidence in a Fast-Moving Environment. Global Business and Organizational Excellence, 33(3), 88-93.
3. Kelley, D., & Kelley, T. 2013. Creative Confidence: Unleashing The Creative Potential Within Us All.
4. Kelley, D. Tom (2013) Creative Confidence: Unleashing the Creative Potential Within Us All.

Course Code	Course Name	L-T-P	Credits
CS169	User Interface Design	2-0-4	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. McKay, E. N. (2013). UI is communication: How to design intuitive, user centered interfaces by focusing on effective communication. Newnes.
2. Johnson, J., & Finn, K. (2017). Designing user interfaces for an aging population: Towards universal design. Morgan Kaufmann.
3. Johnson, J. (2007). GUI bloopers 2.0: common user interface design don'ts and dos. Elsevier.
4. Johnson, J., Jeff, J., Neilsen, J., Card, S., Grudin, J., & Kelly, T. S. (2000). GUI bloopers: Don'ts and Do's for Software Developers and Web Designers. Morgan Kaufmann.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Use empathy to change behaviour and build better relationship skills.
CLO.2 Develop empathy through role-play activities.
CLO.3 Explain what it means to have different perspectives.
CLO.4 Empathy prepares students to be leaders in their community.
CLO.5 Understand the key difference(s) between empathy and sympathy.

Course Outline:

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

Recommended Book(s):

1. Siegel, Daniel J. (2014). Mindsight: Transform your Brain with the new Science of Empathy. New Age Publisher.

2. Wasal , Frans De.(2017).The Age of Empathy: Nature's Lessons for a Kinder Society. Souvenir Press.
3. Kolko, Jon. (2014). Well-Designed: How to use Empathy to Create Products People Love. Harvard Business.
4. Patnaik, Dev. (2018).Wired to Care: How Companies Prosper when They Create Widespread Empathy. Rupa and Co.

Course Code	Course Name	L-T-P	Credits
CS171	User Research & Its Application	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand group of usability experts evaluating website against a list of established guidelines.

CLO.2 Conduct moderated discussion with a group of users, allow to learn about user attitudes, ideas, and desires.

CLO.3 Perform testing method focused on navigation, which can be performed on a functioning website, a prototype, or a wireframe.

CLO.4 Identifies user frustrations and problems with site through one-on-one sessions where a "real-life" user performs tasks on site.

CLO.5 Learn how to leverage various user research methods to meet user needs in product, website, or application.

CLO.6 Get hands-on experience with user experience exercises to practice user research skills.

CLO.7 Dive into a step-by-step approach to usability testing, including how to create a research plan, conduct studies, analyze results, and make effective UX design recommendations.

Course Outline:

User research importance, KPIs in user experience, user research goals, heuristics analysis, user segmentation, user personas, identifying and recruiting users for the research, preparing a questionnaire for user research, user research methodologies-qualitative and quantitative analysis, user interviews, focused group discussion, expert reviews, tools for user research, understanding cognitive psychology and user behaviour, application of user research, building a user lab, creating a user day, constant user feedback, listening posts and user research, understanding user problems, empathy map, performing user research in the ecommerce industry. performing user research in the insurance industry, performing a user research with 20 users on a chosen problem.

Recommended Book(s):

1. Goodman, E., & Kuniavsky, M. (2012). Observing the user experience: A practitioner's guide to user research. Elsevier.
2. Rowland, C., Goodman, E., Charlier, M., Light, A., & Lui, A. (2015). Designing connected products: UX for the consumer Internet of Things. " O'Reilly Media, Inc.".
3. Portigal, S. (2013). Interviewing users: how to uncover compelling insights. Rosenfeld Media.
4. Sharon, T. (2012). It's our research: getting stakeholder buy-in for user experience research projects. Elsevier.
5. Albert, B., & Tullis, T. (2013). Measuring the user experience: collecting, analyzing, and presenting usability metrics. Newness.

Course Code	Course Name	L-T-P	Credits
CS172	Design Thinking & Its Applications	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Better understand characteristics and processes, as well as the differences between novice and expert design thinkers.

CLO.2 Learn design thinking skills, focuses on the end-users and how to improve the user experience and make it more fulfilling.

CLO.3 To perform teams work collaboratively on a project, the joint advantage of experience, expertise and wisdom is available while developing solutions

CLO.4 Focus on finding solutions in an innovative way. So, while solving real problems this produces and delivers value to the end-users

CLO.5 Assists in creating successful brands and generating ROI from these brands.

Course Outline:

Introduction to design thinking, history of design thinking, case studies, design thinking in social innovations, tools of design thinking, customer journey map, product lock down workshops, implementing design thinking for making the process of a user better, case studies in retail, case studies in banking, case studies in management decisions, design thinking process and implementing it for a digital product.

Recommended Book(s):

1. Muller-Roterberg, C. (2002). Design thinking for dummies. John Wiley & Sons.
2. Gallagher, A., & Thordarson, K. (2018). Design thinking for school leaders: Five roles and mindsets that ignite positive change. ASCD.
3. Kumar, K., Zindani, D., & Davim, J. P. (2011). Design thinking to digital thinking. Springer Nature.
4. Lewrick, M., Link, P., & Leifer, L. (2018). The design thinking playbook: Mindful digital transformation of teams, products, services, businesses and ecosystems. John Wiley & Sons.
5. Osann, I., Mayer, L., & Wiele, I. (2003). The Design Thinking Quick Start Guide: A 6-step Process for Generating and Implementing Creative Solutions. John Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS175	Interaction Design and its Applications	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Better understand characteristics and processes, as well as the differences between novice and expert design thinkers.

CLO.2 Learn design thinking skills, focuses on the end-users and how to improve the user experience and make it more fulfilling Interaction Design.

CLO.3 To perform teams work collaboratively on a project, the joint advantage of experience, expertise and wisdom is available while developing solutions Interaction Design

CLO.4 Focus on finding solutions in an innovative way. So, while solving real problems this produces and delivers value to the end-users Interaction Design.

CLO.5 Assists in creating successful brands and generating ROI from these brands.

Course Outline:

Introduction to design thinking of Interaction Design , Skills Required in Interaction Design Courses , history of design thinking, case studies, design thinking in social innovations, tools of design thinking of Interaction Design, customer journey map, product lock down workshops, implementing design thinking for making the process of a user better, case studies in retail, case studies in banking, case studies in management decisions, design thinking process and implementing it for a digital product of Interaction Design, Top Online Interaction Design Courses.

Recommended Book(s):

1. Muller-Roterberg, C. (2002). Design thinking for dummies. John Wiley & Sons.
2. Gallagher, A., & Thordarson, K. (2018). Design thinking for school leaders: Five roles and mindsets that ignite positive change. ASCD.
3. Kumar, K., Zindani, D., & Davim, J. P. (2011). Design thinking to digital thinking. Springer Nature.
4. Lewrick, M., Link, P., & Leifer, L. (2018). The design thinking playbook: Mindful digital transformation of teams, products, services, businesses and ecosystems. John Wiley & Sons.
5. Osann, I., Mayer, L., & Wiele, I. (2003). The Design Thinking Quick Start Guide: A 6-step Process for Generating and Implementing Creative Solutions. John Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS120	Theory of Computation	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Become 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. Mishra,KLP. (2006). Theory of Computer Science". (3rd ed). PHI.
2. Hopcroft & Ullman, (2007). Introduction to Automata Theory, Languages and Computation. (2nd ed). Wesley.
3. Martin, James. (2009). Introduction to Languages and the Theory of Computation. (2nd ed). Tata McGraw Hill, India.
4. Kavi, Mahesh (2011). Theory Of computation: problem-solving approach. (2nd ed). Wiley.
5. Shukla, Rajesh, (2014). Theory of Computation. Cengage Learning.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Learn 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. Patterson, Dan W. & Cliffs, Englewood. (2017). Introduction to Artificial Intelligence & Expert Systems. (2nd ed). Prentice Hall.
2. Elaine, Rich & Knight, Kevin & Shivashankar, B Nair. (2017). Artificial Intelligence McGraw- Hill. (2nd ed).
3. Giarratano & Riley. (2005). Expert Systems Principles and Programming. (2nd ed) Thomson Course Technology. 2005.
4. Russell, v & Peter, Norvig. (2017). Artificial Intelligence-Modern approach. Wiley.

Course Code	Course Name	L-T-P	Credits
CS124	Network Security	4-0-0	4

Course Learning Outcomes:

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. (2010). Cryptography and Network Security- Principles and Practices. (8th ed) Pearson.
2. William Stallings (2013). Computer Security- Principles and Practice. Pearson Education.
3. Stallings, William (2016). Network Security Essentials. (4rth ed). Pearson Publication.
4. Bruce, Schneier. (2001). Applied Cryptography. (5th ed). Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS125	Compiler Design	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the context and use of a compiler.
CLO.2 Skill to implement lexical analysis, parsing of the code and semantic analysis of the source code.
CLO.3 Skill to implement back end, include intermediate code generation, run time environment, code generation and register allocation.
CLO.4 To understand the special aspects of compilers and runtime such as code optimization, garbage collection etc.
CLO.5 Knowledge and ability to devise, select, and use modern techniques and tools needed to design and implement compilers.

Course Outline:

Introduction to compiler, compiler structure, lexical analyzer, top-down parsing, bottom-up parsing, parser generator, YACC, intermediate code generation, Boolean expression, procedure calls, code optimization.

Recommended Book(s):

1. Aho, Alfred V. (et al). (2010). Compilers: Principles, Techniques and Tools.(2nd ed).Pearson Education.
2. Dave, H. & Himanshu B. (2018). Compilers: Principles and Practice. (2nd ed). Pearson Education.

3. Kakde, O.G. (2011). Compiler Design. (4th ed). Laxmi Publications.
4. Aho,Alfred V. (2012). Compilers: Principles Techniques and Tool. (2nd ed). Pearson.

Course Code	Course Name	L-T-P	Credits
CS128	Enterprise Application Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand to integrate knowledge from different business functions to create a business plan

CLO.2 Skill process for developing large scale enterprise applications

CLO.3 Knowledge and ability to develop multi-tier architecture

CLO.4 Develop critical thinking and presentation skills by developing the business plan and presenting their work to a professional audience able to create enterprise applications .

Course Outline:

- Entrepreneurship - Generation/Evaluation of Business Ideas - Group Formation, Enterprise Architecture Design & Review of Database Design, Advanced Servlet Design & Developing Use Cases , Implementation & Technology , Final Presentation, Demonstration, and Code Review

Recommended Book(s):

1. Beginning J2EE 1.4: From Novice to Professional (Apress Beginner Series)
2. Covello & Hazelgren, The Complete Book of Business Plans
3. Ira Pohl & Charlie McDowell, Java by Dissection,
4. The essentials of Java Programming, Updated Edition.
5. Kroenke, David M. (2005). Database Concepts, 2nd Edition. Prentice Hall.

Course Code	Course Name	L-T-P	Credits
CS136	Introduction to DevOps	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Explain the need to do DevOps.
CLO.2 Understand the DevOps foundations, principles, and practices.
CLO.3 Understand, analyze, and map value streams.
CLO.4 Explain and implement the deployment pipeline skills.
CLO.5 Illustrate the concept of Continuous Delivery.
CLO.6 Create a problem-solving culture.

Course Outline:

Amazon Elastic Block Storage – EBS, creating EBS partition, Amazon S3 simple storage services, Amazon S3 storage classes, Amazon EC2 and its pricing, launch EC2 instance, auto-scaling and benefits, IAM, identity & access management, virtual private cloud, VPC-subnet, Internet gateways, elastic IP addresses (EIPs), docker, introduction to container, docker architecture, install docker & its various commands.

Recommended Book(s):

1. Bass, L., Weber, I., & Zhu, L. (2015). DevOps: A software architect's perspective. Addison-Wesley Professional.
2. Davis, J., & Daniels, R. (2016). Effective DevOps: building a culture of collaboration, affinity, and tooling at scale. " O'Reilly Media, Inc.".
3. Stephen Fleming, "Blockchain Technology & Microservices Architecture A Non-Programmer's Handbook, Createspace Independent Publishing Platform, Stephen Fleming, Second editon
4. Bass, L., Weber, I., & Zhu, L. (2015). DevOps: A software architect's perspective. Addison-Wesley Professional.

Course Code	Course Name	L-T-P	Credits
CS139	Parallel and Distributed Computing	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop and apply knowledge of parallel and distributed computing skills and methodologies.
CLO.2 Apply design, development, and performance analysis of parallel and distributed applications.
CLO.3 Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
CLO.4 Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.
CLO.5 Develop and apply knowledge of parallel and distributed computing techniques and methodologies.

Course Outline:

Motivating parallelism, scope of parallel computing. Flynn's classification, pronciples of parallel algorithm design, parallel programming models, effect of granularity, scalability of parallel systems, distributed computing, message passing and RPC, Java RMI, distributed shared memory, distributed databases, distributed operating systems.

Recommended Book(s):

1. Zbigniew, J Czech (2008). Introduction to Parallel Computing. Cambridge University Press.
2. Carlos, Varela (2016). Programming Distributed Computing Systems. MIT Press.
3. BASU, S. K. (2014). Parallel And Distributed Computing: Architectures And Algorithm. PHI Learning Private Limited.
4. Albert, Zomaya.(2016). Parallel & distributed computing handbook. McGraw-Hill Education.

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

Course Learning Outcomes:

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. Eadline, D. (2009). High performance computing for dummies. Wiley Publishing, Inc..
2. Hurwitz, J. S., Kaufman, M., Halper, F., & Kirsch, D. (2012). Hybrid cloud for dummies. John Wiley & Sons.
3. Golden, B. (2013). Amazon web services for dummies. John Wiley & Sons.
4. Buyya, R., Broberg, J., & Goscinski, A. M. (Eds.). (2010). Cloud computing: Principles and paradigms. John Wiley & Sons.

Course Code	Course Name	L-T-P	Credits
CS160	Microprocessor and Assembly Language Programming	3-0-2	4

Course Outcomes:

Students will be able to:

CLO.1 Provides with in-depth knowledge of basic components of microprocessor-based systems
CLO.2 Implement microprocessor-based systems using 8085
CLO.3 Gain skills to write programs using assembly language of 8085 microprocessor
CLO.4 Identify and apply flag registers data to utilize the arithmetic and logic instructions
CLO.5 Analyze programming problems and apply assembly instructions to solve the problems using logic, shift and rotate instructions

Course Outline:

Microprocessor overview and structure, organization of a microprocessor-based system, 8085 instruction set, 8085 pin diagram, instruction word and data formats, assembly language programming, data transfer instructions, arithmetic and logic instructions, addressing modes, functional blocks, bus structure, microprocessor initiated operations, internal data operations, externally initiated operations, memory devices, I/O devices,

logic devices, interrupts, 8085 interrupt structure, interfacing memory, interfacing I/O devices, DMA controller, memory-mapped and IO-mapped I/O, introduction to 8086, 8086 instruction set, 8086 interrupts.

Recommended Book(s) and References:

1. Gaonkar, R. S. (1989). Microprocessor Architecture, Programming, and Applications with the 8085/8080A. Merrill Publishing Company.
2. Douglas, V. Hall, 1992. Microprocessor and Interfacing Programming and Hardware.
3. Harman, T. L., & Lawson, B. (1989). The Motorola MC68000 microprocessor family: assembly language, interface, design, and system design. Prentice-Hall, Inc..
4. Liu, Y. C. (1991). The MC68000 microprocessor family: fundamentals of assembly language programming and interface design. Prentice-Hall, Inc.

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand software testing and quality assurance as a fundamental component of software life cycle
CLO.2 Infer various software models concepts and skills for making the software.
CLO.3 Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.
CLO.4 To make sure that the result meets the business and user requirements Software testing plays an instrumental role.
CLO.5 To 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. Beizer, B. (1984). Software system testing and quality assurance. Van Nostrand Reinhold Co.
2. Deutsch, M. S., & Willis, R. R. (1988). Software quality engineering: a total technical and management approach. Prentice-Hall, Inc..
3. Schulmeyer, G. G. (2007). Handbook of software quality assurance. Artech House, Inc..
4. Vincent, J., Waters, A., & Sinclair, J. (1988). Software quality assurance. Vol. 1: practice and implementation. Prentice-Hall, Inc.

Course Code	Course Name	L-T-P	Credits
CS182	Business Intelligence and Data Warehousing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Speculate various models and algorithms in data warehousing.
CLO.2 Analyze various database problems and to find out the relevant information out of big data.
CLO.3 Implement major algorithms that generates frequent itemset.
CLO.4 Differentiate between OLAP AND OLTP.
CLO.5 Use clustering techniques for maintaining database integrity.
CLO.6 Model an application's data requirements using conceptual model tools skills like BI tools and strategies

Course Outline:

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

Recommended Book(s):

1. Collier, K. (2012). Agile analytics: A value-driven approach to business intelligence and data warehousing. Addison-Wesley.
2. Stackowiak, R., Rayman, J., & Greenwald, R. (2007). Oracle data warehousing & business intelligence SO. John Wiley & Sons.
3. Turban, E., Sharda, R., Aronson, J. E., & King, D. (2008). Business intelligence: A managerial approach (pp. 58-59). Corydon^ eIndiana Indiana: Pearson Prentice Hall.
4. Simon, A. R., & Shaffer, S. L. (2001). Data warehousing and business intelligence for e-commerce. Elsevier.

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.Meier, Reto (2017). Android Application Development. (2nd ed). CreateSpace Independent Publisher.

2.Lee, Wei-Meng (2018). Beginning android 4 application development. Wrox.

3.Burd, Barry. (2014).Android Application Development All-In-One for Dummies, For Dummies. (2nd ed). Wiley.

4.Horton, John (2013). Android Programming with Kotlin for Beginners. Packt Publishing.

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. Sahar, Ahmad (2017). IOS 13 programming for beginners. (4th ed). Packt.
2. Silberschatz, Abraham & Galvin, Peter Baer (2017). Operating System Concepts. (9th ed), John Wiley & Sons (ASIA) Pvt. Ltd.
3. Dhamdhere, D.M. (2016). System Programming & Operating Systems (2nd ed). Tata McGraw Hill.
4. Wahlbeck,Mark (2014). iOS 13 and Swift 5 programming Develops. (2nd ed). BPB Publication.
5. Neuburg, Matt (2015). iOS 13 programming fundamentals with Swift. (3rd ed). O'Reilly Media.

Course Code	Course Name	L-T-P	Credits
CS149	Internet of Things	3-0-0	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. Bahga, Arshdeep & VijayMadisetti. (2017). Internet of Things: A Hands-on Approach. Universities Press.
2. Hersent,Oliver & Boswarthick,David. (2018). The Internet of Things: Key Applications and Protocols.(3rd ed). Wiley Edition.
3. Millman,Jacob & Halkias ,Christos. (2010). Integrated Electronics: Analog and Digital Circuits and Systems. (2nd ed).Tata McGraw-Hill Education.
4. Mano, Morris & Cilette, Michael D. (2014). Digital Design. Pearson.
5. Hersent,Oliver&Boswarthick, David (2016) The Internet of Things: Key Applications and Protocols. Wiley.

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 Perform 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 networks.

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. Murthy, Siva Ram & Manoj, B.S. (2006). Ad Hoc Wireless Networks Architectures and Protocols. (3rd ed). Pearson Education.
2. Toh, C.K. (2007). Ad Hoc Mobile Wireless Networks Protocols and Systems, Pearson Education.
3. Fei Hu, Xiaojun Cao. (2017). Wireless Sensor Networks — Principles and Practice. Press, Taylor & Francis Group.
4. Shih-Liri Wu & Yu-Chee Tseng. Wireless Ad hoc Networking. Auerbach Publications.

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. Kai Hwang & Faye Briggs. (2011) .Computer Architecture & Parallel Processing. (2nd ed).Tata McGraw Hill.
2. Dezso, Sima & Terence Fountain & Peter Karsuk. (2013). Advanced Computer Architectures A Design Space Approach. Pearson Education.
3. Fayé A. Briggs & Kai Hwang (2014). Computer architecture & parallel processing, (2nd ed). McGraw Hill.
4. El-Rewini, H., & Abd-El-Barr, M. (2005). Advanced computer architecture and parallel processing. John Wiley & Sons.

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 Understand and compare various image enhancement techniques.
CLO.4 Understand and implement the skills of basic image segmentation techniques.
CLO.5 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. (2013). Digital Image Processing. (3rd ed). Pearson Education,
2. Pratt, W.K.. (2014). Digital Image Processing. (2nd ed). McGraw Hill.

3. R.C. Gonzalez & R. E. Woods. (2018). Digital Image Processing. (4th ed). Addison Wesley.
4. Jain, Anil Kumar. (2015). Fundamental of Digital Image Processing. Pearson India.

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, color 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. McConnell, J. J. (2005). Computer graphics: theory into practice. Jones & Bartlett Learning.
2. Foley, J. D., & Van Dam, A. (1982). Fundamentals of interactive computer graphics. Addison-Wesley Longman Publishing Co., Inc..
3. Marschner, S., & Shirley, P. (2015). Fundamentals of computer graphics. CRC Press, 2(3), 4.
4. Gomes, J., & Velho, L. (1997). Image processing for computer graphics. Springer Science & Business Media.

Course Code	Course Name	L-T-P	Credits
CS161	Java Programming	0-0-6	3

Course Outcomes:

Students will be able to:

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

CLO.6 Use Html, JavaScript, CSS, Servlets, JSP and XML to develop web based applications.

Course Outline:

Java introduction, history, overview of JDK, JVM, garbage collection, benefits and applications of OOP, basic concepts and characteristics of OOP, abstract methods and classes, packages and interfaces, exception handeling, wrapper classes, Junit, stream classes, object serialization, collection interface, generic classes, Java threads, multithreading, thread controlling, RDBMS, Oracle 11g, DML, DDL, JDBC, HTML, CSS, servlets, JSP, XML, DTD, AJAX.

Recommended Book(s):

1. Balagursamy. (2012). Programming with Java. (4th ed). Tata McGraw Hill.
2. Dhamdhere, D.M. (2015). System Programming & Operating Systems (2nd ed). Tata McGraw Hill.
3. Bayross. (2005). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP. (4th ed). BPB Publications.
4. Sahar, Ahmad (2015). IOS 13 programming for beginners. (2nd ed) Packt.

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

Course Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. Northwood, C. (2018). The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer. Apress.
2. Vogelsteller, F., Strack, I., & Reyna, M. (2016). Meteor: Full-Stack Web Application Development. Packt Publishing Ltd.
3. Gore, A. (2017). Full-Stack Vue. js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel. Packt Publishing Ltd.
4. Mulder, P. (2014). Full Stack Web Development with Backbone. js: Scalable Application Design with 100% JavaScript. " O'Reilly Media, Inc.".

Course Code	Course Name	L-T-P	Credits
CS203	Integrated Project	0-0-8	4
CS204	Lab Oriented Project	0-0-6	3
CS251	Co-op project at Industry (Module-1)	-	12
CS252	Co-op project at Industry (Module-2)	-	12
CS253	Industry Oriented Hands-on Experience	-	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 Outline:

Students will carry out a project in cooperation with a business or organization. As part of a project, students must write a report which has to meet the academic requirements. The report shall be an academic work that must be related to current theory and practice, including the stay.

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

Course Code	Course Name	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
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-										H		M

		to-day conversation primarily focusing on enhancement of oral skills and then the latter three skills of reading, writing and listening.												
		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										H		M

		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.												
CL104	French	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 effectively in both academic and professional setups.							M		H			
GE101	Numerical Ability and Logical Reasoning	CLO1: Student will be able to improve answers during the Aptitude test and develop an all-around personality with a mature outlook.	H	M		M								
		CLO2: Student will be able to enhance their logical thinking, verbal reasoning and numerical reasoning.	H	H									M	

		CLO3: To enhance the employability skills among the students so that they will take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.	H	H							H	M		H
		CLO4: To enhance the problem solving skills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.								H			M	
		CLO5: Enhance the Aptitude Round Clearing ability in interview process										M	H	
HR101	Human Values and Professional Ethics	CLO:1 The students will be able to get awareness on human values and professional ethics	H	M		M								
		CLO:2 The students will understand the core values that shape their ethical behaviour.	H	H									M	
		CLO:3 The Students will be able to enhance skills active part in social, political, economic and cultural activities with responsibility.	H	H							H	M		H
		CLO:4 The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification.								H			M	
		CLO:5 To strengthen the ability to contribute to the resolution of human rights issues and problems.										M	H	
DM101	Disaster Management	CLO:1 To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.	H	H		H								
		CLO:2 To increase the knowledge and understanding of the International Strategy	H	H										

		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.	H		M									H
		CLO:4 Learn the role of institutions and also analyze the inter-relationship between disasters and developmental projects and their vulnerabilities.	H	H										M
		CLO:5 Gain skills required for the safety of lives during the occurrence of disasters.	H		H									M
CS501	Cyber Security	CLO:1 Acquire Information and risk models including confidentiality, integrity and availability	H	H		H								
		CLO:2 Skill to analyze on Threats and attacks and exploit vulnerabilities	H	H										
		CLO:3 To gain knowledge on Cyber security architecture and operations	H		M									H
		CLO:4 Understand how Cyber security is conceptualized and carried out	H	H										M
		CLO:5 Articulate informed opinion about issues related to cyber security	H		H									M
ES101	Environmental Sciences	CLO1: Students will be able to understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.						H	M					
		CLO2: Students will be able to identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and		M				H	H					

		global warming).												
		CLO3: Students will be able to understand the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs and skills.						H	H	M				
		CLO4: Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and also to students to real-world issues.						M	H		M	M		
		CLO5: Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.							H		M			
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									
PH101	Engineering 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 solve related problems and their application in engineering domain.	H		H									
		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									
PH103	Engineering	CLO:1 Possess an ability to apply		H	M									

	Physics Lab	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.				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		
EE101	Basics of Electrical Engineering	CLO:1 Understand and analyse the concepts of DC circuits.			M	H									
		CLO:2 Understand AC circuits and their power measurements				H									
		CLO:3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.		H		M									
		CLO:4 CLO.4 Understand the basic knowledge of transducers and measuring instruments.						M						H	

		CLO:5 CLO.5 Skilled to conduct experiments, understand the principle, construction and working of electrical devices.							M					H	
EE102	Basics of Electrical Engineering Lab	CLO:1 Know the basics components of electrical elements, equipment and their functionality with applications.		M	H										
		CLO:2 Possess an ability to analyze and characterize the electrical equipment's and instruments basics for their implementation.			H										
		CLO:3 Measure power and power factor of ac circuits and understand three-phase star and delta connections with and without applying loads to calculate 3-phase power.	H		M										
		CLO:4 Possess an ability to perceive the concept of Fuse/MCB characteristics for different fault currents.					M						H		
		CLO:5 Skilled to conduct experiments, understand the principle, construction and working of electrical devices.						M					H		
ME102	Engineering Graphics	CLO1: Improve the technical writing skills.	M	H											
		CLO2: Improve the basic sketching and drawing.		H											
		CLO3: Use engineering scale effectively.		M											
		CLO4: Use dimensioning effectively.				M						H			
		CLO5: Use development of surfaces.					M					H			
		CLO6: Communicate through Engineering Graphics.					M								
ME153	Engineering Graphics Lab	CLO:1 Improve the technical writing skills.		M	H										
		CLO:2 Improve the basic sketching and drawing.			H										

		CLO:3 Use engineering scale effectively.			M									
		CLO:4 Use dimensioning effectively.					M							H	
		CLO:5 Use development of surfaces.						M						H	
		CLO:6 Will be skilled to communicate through Engineering Graphics.						M							
EC105	Digital Electronics and Logic Design	CLO1: Understand the underlying differences between analog and digital systems, and interconversion between the two.	H		M										
		CLO2: Understand and apply mathematical skills to solve digital design problems involving Boolean logic.	M	M	H										
		CLO3: Understand the underlying differences between combinational and sequential circuits.		M											
		CLO4: Understand and apply the design methodologies skills for implementing combinational and sequential circuits.	H		M										
		CLO5: Understand the concept of memories and Programmable Logic Devices and their classification.			M									M	
		CLO6: Understand the concept of memories and Programmable Logic Devices and their classification		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		H	M										

		design and simulation of digital logic circuits												
		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: Implenetation of the concept of memories and Programmable Logic Devices and their classification.			H								M	
CS101	Introduction to C Programming	CLO1: Understanding a functional hierarchical code organization.		H	H									
		CLO2: Ability to define and manage data structures based on problem subject domain.			H	H							H	H
		CLO3: Ability to work with textual information, characters and strings.			H	M					H			H
		CLO4: Ability to work with arrays of complex objects.		H	H						M		H	
		CLO5: Understanding and develop the skills to a concept of object thinking within the framework of functional model.			H	H								H
CS109	Core Java	CLO1: Implement the concept of object-oriented techniques and methodologies using Java			H		H							
		CLO2: Use Exception Handling concepts and skills for a Robust Application in Java.				H	H							

		CLO3: Demonstrate an understanding of Java Input and Output		H		H								
		CLO4: Develop applications using multithreading concept of Java.		H	H		H						H	
		CLO5: Use and Implement several Data structures using Collection Framework			H		H						H	M
CS107	Object Oriented Software Engineering	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.			H		H							
		CLO:2 Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.				H	H							
		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.		H		H								
		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.		H	H		H						H	
		CLO:5 To learn and understand various object oriented concepts along with their applicability contexts			H		H						H	M
CS110	Introduction to Linux	CLO1: Student should be able to identify and use UNIX/Linux utilities to create and manage simple file processing operations,		H	H									

		organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.												
		CLO2: Student should be able to effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.		H	H									H
		CLO3: Student should be able to monitor system performance and network activities.		H	H		H						H	
		CLO4: Student should be able to effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.		H									H	
		CLO5: Student should be able to comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines				M	H							
CS111	Introduction to Web Technologies	CLO:1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.		H	H									
		CLO:2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.		H	H									

		CLO:3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.		H	H		H						H	
		CLO:4 Describe how intended website design features will specifically benefit a target user group content strategy.		H									H	
		CLO:5 Demonstrate and develop web-portals independently or in teams.				M	H							
CS112	Advanced Web Programming	CLO:1 Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.		H	H									
		CLO:2 Implement form validation using regular expressions.		H	H									
		CLO:3 Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.		H	H		H						H	
		CLO:4 Use and Implement AJAX to fetch data from the server in JQuery and React.		H									H	
		CLO:5 Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.				M	H							
CS114	Data Structures	CLO1: Students will be able to analyse algorithms and algorithm correctness.		H	H		M							
		CLO2: Students will be able to analyse time complexities of algorithms using asymptotic		H	H	M								

		analysis.												
		CLO3: Students will be able to summarize searching and sorting techniques.			H									M
		CLO4: Students will be able to describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.		H	H						M			
		CLO5: Students will be able gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.		H	H						M		H	M
CS115	Operating System	CLO1: Students will be able to identify different types of Operating System and their components.		H	M									
		CLO2: Design and implementation of new system calls for any open source operating system.		M	H									
		CLO3: Implementation of existing resource management algorithms in Linux operating system.			H		H						H	
		CLO4: Students will be able to identify various system security and protection issues.		H	H									M
		CLO5: Students will be able to completely administer the system using various Operating systems (Windows and Ubuntu)		H	H								H	

		skills for managing its resources.												
CS116	Database Management System	CLO:6 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	H									
		CLO:7 Describe relational algebra expression and tuple relation expression from queries.			H		H						H	
		CLO:8 Implement the concept of normalization and functional dependency while designing the databases.		H	H									M
		CLO:9 Apply the concept of transaction, concurrency control, security and recovery in database.		H	H								H	
		CLO:10 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.												
CS117	Computer Networks	CLO1: Students will be able to describe and analyze the hardware, software, components of a network and the interrelations.		H	H									
		CLO2: Explain networking protocols and their hierarchical relationship hardware and software.		M			H						H	
		CLO3: Compare protocol models and select appropriate protocols for a particular design.		H	M								M	
		CLO4: Manage multiple operating systems, systems software, network services and security.					H							
		CLO5: Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing	M	H	M		M						M	

		performance and implementing new technologies.												
		CLO6: Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure					M			H				
		CLO7: Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.								M				
		CLO8: Effectively communicate technical information verbally, in writing, and in presentations.										M		
CS118	Computer System Architecture	CLO1: Ability to Understand Basic structure of computer		H	M									H
		CLO2: Ability to perform Computer's Arithmetic Operations		H	M									
		CLO3: Ability to understand control unit operations		H	M									
		CLO4: Ability to learn the design skills of memory organization that uses different word size operations		H	M		M							M
		CLO5: Ability to understand concept of cache memory technique.		H	M									
		CLO6: Ability to conceptualize instruction	M	H	M		H							H

		level parallelism.												
CS113	Advanced Programming Concepts	CLO1: Versed with pointers and structures in C.		H	M									H
		CLO2: Apply linear data structure.		H	M									
		CLO3: Choose the appropriate searching and sorting technique.		H	M									
		CLO4: Demonstrate the advantages and disadvantages of specific techniques to be used.		H	M		M							M
		CLO5: Develop programs using basic data structures like stack and queue.		H	M									
CS126	Algorithm Design & Implementation	CLO:1 Well versed with Object Oriented Concepts and Java skills.		M										
		CLO:2 Have idea of graph traversal algorithms and hashing techniques.		H										
		CLO:3 Write program in Java to solve graph-based problems.			H		H						H	H
		CLO:4 Apply graph searching algorithms to real life problems.	H		H		H							
		CLO:5 Simulate real world problems to Java based software solutions.		H	H									
CS111	Introduction to Web Technologies	CLO1: Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.			H									
		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						H	
		CLO4: Describe how intended website design features will specifically benefit a			H									

		target user group content strategy.												
		CLO5: Demonstrate and develop web-portals independently or in teams.					H							
CS163	Advanced Web Development	CLO1: Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.		H	H	H								
		CLO2: Implement form validation using regular expressions.			H		H						H	
		CLO3: Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.			H									
		CLO4: Use and Implement AJAX to fetch data from the server in JQuery and React.			H	H	H							
		CLO5: Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.					H						H	
CS116	Database Management System	CLO1: 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	H								H	
		CLO2: Describe relational algebra expression and tuple relation expression from queries.		M	H	M								

		CLO3: Implement the concept of normalization and functional dependency while designing the databases.		M	M									
		CLO4: Apply the concept of transaction, concurrency control, security and recovery in database.			H		H							
		CLO5: Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.		M	H								H	
		CLO6: Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.	H		H		H						H	
CS107	Object Oriented Software Engineering	CLO1: Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.		M										M
		CLO2: Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.		M	H									
		CLO3: 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		M	H		H							

		management skill.												
		CLO4: 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	H	H							
		CLO5: To learn and understand various object oriented concepts along with their applicability contexts			M	H	H							
CS135	Advanced Java	CLO1: Students will be able to design the website			H									
		CLO2: Students can develop project using Spring framework skills			H								H	
		CLO3: Students can maintain and enhance existing web platform		H		H								M
		CLO4: Use and Implement several Data structures using Collection Framework.			H								H	
		CLO5: Use database connectivity for a complete Java application.		H		H								M
CS145	Front-end Development	CLO:1 Identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.					H							
		CLO:2 Describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.				H		H						
		CLO:3 Use Javascript to manipulate elements in the DOM to change appearance				H	M	H						

		and visibility.												
		CLO:4 Describe how intended website design features will specifically benefit a target user group content strategy.				H	M							
		CLO:5 Understanding the role and functions of Web servers and server frameworks.				H		H						
CS146	Web Application Development	CLO:1 Apply the web application development skills to design the responsive website				H	M							
		CLO:2 Develop multi/ single page interactive website		M	H		H							
		CLO:3 Maintain and enhance existing web application			H	H								M
		CLO:4 Perform the experiment the web programming concepts to modify the design and layouts of web pages.		M	H		H							M
		CLO:5 Examine the adaptability of scripting languages in web development.		M			H							M
CS159	Back-end Development	CLO.1 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.					H							
		CLO.2 Understand the concept of full stack development and APIs.			H		H							
		CLO.3 Learn debugging issues and end-to-end testing.			H	M	H							
		CLO.4 Deliver features in an agile development environment.		M	H	M								
		CLO.5 Architect solutions to programming problems by combining visual components and classes and develop a fully functioning website and deploy on a web server.					H							
CS108	Python Basics	CLO1: Designing real life scenario problems, identifying and analysing solutions for it.		H	H									
		CLO2: Accurately and efficiently designing		M	H	M	H							

		the solutions in python.												
		CLO3: To be able to use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.			H	H								
		CLO4: Use indexing and slicing to access data in Python programs.		M	H	M	H							
		CLO5: Design loops and decision statements in Python.			H	H								
CS133	Data Visualization and Query Language	CLO1: Students will infer skills for various performance measures and benchmarking progress towards business goals.			H	H		M						
		CLO2: Students will analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.			H	H		M						
		CLO3: Students will create database and work on complex queries.		M	H		H							
		CLO4: Students will be able to differentiate various mapping tools.			H	H		M						
		CLO5: Students will be able to learn web mapping services requirements.		M	H		H							
CS134	Business Analytics	CLO1: Understand and critically apply the concepts and methods of business analytics		M	M									M
		CLO2: To use basic functions and packages in Python.			H		H							

		CLO3: To understand statistical concepts, skills and different hypothesis tests.		M		H								M
		CLO4: To learn how to prepare data using Python.			H		H							
		CLO5: To learn how to prepare data using Python		M		H								M
CS138	Machine Learning	CLO1: Students will understand and implement classical models and algorithms in machine learning as well as python programming concepts.		M	H	H								
		CLO2: Students will analyze the data, identify the problems.		H			H							
		CLO3: Students will learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.		M	H	H								
		CLO4: Students will be able to understand the comparative study of the related approaches.			H		H	H						
		CLO5: Students will be able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.			H		H	H						
CS174	Applications of Data Science	CLO:1 Apply quantitative modeling skills and data analysis techniques to the solution of real-world business problems, communicate findings, and effectively present results using data visualization techniques.				M	H	H						

		CLO:2 Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.				H			H					
		CLO:3 Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.				M	H	H						
		CLO:4 Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.					H		H	H				
		CLO:5 Apply principles of Data Science to the analysis of business problems.					H		H	H				
CS129	Introduction to Cyber Security	CLO1: Review and practice computer and network etiquette and ethics found in working environments						H		H				
		CLO2: Perform risk assessment		H	H									H
		CLO3: Install, configure, use and manage anti malware software on a working network			H	H								
		CLO4: Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems			H		H							
		CLO5: Articulate informed opinion about issues related to cyber security			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.		M	M									
		CLO2: Understand the file system storage mechanisms of two common desktop			H	H								

		operating systems (i.e. versions of Microsoft Windows and LINUX).												
		CLO3: Use tools for faithful preservation of data on disks for analysis.		M	H	H		M		H	M			
		CLO4: Find data that are hidden on a computer disk.					H	M		H		M		
		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	M		M				
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		M	H									

		advanced static malware analysis.												
		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								
CS135	Advanced Java	CLO:1 Design the website.			M	H								
		CLO:2 Develop project using Spring framework skills			M	H								
		CLO:3 Maintain and enhance existing web platform				H		H						
		CLO:4 Use and Implement several Data structures using Collection Framework.				M		H						
		CLO:5 Use database connectivity for a complete Java application.			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		M	H	H							H	

		theories and approaches that inform contemporary for skill development and creative work												
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			H	H	H						H	

		self-directed study.												
CS176	Immersive Reality	CLO1: Describe how IR systems work and list the applications of IR.					H	H		M		M		
		CLO2: Understand the design and implementation of the hardware that enables IR systems to be built.					H	M		H	M	H		
		CLO3:Understand the system of human vision and its implication on perception and rendering. CO4: Explain the concepts of motion and tracking in IR systems.				M	H				M		H	
		CLO4: Explain the concepts of motion and tracking in IR systems.					H	M		H	M	H		
		CLO5:Describe the importance of interaction and audio in IR systems.				H	H				H		H	
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	CLO1: Understanding of the key concepts, skills and trends associated with Digital Marketing & Internet Technologies for becoming entrepreneurs.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing &					H	M		H	M	H		

		Internet Technologies.												
		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 & Internet Technologies for entrepreneurs.				H	H				H		H	
		CLO4: Analyze the confluence of marketing, operations, and human resources in real-time					H	M		H	M	H		

		delivery.												
		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.				H	H				H		H	
CS144	Affiliate Marketing and Online Reputation	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		

	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.	H			H	H				H		H	
CS177	Advance Affiliate Marketing, Drop Shipping and online Customer Support	CLO.1 Understand the key concepts and trends associated with Affiliate Marketing & Internet Technologies.		H					H					
		CLO.2 Perform hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Affiliate Marketing & Internet Technologies.		M	H									
		CLO.3 Apply 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								

		CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization.		H	H			M					H	
		CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques useful for entrepreneurs.			M		H						H	
EP101	Entrepreneurship and Opportunity	CLO:1 Sell themselves and their ideas and become entrepreneurs.			H	M		H	M	H				
		CLO:2 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			
		CLO:3 Find problems worth solving.			H	M		H	M	H				
		CLO:4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.		H	H				H		H			
		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.			H	H		M		M				
EP102	Consumer & Market Research for Entrepreneurs	CLO.1 Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.			H	M		H	M	H				
		CLO.2 Understand the process that enables entrepreneurs with limited resources.		H	H				H		H			
		CLO.3 Understand and apply fundamental aspects as a means of personal			H	M		H	M	H				

		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.		H	H				H		H			
		CLO.5 Satisfy customer's specific needs through a required product or service.			H	H		M		M				
EP103	New Venture Creation	CLO:1 Develop critical thinking skills and work in a team used for entrepreneurs.			H	M		H	M	H				
		CLO:2 Transform a simple idea into a sustainable success.		H	H				H		H			
		CLO:3 Understand the market needs and apply fundamental aspects to position the developed product.			H	M		H	M	H				
		CLO:4 Understand the concept of entrepreneurship and skill sets of an entrepreneur.		H	H				H		H			
		CLO:5 Examine historical and theoretical perspective of entrepreneurship.			H	H		M		M				
		CLO:6 Enable recognition and shaping of various opportunities for new venture.				H	M		H	M	H			
EP104	The Entrepreneurial Innovator	CLO:1 Establish goals, identify resources and determine the steps required to accomplish their goals.			H	H				H		H		
		CLO:2 Identify and interact with local entrepreneurs and business owners within their own communities.				H	M		H	M	H			
		CLO:3 Develop initial competitive landscape and future growth for potential viable business idea.			H	H				H		H		
		CLO:4 Have the ability to discern distinct entrepreneurial traits				H	H		M		M			
		CLO:5 Know the parameters to assess opportunities and constraints for new business ideas.					H		H					
CS178	Practice Venture Building	CLO.1 Establish goals, identify resources and determine the steps required to												

		accomplish their goals.												
		CLO.2 Identify and interact with local entrepreneurs and business owners within their own communities.			H	M								
		CLO.3 Develop initial competitive landscape and future growth for potential viable business idea.				M								
		CLO.4 Have the ability to discern distinct entrepreneurial traits.					M							
		CLO.5 Know the parameters to assess opportunities and constraints for new business ideas.								H				
CS168	UX Design and Digitalization	CLO:1 Understand what interaction design is, the importance of user-centred design and methods of user information gathering.			H									
		CLO:2 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.		H					H					
		CLO:3 Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.			H									
		CLO:4 Analyse and critique the design of interactive products.									H			
		CLO:5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.				H								
CS169	User Interface Design	CLO:1 Construct navigation that enables users to easily accomplish tasks.										H		
		CLO:2 Determine which data to display in order to meet user needs.			H									

		CLO:3 Enable users make social connections through their mobile devices.									H			
		CLO:4 Focus on patterns that bring clarity.					H							
		CLO:5 Learn the skills of design strategy development that provides solutions to meet business and user goals.						H						
CS170	Empathy & its Tools	CLO:1 Use empathy to change behaviour and build better relationship skills.				H								
		CLO:2 Develop empathy through role-play activities.									H			
		CLO:3 Explain what it means to have different perspectives.							H					
		CLO:4 Empathy prepares students to be leaders in their community.			M									
		CLO:5 Understand the key difference(s) between empathy and sympathy.		M										
CS171	User Research & Its Application	CLO:1 Understand group of usability experts evaluating website against a list of established guidelines.									H			
		CLO:2 To conduct moderated discussion with a group of users, allow to learn about user attitudes, ideas, and desires.				H								
		CLO:3 Perform testing method focused on navigation, which can be performed on a functioning website, a prototype, or a wireframe.				H								
		CLO:4 Identifies user frustrations and problems with site through one-on-one sessions where a "real-life" user performs tasks on site.			M							H		
		CLO:5 Learn how to leverage various user research methods to meet user needs in product, website, or application.							H					
		CLO:6 Get hands-on experience with user								H				

		experience exercises to practice user research skills.												
		CLO:7 Dive into a step-by-step approach to usability testing, including how to create a research plan, conduct studies, analyze results, and make effective UX design recommendations.						H						
CS172	Design Thinking & Its Applications	CLO:1 Better understand characteristics and processes, as well as the differences between novice and expert design thinkers.				H								
		CLO:2 Learn design thinking skills, focuses on the end-users and how to improve the user experience and make it more fulfilling.								H				
		CLO:3 To perform teams work collaboratively on a project, the joint advantage of experience, expertise and wisdom is available while developing solutions			M									
		CLO:4 Focus on finding solutions in an innovative way. So, while solving real problems this produces and delivers value to the end-users										H		
		CLO:5 Assists in creating successful brands and generating ROI from these brands.									H			
CS175	Interaction Design and its Applications	CLO.1 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.			M									
		CLO.2 Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration									H			
		CLO.3 Analyse and critique the design of					M							

		interactive products.												
		CLO.4 CLO.5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.						H						
		CLO.5 Construct navigation that enables users to easily accomplish tasks.				M								
CS120	Theory of Computation	CLO1: Students will become familiar with skills of basic automata theory of computer system.		H			H							
		CLO2: Students would be able to understand the working and data flow in computer components.	H	H	H	H								
		CLO3: To understand the challenges for Theoretical Computer Science and its contribution to other sciences such as biology, economics, physics, and many other fields.	H	H		H								
		CLO4: Students will able to deal with the problems efficiently on a model of computation using an algorithm.			H		H							
		CLO5: Describe unrecognizable languages and undecidable problems.			H		H							
CS123	Artificial Intelligence and Expert System	CLO1: Learning the basic concepts and skills of Artificial Intelligence.	H											
		CLO2: Represent Knowledge using		H										

		propositional calculus and predicate calculus.												
		CLO3: Use inference rules to produce predicate calculus expression.		H	H									
		CLO4: Demonstrate awareness of informed search and uninformed search techniques.			H	H								
		CLO5: Explain about AI techniques for planning, knowledge representation and management.		H	H	H	H							
		CLO6: Outline the process involved in Expert systems and in building such systems.			H	H								
CS124	Network Security	CLO1: Identify common network security vulnerabilities/attacks		H	H									
		CLO2: Explain the foundations of Cryptography and network security		M	H									
		CLO3: Gain skills to critically evaluate the risks and threats to networked computers.			H	H								
		CLO4: Demonstrate detailed knowledge of the role of encryption to protect data.	H	H	H	H								
		CLO5: Analyze security issues arising from the use of certain types of technologies.	H	H		H								
		CLO6: Identify the appropriate procedures required to secure networks.		H		H	H							
CS125	Compiler Design	CLO.1 To understand the context and use of a compiler.												
		CLO.2 Skill to implement lexical analysis, parsing of the code and semantic		H										

		analysis of the source csode.												
		CLO.3 Skill to implement back end, include intermediate code generation, run time environment, code generation and register allocation.		H										
		CLO.4 To understand the special aspects of compilers and runtime such as code optimization, garbage collection etc.		H	H	M								
		CLO.5 Knowledge and ability to devise, select, and use modern techniques and tools needed to design and implement compilers.				H	H	M						
CS128	Enterprise Application Development	CLO:1 Understand to integrate knowledge from different business functions to create a business plan		M	H									
		CLO:2 Skill process for developing large scale enterprise applications		H	H	H								
		CLO:3 Knowledge and ability to develop multi-tier architecture		M	H									
		CLO:4 Develop critical thinking and presentation skills by developing the business plan and presenting their work to a professional audience		H	H	M								
		CLO:5 Able to create enterprise applications .		H	H	M								
CS136	Introduction to DevOps	CLO:1 Explain the need to do DevOps.						H		H	H			
		CLO:2 Understand the DevOps foundations, principles, and practices.									H	H		
		CLO:3 Understand, analyze, and map value streams.			H			H		H				
		CLO:4 Explain and implement the deployment pipeline skills.		M	H			M						M

		CLO:5 Illustrate the concept of Continuous Delivery.		M			H				H	H		
CS139	Parallel and Distributed Computing	CLO:1 Develop and apply knowledge of parallel and distributed computing skills and methodologies.												
		CLO:2 Apply design, development, and performance analysis of parallel and distributed applications.												
		CLO:3 Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.												
		CLO:4 Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.												
		CLO:5 Develop and apply knowledge of parallel and distributed computing techniques and methodologies.												
CS150	Mobile Ad-hoc and Sensor Networks	CLO:1 Skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid		H	H									
		CLO:2 To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.		H	H									
		CLO:3 Identify the issues and challenges in providing QoS		M	H									
		CLO:4 Explain about the energy management in ad-hoc networks			H	H								
		CLO:5 Demonstrate various types of mesh networks.			H	H								
CS151	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.		H		H								
		CLO:2 Students will be able to explain the core issues of cloud computing such as		H		H								

		security, privacy, and interoperability.												
		CLO:3 Students will be able to identify problems, and explain, analyze, and evaluate various cloud computing solutions.		H									H	
		CLO:4 Students will be able to provide the appropriate cloud computing solutions and recommendations according to the applications used.			H	H							H	
		CLO:5 Students will be able to build skills to generate new ideas and innovations in cloud computing.			H	H	H							
CS160	Microprocessor Language Programming	CLO:1 Provides with in-depth knowledge of basic components of microprocessor-based systems		H		H								
		CLO:2 Implement microprocessor-based systems using 8085		H		H								
		CLO:3 Gain skills to write programs using assembly language of 8085 microprocessor		H										
		CLO:4 Identify and apply flag registers data to utilize the arithmetic and logic instructions			H	H								
		CLO:5 Analyze programming problems and apply assembly instructions to solve the problems using logic, shift and rotate instructions			H	H	H							
CS181	Software Quality Assurance and Testing	CLO:1 Understand software testing and quality assurance as a fundamental component of software life cycle			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									
		CLO:4 To make sure that the result meets the business and user requirements Software testing plays an instrumental role.				H	H							

		CLO:5 To 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.				H	H	H							
CS182	Business Intelligence and Data Warehousing	CLO:1 Speculate various models and algorithms in data warehousing.	H		H										
		CLO:2 Analyze various database problems and to find out the relevant information out of big data.	H		H										
		CLO:3 Implement major algorithms that generates frequent itemset.	H												
		CLO:4 Differentiate between OLAP AND OLTP.		H	H										
		CLO:5 Use clustering techniques for maintaining database integrity.		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											
		CLO:4 Apply Java programming skills and concepts to Android application development.			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		H						
		CLO:2 Demonstrate and understanding of					H		H						

		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.					H							
		CLO:4 Create a basic iOS app to get familiar using Xcode.						H	H					
		CLO:5 Test and debug apps in a Mac, using the Simulator from Xcode.						H	H	H				
CS149	Internet of Things	CLO:1 Know the architectural overview of the IoT applications.		H		H								
		CLO:2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.		H		H								
		CLO:3 Apply communication protocols for IoT application development.		H										
		CLO:4 Possess an ability to push the data onto the cloud services.			H	H								
		CLO:5 Analyze the sensor data and take necessary action associated with it.			H	H	H							
CS152	Advanced Computer Architecture	CLO:1 Students will know the classes of computers, and new trends and developments in computer architecture.	H	M	M									
		CLO:2 Students will understand pipelining, instruction set architectures, memory addressing.		M	M									
		CLO:3 Students will be able to understand multithreading by using ILP and supporting thread- level parallelism (TLP).		M	H	H								
		CLO:4 Students will build skills to understand the performance and efficiency in advanced multiple- issue processors.	H		H	M	H							
		CLO:5 Students will build skills to understand the performance of multi-core processors using SPEC benchmarks.		M	H	M								H
		CLO:6 Students will be able to understand	M		H		H							

		storage systems, RAID, I/O performance, and reliability measures.												
CS153	Digital Image Processing	CLO:1 Understand fundamental steps of digital image processing	H	M										
		CLO:2 Examine various types of images, intensity transformations and spatial filtering.			H									
		CLO:3 Skill to understand and compare various image enhancement techniques			H	H								
		CLO:4 Skill to understand and implement basic image segmentation techniques		M	H	H	M							
		CLO:5 Skill to understand and implement and compare various image restoration techniques	H				M							
CS154	Computer Graphics	CLO:1 Students will be able to explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.	H	M	H								M	
		CLO:2 Students will be able to apply the concepts of colour models, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering.	H	M	M								M	
		CLO:3 Students will be able to interpret the mathematical foundation of the concepts of computer graphic skills.	H	H		M								
		CLO:4 Students will be able to describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.	M	M		M								
		CLO:5 Students will be able to identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.	M	M	H									
		CLO:6 Students will be able to create effective programs to solve graphics programming issues, including 3D		H	H									

		transformation, objects modelling, colour modelling, lighting, textures, and ray tracing.												
CS161	Java Programming	CLO:1 Implement the concept of object-oriented techniques and methodologies using Java.						H	M	H				
		CLO:2 Use Exception Handling skill for a Robust Application in Java.								H	M	M		
		CLO:3 Demonstrate an understanding of Java Input/Output and Multithreading.						H				M		
		CLO:4 Use and Implement several Data structures using Collection Framework.								H	M	M		
		CLO:5 Use database connectivity for a complete Java application.						H				M		
CS162	Full Stack Development	CLO:1 Use their learned skills, knowledge and abilities to develop web sites for the internet						H			H			
		CLO:2 Apply basic design principles to present ideas, information, products, and services on websites						M	H		H			
		CLO:3 Apply basic programming principles to the construction of websites						H	M					
		CLO:4 Effectively manage website projects using available resources						M	H		H			
		CLO:5 Demonstrate communication skills, service management skills, and presentation skills						H	M					
CS203	Integrated Project	CLO:1 To acquire presentation and communication skills and become employable.					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		M	H	H	H				H		H	M

		complex problems utilizing a systems approach												
		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
CS204	Lab Oriented Project	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
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 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
CS253	Industry Oriented Hands-on Experience	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