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

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

CHITKARA UNIVERSITY

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NAAC ACCREDITED

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

1.1 Programme Educational Objectives (PEO)

PEO 1.	To 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 (BSC)
c) Engineering Science (ESC)
d) Professional Core (PC)

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

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

Mandatory Courses: These courses are intended for students to gain general knowledge, learn a new skill or develop personal interests. 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 Graphics	4-0-2	5
2	Disaster Management	1-0-0	1
3	Environmental Sciences	4-0-0	4
4	Basics of Electrical Engineering	3-1-2	5
5	Engineering Chemistry	3-1-2	5
6	Engineering Mathematics – I	4-1-0	5
		28	**25**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Engineering Physics	4-1-2	6
2	Manufacturing Practice	0-0-4	2
3	Basics of Electronics Engineering	3-1-2	5
4	Introduction to C Programming	4-1-0	5
5	Engineering Exploration	2-0-2	3
6	Discrete Structures	4-1-0	5
		31	**26**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Human Rights and Values	3-0-0	3

2	Computer Network and Security	2-0-0	2
3	Digital Electronics and Logic Design	3-1-2	5
4	Introduction to Linux	0-0-6	3
5	Operating System	3-1-0	4
6	Computer Networks	3-0-4	5
7	Object Oriented Programming using C++	4-1-0	5
		36	**27**

Semester-4			
S.No	**Course Title`**	**L-T-P**	**Credits**
1	Cyber Security	2-0-0	2
2	Database Management System	3-1-4	6
3	Client Side Technologies	4-0-6	7
4	Software Engineering	3-0-2	4
5	Engineering Exploration – II	0-0-4	2
6	Core Java	0-0-10	5
		39	**26**

Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Professional Elective – I	**	5-9#
2	Professional Elective – II	**	
3	Computer System Architecture	3-1-0	4
4	Advanced Database Management System	2-0-4	4
5	Data Structures	4-1-0	5
		15	**18#**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Professional Elective – III	**	8-18#
2	Professional Elective – IV	**	
3	Professional Elective – V	**	
4	Numerical Ability and Logical Reasoning	4-0-0	4
5	Professional Practices	2-0-0	2
6	Integrated Project – III	0-0-6	3
		12	**17#**

Semester-7			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Open Elective – I	**	13#
2	Open Elective – II	**	
3	Open Elective – III	**	
4	Lab Oriented Project(CSE)	0-0-8	4
OR			
1	Co-opt Training Module – I	-	20
		8	**20***

Semester-8			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	- - -	25*
OR			
1	Co-opt Training Module – II	-	**20***

*** Students can also earn these credits by opting co-op training in seventh and eighth semesters.**
 # Credits can vary according to student's choice based credit system.
**** L-T-P will be based on the different electives chosen by the students.**

6. Assessment and Evaluation

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

Evaluation for Core / Elective / Specialization Course:

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

Evaluation components for Theory Courses

There are three Sessional Tests (STs) for all theory papers, the average of the best two are considered. However, the course coordinator, with the approval of Head of the 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 SGPA of the student would be

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

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

List of Courses:

Course Code	Course Name	L-T-P	Credits
Humanities, Social Science and Management Courses (HSM)			**16**
GEL4101	Environmental Sciences	4-0-0	4
HUL2401	Cyber Security	2-0-0	2
HUL3301	Human Rights and Values	3-0-0	3
HUL2101	Disaster Management	1-0-0	1
CLP2305	Industry Interface	0-0-4	2
GTI4301	Numerical Ability and Logical Reasoning	4-0-0	4

Basic Science Courses (BSC)			**21**
AML5101	Engineering Mathematics – I	4-1-0	5
AML4209	Discrete Structures	4-1-0	5
PYL5101	Engineering Physics	4-1-0	5
PYP1101	Engineering Physics Lab	0-0-2	1
CHL4101	Engineering Chemistry	3-1-0	4
CHP1101	Engineering Chemistry Lab	0-0-2	1

Engineering Science Courses (ESC)			**29**
MEW2101	Manufacturing Practice	0-0-4	2
CSL2378	Professional Practices	0-0-4	2
MEL4102	Engineering Graphics	4-0-0	4
MEP1102	Engineering Graphics Lab	0-0-2	1
EEL4103	Basics of Electrical Engineering	3-1-0	4
EEP1103	Basics of Electrical Engineering Lab	0-0-2	1
ECL5101	Basics of Electronics Engineering	3-1-0	4
ECP1101	Basics of Electronics Engineering Lab	0-0-2	1
ECL4207	Digital Electronics and Logic Design	3-1-0	4
ECP1207	Digital Electronics and Logic Design Lab	0-0-2	1
CS101	Introduction to C Programming	4-1-0	5

Professional Core Courses (PC)			**46**
CS102	Object Oriented Programming using C++	3-0-4	5
CSP3213	Introduction to Linux	0-0-6	3
CSL4207	Operating Systems	3-1-0	4
CSL4208	Computer System Architecture	3-1-0	4
CSL3203	Computer Networks	3-0-0	3
CSP2203	Computer Networks Lab	0-0-4	2

CSL4209	Client Side Technologies	4-0-0	4
CSP3209	Client Side Technologies Lab	0-0-6	3
CSL3307	Software Engineering	3-0-0	3
CSP1307	Software Engineering Lab	0-0-2	1
CSL4206	Database Management System	3-1-0	4
CSP2206	Database Management System Lab	0-0-4	2
CSL2301	Advanced Database Management System	2-0-0	2
CSP2301	Advanced Database Management System Lab	0-0-4	2
CSL4318	Advanced programming Concepts	4-0-0	4

Professional Electives (PE)			**13-33#**
A. Open Track			
CS109	Core Java	0-0-10	5
CSL4349	Advanced Java	0-0-8	4
CS114	Data Structures	4-1-0	5
CSP2210	Data Structures Lab	0-0-4	2
CSL3303	Design and Analysis of Algorithm	4-0-0	4
CSP2303	Design and Analysis of Algorithm Lab	0-0-4	2
CSL5302	Web Programming	0-0-10	5
CSL2347	Introduction to DevOps	2-0-0	2
CSL5356	Front-end Development	0-0-10	5
CSL5359	Back-end Development	0-0-10	5
CSL5357	User Interface Design	2-0-4	4
CSL4377	AWS – Introduction to Cloud Computing	0-0-8	4
CSL4378	Dynamic Programming	4-0-0	4
CSL4381	PEGA (Computer Solution Architect)	0-0-8	4
EP3001	Entrepreneurship	2-0-0	2
B. Specialization Tracks			
a) Programming			
CSL4336	Algorithm Design & Implementation	4-0-0	4
CSL4306	Designing Front End Using JavaScript	4-0-0	4
CSP2325	Essentials of Operating System	0-0-4	2
CSL4379	AWS- Module1(APP Development)	4-0-0	4
CSL4380	AWS- Module2(APP Development)	4-0-0	4
CS161	Java Programming under Wipro Talent Next	2-0-4	4
b) Data Science			
CSL4341	Python Basics	4-0-0	4
CSA3103	Data Visualization and Query Language	0-0-4	2
CSL4348	Business Analytics	2-0-4	4
CSL5358	Industry Competitiveness Preparation	2-0-4	4
c) Cyber Security			
CSQ3101	Cyber Security for under graduates – I	3-0-0	3

CSQ3102	Cyber Security for Forensics & Investigation	3-0-2	4
CSQ3103	Malware and Reverse Engineering – I	3-0-0	3
CSQ3104	Malware and Reverse Engineering – II	3-0-0	3
CSQ3105	Introduction to Cyber Security	3-0-0	3
CSQ3106	Digital Security and Advanced Cryptography	3-0-0	3
CSQ3107	Secure Software Development	3-0-0	3
d) Game Development			
GID5356	Fundamentals of Game Programming	1-0-8	5
GID5357	Introduction to Game Engine	1-0-8	5
GID5358	Graphics Programming	1-0-4	3
GID5352	Game Design	1-2-0	3
GID5359	Game Design 2D & 3D	2-2-0	4
GID5360	Game Design BG	1-0-4	3
GID5361	Game Testing	1-0-2	2
GID5362	AI/ML	1-0-6	4
GID5363	Unity Game Development	1-0-8	5
GID5364	AR/VR	1-0-6	4

e) Digital Marketing			
CSL3361	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	3-0-0	3
CSL3362	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	3-0-0	3
CSL3363	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	3-0-0	3
CSL3364	Affiliate Marketing and Online Reputation Management (ORM)	3-0-0	3
f) UI/UX			
CSA4301	UX Design & Digitalization	4-0-0	4
CSA3302	Empathy & its Tools	3-0-0	3
CSA2301	User Interface Design	0-0-4	2
CSA4302	User Research and its applications	0-0-4	2
CSA4303	Design Thinking and its applications	0-0-4	2
C. Open Elective Courses (any three)			**9**
CSL3308	Software Testing & Quality Assurance	3-0-0	3
CSP1308	Software Testing & Quality Assurance Lab	0-0-2	1
CSL3310	Business Intelligence and Data Warehousing	3-0-0	3
CSP1310	Business Intelligence and Data Warehousing Lab	0-0-2	1
CSL3304	Artificial Intelligence and Expert System	3-0-0	3
CSP1304	Artificial Intelligence and Expert System Lab	0-0-2	1
CSL4305	Theory of Computation	3-1-0	4

CSL5407	Compiler Design	4-1-0	5
CSL5411	Network Security	4-1-0	5
CS162	Full Stack Development	0-0-8	4
ER101	CAP Cohort-II(1)	2-0-0	2
ER102	CAP Cohort-II(2)	2-0-0	2

	Special Courses			**45***
	a) Project			
	CS203	Integrated Project	0-0-4	2
	CSP3203	Integrated Project – III	0-0-6	3
	CLP2305	Industry Interface	0-0-4	2
	CSP4401	Lab Oriented Project(CSE)	0-0-8	4
	CST9411	Co-op project at Industry (Module-1)	-	20
	CST9412	Co-op project at Industry (Module-2)	-	20
	CST9401	Industry Oriented Hands-On Course	-	25
	b) Engineering Exploration			**5**
	ASE3101	Engineering Exploration	2-0-2	3
	CS201	Engineering Exploration-I	0-0-4	2
	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 can also earn these credits by opting co-op training in seventh and eighth semesters**
 # Credits can vary according to students choice-based credit system
+ Additional Credits under Global Engineering Week

Course type		**HSM**	**BSC**	**ESC**	**PC**	**PE**	**OE**	**SC**	**Total**
Credits	**Co-op**	16	21	29	46	13-33#	-	40	**165-185#**
	Other	16	21	29	46	13-33#	9-14#	29	**163-188#**

 # Credits can vary according to student's choice based credit system.

- 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 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
Nanodegree Courses	Android Basics
	Android Developer Term 1
	Android Developer Term 2
	Front End 1
	Full Stack 1
	Machine Learning Term 1
	Machine Learning Term 2
	Introduction to Programming
	Artificial Intelligence with Python
	Deep Learning
	Data Analyst
	Business Analytics
	React
	Data Scientist Term 1

	Data Scientist Term 2
	Machine Learning Foundation
	Big Data Foundation

Course Code	Course Name	L-T-P	Credits
GEL4101	Environmental Sciences	4-0-0	4

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

Course Code	Course Name	L-T-P	Credits
HUL2401	Cyber Security	2-0-0	2

Course Outcomes:

CLO.1 Acquire Information and risk models including confidentiality, integrity and availability

CLO.2 Acquire knowledge on Threats and attacks and exploit vulnerabilities

CLO.3 To gain knowledge on Cybersecurity architecture and operations

CLO.4 Install, configure, use and manage anti malware software on a working network

CLO.5 Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems

Course Outlines:

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. Chwan-Hwa, Wu & Irwin, J David. (2017). Introduction to Computer Networks and &security. (2nd ed). CRC Press.
2. Brooks, J. (2016). Security Essentials, (2nd ed). Wiley.
3. Slavio, John. (2017). Hacking: A Beginners' Guide to Computer Hacking, Basic Security and Penetration Testing. (2nd ed). Addison Wiseley.
4. Mitnick, Kevin. (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. (2nd ed).IT Revolution Press.

Course Code	Course Name	L-T-P	Credits
HUL3301	Human Rights and Values	3-0-0	3

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
HUL2101	Disaster Management	1-0-0	1

Course Learning Outcomes:

Students will be able to:

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

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

Course Code	Course Name	L-T-P	Credits
CLP2305	Industry Interface	0-0-4	2

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:

The Student Industry Interface programme acts as a bridge between Industry and Academia, the Industry Interface programme for Students aims at achieving the objective of providing industry exposure to the students. To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

Recommended Book(s):

1. Various industry seminars and workshops are conducted for the students throughout the academic year.

Course Code	Course Name	L-T-P	Credits
GTI4301	Numerical Ability and Logical Reasoning	4-0-0	4

Course Learning Outcomes:

Student 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, verbal reasoning and numerical reasoning.

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, Data Interpretation - Data Interpretation, Tables, Column Graphs, Bar Graphs, Line Charts, Pie Chart, Venn Diagrams, 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, Non-verbal.

Recommended Book(s):

1. Abhijit Guha. (2016). Quantitative Aptitude for All Competitive Examination, MC Graw Hill.
2. Chowdhary,S.S. (2017). Test of Reasoning & Numerical Ability. Sahitya Bhawan.
3. Bs Sijwali, Indu Sijwali, Arihant, A New Approach To Reasoning Verbal & Non-Verbal - Verbal, Non - Verbal & Analytical 2nd Edition, 2017
4. Subject, E. (2017). ESE/GATE/PSUs Numerical Ability, Logical Reasoning & Analytical Ability. ACE Engineering Publications.

Course Code	Course Name	L-T-P	Credits
AML5101	Engineering Mathematics - I	4-1-0	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Introduce and form matrices to present mathematical skill 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 Synthesize and apply multivariable vector-valued functions, their derivatives and integrals to live problems, graphically and analytically.

Course Outline:

Differentiation: Geometrical interpretation of derivative, Indefinite and definite (integration by substitution, by parts, by partial fraction), Reduction formulae sine and cosine (with limit 0 – $\pi/2$).

Probability of Statistics: Functions of random variables, probability distribution functions, expectation, moments Statistical hypothesis tests, t-tests for one and two samples, F-test, χ 2 - test Statistical Methods for Data Fitting: Linear, multi-linear, non-linear regression.

Matrices: Review of matrices and determinants, Elementary operations, rank, Inverse of matrix(using rank), Normal form(using rank), Cayley Hamilton theorem(without proof), Solution of a system of linear equations by using rank, Characteristics equations, Eigen values and vectors.

Differential Calculus: Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, convexity of functions, Radius of curvature.

Partial Differentiation & its Applications: Introduction to Partial Derivatives: Function of several variables, Limit and continuity Partial Differentiation, Euler's Theorem, Total derivatives, Partial Derivative of Composite Functions, Implicit Functions, Jacobians, Taylor's Series Expansion, Maclaurin's Series (one and two variables). Applications: Maxima and Minima of functions of two and three variables, Lagrange's method of Undetermined Multipliers.
Multiple Integration and its Applications: Introduction to Double Integration using Cartesian & polar coordinate, Change of order in double integration, Introduction to Triple Integration, Change of variables in Polar, Cylindrical and Spherical Coordinates, Applications of multiple integral to find Area enclosed by Plane curves, Applications of multiple integral to find Volume, Improper integrals of first and second kind, Special Functions: Beta and Gamma functions.
Introduction to Scalars and Vector: Vector Function (Derivative and integral), tangent to the curve, Unit tangent, Scalar and Vector Field, Gradient and its Physical Interpretations, Directional Derivatives. Divergence and its Physical Interpretations, Curl and its Physical Interpretations, Properties of Gradient, Divergence and Curl , Line Integrals, Surface & Volume Integral , Green's Theorem in the Plane (without proof) and applications , Stokes's Theorem (without proof) and applications , Gauss Divergence Theorem (without proof) and applications.

Recommended Book(s):

1. Erwin, Kreyszig .(2016). Advanced Engineering Mathematics. Wiley India Pvt. Ltd.
2. Ramana, B.V. (2015). Higher Engineering Mathematics. Tata McGraw-Hill Education.
3. Srimanta Pal & Subodh C. Bhunia. (2017). Engineering Mathematics (2nd Ed). Oxford University Press.
4. Bali, n. P. & goyal, manish. (2014). A textBOOK of engineering mathematics. Laxmi publication.

Course Code	Course Name	L-T-P	Credits
AML4209	Discrete Structures	4-1-0	5

Course Learning Outcomes:

Students will be able to:

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

CLO.2 Solve real life problems using combinatorics.

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

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

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

Course Outline:

Introducing sets, relations, functions, permutations & combinations, recurrence relation, characteristic polynomial & introduction to generating functions, logic, lattices, Boolean algebra, graph theory, multi-graph, adjacency matrix, complete bipartite graph & spanning graph, Euler's formula & its applications, trees, shortest path algorithm, Warshall's algorithm, Prim's algorithm. Counting- The pigeonhole principle , Permutations and combinations , Discrete probability, Probability theory , Generalized permutations and combinations ,Recurrence relations ,Generating functions.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
PYL5101	Engineering Physics	4-1-0	5

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

Course Code	Course Name	L-T-P	Credits
PYP1101	Engineering Physics Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CHL4101	Engineering Chemistry	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop skills to innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CLO.2 Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.

CLO.3 Design economically and new methods of synthesis nano materials.

CLO.4 Apply their knowledge for protection of different metals from corrosion.

CLO.5 Implement the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.

Course Outline:

Water Technology: Introduction, Sources of water, Impurities in water, Hard and soft water, Units of hardness (Numericals included), Specification for boiler feed water
Boiler problems: Scale and sludge formation, Caustic embrittlement, Priming and Foaming, Boiler corrosion due to oxygen and carbon dioxide, External treatment: Lime –soda process (Numericals included), Zeolite process, Ion exchange process, Internal treatment (different types of conditioning), Specification of water for domestic use, Treatment for domestic use(break point chlorination); Treatment of brackish water(reverse osmosis, electrodialysis using ion selective membrane). Water quality parameters: Acidity, alkalinity, BOD, COD, Dissolved oxygen, Conductivity, pH.
Polymer Sciences: Elementary ideas about polymers, Classification of polymers, Types of polymerization, Determination of average molecular mass of polymers. Chemical reaction for the synthesis of polymers: Teflon, PMMA, Polyester-(Dacron), Nylon6, 6; Novalac, Phenol formaldehyde resin (Bakelite), PC (Polycarbonate). Classification of Electroactive Polymers, Application of polymers in various devices (Electronic, Computer and Mechanical): Electro active polymer, Ferroelectric Polymer, Biodegradable polymer as orthopedic devices, conducting polymers.

Liquid Crystal Technology: Introduction, Classification of liquid crystals: Smetic liquid crystal, Nematic liquid crystal, Cholestic liquid crystal, Principle of liquid crystal Display(LCD), Different liquid crystal display materials, Polymer dispersed LCD – Molecular arrangement in various types of liquid crystals.
Phase Equilibrium: Introduction, Gibbs phase rule, Application of phase rule in one component system, Water system, Carbon dioxide system, Sulfur system Condensed phase rule, two component system, Eutectic mixture, Lead silver system. Two component system: Potassium iodide -water system, Ferric chloride water system and Iron-Carbon system.
Battery Technology: Introduction, Numericals based on EMF of cell, Relationship between e.m.f. and Thermodynamic properties (ΔH, ΔS, ΔG), Electroless plating, Preparation of PCB(Printed circuit board), Dry cell, lead storage batteries. Applications and function of batteries used in Laptops: Lithium ion battery, NiMH battery, Nano battery, Gel battery. Batteries used in rockets &submarine , Fuel cell (hydrogen-oxygen ¬¬alkaline fuel cell, molten carbonate fuel cell, Phosphoric acid fuel cell) Batteries used in electronic devices ,Solar cell.
Corrosion and its control: Introduction, Causes of corrosion, effects of corrosion, Types and mechanism of corrosion, Direct chemical (dry) corrosion. Electrochemical (wet) corrosion, Comparison of Chemical and electrochemical corrosion. Types of electrochemical corrosion, Other forms of corrosion (Underground or soil corrosion, Microbial corrosion, Erosion

corrosion, Intergranular, Crevice, atmospheric corrosion), Passivity of corrosion, Factors influencing corrosion: Nature of the metal, Nature of corroding environment, Prevention of corrosion, Use of protective measurements-Cathodic protection.
Green Chemistry and Green Engineering: Introduction, Principles of green chemistry and Green Engineering, Green Reagents- Polymer supported reagents, Green Chemistry in India (examples of Microwave assisted synthesis), Traditional and alternative synthesis of Ibuprofen, Adipic acid, Urethane..

Recommended Book(s):

1. Chawla, Sashi. (2006). Engineering Chemistry.Dhanpai Rai Publication.
2. Sivasankar, B. (2002). Engineering Chemistry. Tata McGraw Hill.
3. Palanna, O.G. (2011). Engineering Chemistry. Tata McGraw Hill.
4. Oberio, Shelly. (2010). Engineering Chemistry. Cengage Publication.

Course Code	Course Name	L-T-P	Credits
CHP1101	Engineering Chemistry Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Gain skills to determine the parameters like hardness and chloride content in water.

CLO.2 Estimate the rate constant of a reaction from concentration – time relationships.

CLO.3 Determine the physical properties like adsorption, surface tension and viscosity.

Course Outline:

Determination of total hardness, permanent hardness and temporary hardness by Complex metric method. Determination of residual chlorine in water. Determination of dissolved oxygen in the given water sample. To determine Biological Oxygen Demand in the given water sample. To draw the chemical equations of Traditional and Green synthesis of Adipic acid using CHEM SKETCH. To study the electro-optic behavior of liquid crystal cell. Preparation of Bakelite using phenol-formaldehyde. Preparation of urea –formaldehyde resin. Preparation of copper ammonia Complex. To determine the acid strength by using pH meter. To determine the acid strength by using conductometer. To determine the surface tension by drop number method using Stalgamometer. To determine the % moisture, volatile, ash and carbon content of coal sample by proximate method.

Recommended Book(s):

1. Chawla, Sashi. (2015). Engineering Chemistry lab manual.Dhanpai Rai Publication.
2. Chawla, Sashi. (2006). Engineering Chemistry.Dhanpai Rai Publication.
3. Sivasankar, B. (2002). Engineering Chemistry. Tata McGraw Hill.
4. Palanna, O.G. (2011). Engineering Chemistry. Tata McGraw Hill.
5. Oberio, Shelly. (2010). Engineering Chemistry. Cengage Publication.

Course Code	Course Name	L-T-P	Credits
MEW2101	Manufacturing Practice	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Acquire skills in basic mechanical engineering practice.
CLO.2 Identify the hand tools and instrument
CLO.3 Acquire measuring skills
CLO.4 Implement knowledge of job materials in various shops
CLO.5 Posses the knowledge of core technical subjects for making and working of any type of projects

Course Outline:

Introduction to manufacturing: set up and course requirement; work culture; safety requirements; fire, firefighting& accident handling; and first aid. Hands on practice in the following works area- Carpentry Shop, Fitting Shop, Sheet Metal Shop, Machine Shop, Welding Shop, Electrical & Electronic Shop, Computer Work Bench.
Carpentry Shop: Various types of timber and practice boards, defects in timber, seasoning of wood; tools, wood operation and various joints; exercises involving use of important carpentry tools to practice various operations and making joints.
Fitting Shop: Introduction of fitting practice & tools used in fitting shop; exercise involving marking, cutting, fitting practice (Right Angles), male-Female mating parts practice, trapping practice.
Sheet Metal Shop: Development of surfaces of various objects; sheet metal forming and joining operations, joints, soldering and brazing; exercises involving use of sheet metal forming operations for small joints.
Machine Shop: Introduction to various machine tools, grinders etc; cutting tools and operations; exercises involving lathe, various tools used on lathe, drilling m/c, grinder etc.
Welding Shop: Introduction to different welding methods; welding equipment; electrodes; welding joints; welding defects; exercises involving use of gas/ electric arc welding.
Electrical & Electronic Shop: Electrical: Introduction to electrical wiring; Testing tools and apparatus. Electronic: Introduction to electronic components (Diode, Resistor, Transistors, Capacitors, LED's, PCB's etc) Preparation of PCBs involving soldering applied to electronic applications. Introduction to tools & test apparatus, troubleshooting of electronic circuits.
Computer Bench Work: Introduction to computer Hardware & peripherals Parts- Motherboard, Processor, Socket types, Input/output ports, Memory (primary, secondary), hard disc, CD/DVD drive, keyboard, mouse, SMPS. Assembling/Dissembling and Fault identification: SMPS function and power distribution, testing (using multi meter), part connectivity, error correction and detection. Introduction to advance technology and current wireless technologies (laptop component identification, Bluetooth, Wi Fi RF, IRDA etc.)

Recommended Book(s):

1. Rao, P. (2008). Manufacturing Technology: Metal cutting & Machine Tools. Mc Graw Hill.
2. Ahmded, Waqar. (2009). Emerging nano technology for manufacturing. William Andrew Publisher.
3. Sharma, P. C. (2011). A Text book of Manufacturing Technology. S Chand Publisher.
4. Sharma, P. C. (2006). Production Technology. S Chand Publisher.

Course Code	Course Name	L-T-P	Credits
CSL2378	Professional Practices	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify a new technology that will solve a problem in an organization

CLO.2 Gain skillset to examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G technologies

CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field

CLO.4 Understand and contrast supervised and un-supervised learning algorithms.

CLO.5 Understand the context of information security with respect to social engineering and cyber security.

CLO.6 Recognize the importance of ethical practices with new technologies

CLO.7 Understand and review current literature on the selection, implementation, and evaluation of new and emerging technologies and their impacts

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
MEL4102	Engineering Graphics	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Improve skills of technical writing.
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. sometric 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, David. OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 & C++17. (3rd ed). Ingram
2. Eric, Lengyel.(2014). Foundations of Game Engine Development. (Vol 1). Mathematics. Packt Press.
3. Kessenich, John & Sellers, Graham. (2016). OpenGL Programming Guide: The Official Guide to Learning OpenGL. (9th ed). Ingram.
4. Thorn, Alan & Doran, John. Complete Unity Game Development: Explore techniques to build 2D/3D application using real-world examples. Packt.

Course Code	Course Name	L-T-P	Credits
MEP1102	Engineering Graphics Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify and implement skills of basic concepts of BIS conventions to sketch Engineering drawing.
CLO.2 Create geometric constructions with hand tools.
CLO.3 Construct orthographic projection and sectional view of a machine part.
CLO.4 Create isometric projection from multiview drawings of an object.
CLO.5 Sketch projection of solids and development of lateral surfaces of solids

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, David. (2017). OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 & C++17. (2nd ed). Ingram
2. Eric, Lengyel.(2014). Foundations of Game Engine Development. (Vol 1). Mathematics. Packt Press.
3. Kessenich, John & Sellers, Graham. (2016). OpenGL Programming Guide: The Official Guide to Learning OpenGL. (9th ed). Ingram.
4. Thorn, Alan & Doran, John. (2017). Complete Unity 2017 Game Development: Explore techniques to build 2D/3D application using real-world examples. Packt.

Course Code	Course Name	L-T-P	Credits
EEL4103	Basics of Electrical Engineering	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Recognize and analyse the skills and concepts of DC circuits
CLO.2 Realize AC circuits and their power measurements
CLO.3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.
CLO.4 Know 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.

Recommended Book(s):

1. Rao, Uma (2014). Basic Electronic Dreamtech Press
2. Patil, B.R. (2016). Basic Electrical and Electronics Engineering. (2nd ed). Oxford Higher Education
3. Bhattacharya, D. K. & Sharma, Rajnish (2014). Solid State Electronic Devices. (2nd ed). Oxford University Press.
4. Bhargava, N. N. & Kulshreshtha, D. C (2015). Basic Electronics and Linear Circuits. McGraw Hill Publications

Course Code	Course Name	L-T-P	Credits
EEP1103	Basics of Electrical Engineering Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the basics components of electrical elements, equipment and their functionality with applications.
CLO.2 Possess an ability and skills 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 Conduct experiments, understand the principle, construction and working of electrical devices.

Course Outline:

Practical Implementation of theoretical concepts of basics of electrical engineering.

Recommended Book(s):

1. Muthusubramanian, R. (2009). Basic Electrical and Electronics Engineering. McGraw Hill Education.
2. D.C, Kulshreshtha. (2012). Basic Electrical Engineering. McGraw Hill Education.
3. Rao, Uma (2014). Basic Electronic Dreamtech Press
4. Patil, B.R. (2015). Basic Electrical and Electronics Engineering. Oxford Higher Education.

Course Code	Course Name	L-T-P	Credits
ECL5101	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. R. Muthusubramanian, S. Sahlivahanan,"Basic Electrical and Electronics Engineering", McGraw Hill, First Edition, 2010.
2. N. N Bhargava, D. C Kulshreshtha, S. C Gupta," Basic Electronics and Linear Circuits", McGraw Hill Publications, Second Edition.
3. D. P. Kothari, I. J. Nagrath," Basic Electronics", McGraw Hill, Second Edition.
4. D. K. Bhattacharya, Rajnish Sharma, "Solid State Electronic Devices", Oxford University Press", Second Edition.
5. Albert Malvino, David J. Bates," Electronic Principles" Mcgraw Hill Education, Seventh Edition.

Course Code	Course Name	L-T-P	Credits
ECP1101	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. R. Muthusubramanian, S. Sahlivahanan," Basic Electrical and Electronics Engineering", McGraw Hill, First Edition.
2. D. P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill, Second Edition.
3. B.R. Patil, "Basic Electrical and Electronics Engineering", Oxford Higher, Education Revised Second Edition.
4. T.K Nagsarkar & M.S Sukhija,"Basic Electrical Engineering", Oxford, Second Edition.
5. D.C, Kulshreshtha, "Basic Electrical Engineering ", TMH, First Editon.

Course Code	Course Name	L-T-P	Credits
ECL4207	Digital Electronics and Logic Design	3-1-0	4

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 Recognize and apply mathematical skills to solve digital design problems involving Boolean logic.

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

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

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

CLO.6 Comprehend the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
ECP1207	Digital Electronics and Logic Design Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CS101	Introduction to C Programming	4-1-0	5

Course Learning Outcomes:

Students will be able to:
CLO.1 Analyse the problem statement.
CLO.2 Choose the appropriate C programming constructs to solve the problems.
CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.
CLO.4 Differentiate between efficient and inefficient way of programming skills.
CLO.5 Determine and demonstrate bugs in a program and recognize needed basic operations.
CLO.6 Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outline:

Introduction: Structure of a C program, Compilation, Linking & Execution, Comments in C, Identifiers: Nomenclature of an Identifier, Variables, Constants, and Reserved Keywords.

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.

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

Selection control Statements: if, if – else, Switch.

Arrays: Introduction, Need & Importance Types of Arrays: One Dimensional Arrays, Two Dimensional Arrays, Initialization of arrays, inputting values, assigning Values. Multi-Dimensional Arrays: Declaration of an Array, Initialization of an Array, Passing 1-D to Function, passing 2-Darray to function. Representing arrays as pointer. Arrays of pointers.

Strings: Introduction, Reading and writing strings,.String functions (Predefined): isalpah(), isdigit(), isspace(), strcat(), strncat(),strcpy(), strncpy(), strlen(), strncpy. Pointers and Strings.

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 Padding and data packing in structures Union Bit Fields in c. enum in c. Dynamic memory Allocation in c. Function pointer in C. Recursive functions – 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 (passing an array to a function)

Recommended Book(s):

1. Balagurswamy, E. (2014). Object Oriented Programming with C++ (4th ed). McGraw Hill.
2. Moseley, Kristina & Ralph. (2006).Developing Web Applications. Wiley publications.
3. Andrews, Gregory R. (2014). Concurrent Programming: Principles and Practice by Gregory R. Andrews. Cummings Publishing Company.
4. Rayna, Michael (2012). Concurrent Programming: Algorithms, Principles, and Foundations. Springer.

Course Code	Course Name	L-T-P	Credits
CS102	Object Oriented Programming Using C++	3-0-4	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Formulate problem solutions by incorporating advanced C programming skills.

CLO.2 Choose the appropriate searching and sorting technique.

CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.

CLO.4 Develop programs using basic data structures like stack and queue.

CLO.5 Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outline:

Introduction to Object Oriented Programming: Structure of C++ program, Keywords, Basic Data Types, Derived Data Types, Declaration of Variables, Operators in C++, Scope Resolution Operator, Control Structure, Actual & Formal arguments, Default Arguments, Storage Class Specifiers, Functions, Arrays Declaration, Initialization, Processing Arrays, Arrays and Functions, Character Array, Pointers declaration, Pointer Arithmetic, Pointers And Function, Pointers And Arrays.

Classes: Class Declaration, Member functions, Inline Function, Arrays within class, Static data, Static member functions, Friend Functions, Friend class, Constructors, Parameterized constructor, Multiple Constructor, Copy Constructor, Destructor, Dynamic memory Allocation.

Overloading: Operator Overloading, Overloading assignment operator, overloading arithmetic operator, Overloading comparison operator, Function Overloading.

Inheritance: Hierarchical, Hybrid, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Advantages & Disadvantages of Inheritance, Virtual Functions, Pure Virtual Functions, Virtual Base class, Abstract Class Templates, Function Template, Class Template.

Files: File Stream, Opening and Closing Files, File modes, Sequential Input output, Random Access Files, Updating Files, Exception Handling, Graphic Functions in C++.

Recommended Book(s):

1. Dennis, Ritchie & Kernighan, B. W. (2016). The C Programming Language (2nd Ed.). Prentice-Hall.
2. Kernighan, Brain W. & Ritchie, Dennis (2015). The C Programming Language (2nd ed), Pearson.
3. Kamthane, (2015). Programming in C++. (3rd ed) Pearson.
4. Herbert, Schildt, C. (2012). The Complete Reference. (4th ed.). McGraw-Hill.
5. Gottfried, Byron (2016). Programming with C++. (2nd ed). McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CSP3213	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. Navigating the file system.cat , grep , and the wonders of piping.find. File permissions and ownership. reverse-i-search. Watching, Tailing,

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4207	Operating Systems	3-1-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Introduction to operating system, computer system architecture, single processor and multiprocessor systems, OS structure, components of OS, process management, I/O management, storage management, protection and security, OS services, process and threads, CPU scheduling, process synchronization, semaphores, deadlock, memory management, paging and segmentation, virtual memory, file system, case studies. Secondary Storage Structure: Disks, Structure, Scheduling, FCFS, SSTF, SCAN. Memory Management and Virtual Memory - Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Page Replacement, Page Replacement Algorithms.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4208	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. Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL3203	Computer Networks	3-0-0	3

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 Impart skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

CLO.7 Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.

CLO.8 Effectively communicate technical information verbally, in writing, and in presentations.

Course Outline:

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

Recommended Book(s):

1. Forouzan,"Data Communications and Networking", McGraw-Hill , 5TH edition
2. Andrew S,"Computer Networks by Andrew", Pearson Education, Fourth Edition
3. William Stallings,"Data and computer Communications", Pearson, Eigth Edition
4. Todd Lammle,"CCNA Cisco Certified Network Associate Study Guide", Wiley, Second Edition

Course Code	Course Name	L-T-P	Credits
CSP2203	Computer Networks Lab	0-0-4	2

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the practical approach to network communication protocols.
CLO.2 Understand network layers, structure/format and role of each network layer.
CLO.3 Able to design and gain skills to implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.
CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4209	Client Side Technologies	4-0-0	4

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. JavaScript and VBScript scripting languages, cascading style sheets, browser recognition, browser-specific content, data validation and layers

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP3209	Client Side Technologies Lab	0-0-6	3

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 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:

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. JavaScript and VBScript scripting languages, cascading style sheets, browser recognition, browser-specific content, data validation and layers

Recommended Book(s):

1. Learning Web Design: a beginner's guide to HTML, CSS, Javascript, and Web Graphics, Fifth Edition, O'Reilly Media, 2017
2. Don't make me think, revisited: a common sense approach to web usability, 3rd edition, New Riders, 2014
3. Jennifer Kyrnin, Laura Lemay, Rafe Coburn, Mastering HTML, CSS & JAVAScript Web Publishing, 7th edition, SAMS publication.
4. Niederst Robbins, Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics, 4th Edition, Oreilly Publication

Course Code	Course Name	L-T-P	Credits
CSL3307	Software Engineering	3-0-0	3

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:

Introduction to Software Engineering: The Evolving Role of Software, Changing nature of software, The Software Process: Software Engineering –Layered Technology.

Process Models: The Waterfall Model Evolutionary Process Models – Incremental Models, Spiral Model

Requirements Engineering: Requirements Engineering Tasks, Initiating Requirement, engineering Process, Eliciting Requirements, Developing Use Cases.

Creating an architectural design: software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

Building Analysis Model: Requirement Analysis, Data modeling Concepts, Flow Oriented Modeling, Software Testing Strategies and Tactics-A strategic approach for Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing White-Box Testing Techniques-

Basis Path Testing, Control Structure Testing Black -Box Testing Techniques-Equivalence Partitioning and Boundary Value Analysis

Project Management & Metrics: The management spectrum, Metrics for process & project, Metrics for Software Quality Estimation-Objective of Software Project Planning, Software Scope and Resources, Software Project Estimation and Decomposition Techniques (LOC, FP) Empirical Estimation Models: COCOMO Model

Project Scheduling: Basic Concepts of Scheduling, Project Scheduling, Earned Value Analysis

Risk Management: Software Risks & Risk Strategies, Risk Identification, Risk

Projection, Risk Mitigation, Monitoring and Management (RMMM) plan Overview of Quality Management and Change Management

Recommended Book(s):

1. Pressman, Roger S. (2010).Software Engineering, A practitioner's Approach. (7th ed).McGraw-Hill.
2. Pressman, Roger S. (2013). Software Engineering, A practitioner's Approach. (6th ed) McGraw-Hill.
3. Sommerville, Ian (2014). Software Engineering, (6th ed). Adison-Wesley Pub.
4. Jalote, Pankaj. (2015). An Integrated Approach to Software Engineering. (3rd ed). McGraw-Hill.
5. Naik, Sagar (2017). Software Testing and Quality Assurance: Theory and Practice. (2nd ed).Wiley

Course Code	Course Name	L-T-P	Credits
CSP1307	Software Engineering Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Acquire strong practical knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.
CLO.2 Design and implement skills applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.
CLO.3 Implement 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.4 Learn and apply various object oriented concepts along with their applicability contexts

Course Outline:

Introduction to UML and RSA (Rational software architect), Use-case Diagram of Management System and college Information System, Class diagram for Hospital Management System and College Information System, Interaction diagrams for College information system, Activity diagram for Bug Removal System and Admission Enrollment, Implementation diagram for University Information System and Hospital Management System. Programs using the I/O system calls of UNIX/LINUX operating system (open, read, write, close, fcntl, seek, stat, opendir, readdir)

Recommended Book(s):

1. Pressman, Roger S. (2010).Software Engineering, A practitioner's Approach. (7th ed).McGraw-Hill.
2. Pressman, Roger S. (2013). Software Engineering, A practitioner's Approach. (6th ed) McGraw-Hill.
3. Sommerville, Ian (2014). Software Engineering, (6th ed). Adison-Wesley Pub.
4. Jalote, Pankaj. (2015). An Integrated Approach to Software Engineering. (3rd ed). McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CSL4206	Database Management System	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.

CLO.2 Describe relational algebra expression and tuple relation expression from queries.

CLO.3 Implement the concept of normalization and functional dependency while designing the databases.

CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.

CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.

CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.

Course Outline:

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

Recommended Book(s):

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

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

Course Learning Outcomes:

CLO.1 Students will be able to:
CLO.2 Design and implement skills of database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities.
CLO.3 Describe relational algebra expression and tuple relation expression from queries.
CLO.4 Implement the concept of normalization and functional dependency while designing the databases.
CLO.5 Apply the concept of transaction, concurrency control, security and recovery in database.
CLO.6 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming.
CLO.7 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
CSL2301	Advanced Database Management System	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Learn the basic concepts of advanced database concepts of advanced database management system and understanding database concepts and structures.
CLO.2 Students would be able to understand the role and importance of ADBMS with the help of live database example.
CLO.3 Over this, entire course is designed for skill based that, students to understand data modelling and database development process, construct and normalize conceptual data models.
CLO.4 Implement a relational database into a database management system. Use of database management systems such as Oracle, SQL and PostGre SQL and become proficient in using PL / SQL.
CLO.5 Students will be able to design logic to automatically manage the database during any DML or DDL transaction and understand the issues related to database performance.

Course Outline:

Introduction to Database Server Architecture: Review of DBMS and Introduction to Database Server Architecture, SQL Performance Tools (Indexes, Views, Clusters, Sequences), PL/SQL concepts, Introduction to XML databases, Structured, Semi-structured, Unstructured data, XML hierarchical Data Model, XML Documents, XML DTD.

Introduction to XML databases: XML Schema, XML Languages, Distributed Databases, Introduction to Distributed Databases, Advantages and Functions of Distributed Databases, Data Fragmentation, Replication and allocation techniques for Distributed Database design, Types of Distributed Databases System (Homogeneous and Heterogeneous), Parallel DBMS vs Distributed

ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks),Time stamping methods, optimistic methods, database recovery management.

DBMS, Distributed DBMS architectures, Client-server architecture, peer to peer, Multi DBMS architecture (model with GCS, model without GCS).

Query processing overview, query processing problem, Layers of query processing, Query Processing in Distributed Databases: Query Decomposition, Normalization, Analysis, Elimination of Redundancy, Rewriting.

Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

Introduction to Data Warehousing and OLAP: Data Warehouse, Introduction to Data Warehousing, Conceptual Structure of Data Warehouse, Data Warehouse Modeling, Data Cube and OLAP Operations, Data Mart, OLTP vs OLAP, OLAP vs ROLAP vs MOLAP, Data Mining concepts, Introduction to Mining, KDD Process, Types of Knowledge, Association Rules (Market- Basket Analysis, A-priori Algorithm).Association Rules, Sampling Algorithm, FP-Growth Algorithm and Partition Algorithm

Recommended Book(s):

1. Bayross, Ivan (2016). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP (4th ed)., BPB Publications.
2. Silberscatz, Abraham & Korth, Henry F. (2016). Database System Concepts. (5th ed). McGraw-Hill.
3. Date, C.J. (2017). An Introduction to Database Systems (8th ed). O'Reilly Media.
4. Desai, Bipin.C.(2017). An Introduction to Database Systems (11th ed). West Group Division.
5. Elmasri, Ramez Z.& Navathe, Shamkant B. (2013). Database Systems. (7th ed). Pearson Education.
6. Elmasri, Ramez Z.& Navathe, Shamkant B. (2014). Fundamentals of Database Design. (7th ed). Pearson Education.

Course Code	Course Name	L-T-P	Credits
CSP2301	Advanced Database Management System Lab	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Make student familiar with basic concepts of advanced database concepts of PL/SQL skills
CLO.2 Able to understand the role and importance of Programming logic in databases
CLO.3 Understand the concepts of procedures, Triggers and cursors.
CLO.4 Implement a relational database into a database management system. Use of database management systems such as Oracle and become proficient in using PL / SQL.
CLO.5 Design logic to automatically manage the database during any DML event if occurred in database.

Course Outline:

Practical Implementation of Theoretical Concepts. Use all concepts of PL/SQL. 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. PL/SQL block to satisfy some conditions by accepting input from the user. 8. Write a PL/SQL block that handles all types of exceptions.

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
CSL4318	Advanced Programming Concepts	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstrate high-level working knowledge skills and understanding of advanced programming concepts through consistent problem solving and program implementation

CLO.2 Investigate and design an interactive application that contains appropriate user interfaces and functional components

CLO.3 Develop an interactive application that exhibits effective user interfaces and efficient functional components

CLO.4 Critically evaluate data structures and algorithms relevant to a particular problem and choose appropriate ones for the stewardship of computing resources

Course Outline:

This course is aimed at advancing concepts of programming and software code organization within the framework of structural and procedural programming paradigms. The special track is organized as a series of lectures, hands-on workshops and exercises using different programming languages and focusing on discussing how to write a program of moderate complexity by using language.

Recommended Book(s):

1. Greg Perry, Dean Miller. "C Programming Absolute Beginner's Guide", 3rd ed., Que Publishing, 2013.
2. Stephen G. Kochan. "Programming in C", 4th ed., Addison-Wesley Professional, 2014.
3. Paul Deitel and Harvey Deitel. "C for Programmers with an Introduction to C11", Prentice Hall, 2013.
4. Stephen Prata. "C Primer Plus", 6th ed., Addison-Wesley Professional, 2013.
5. Samuel P. Harbison and Guy L. Steele Jr. "C: A Reference Manual", 5th ed., Pearson, 2002.
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. "Introduction to Algorithms", 3rd ed. MIT Press, 2009. Info here: https://mitpress.mit.edu/books/introductionalgorithms
7. Jeffrey McConnell. "Analysis of Algorithms", 2nd ed., Jones & Bartlett Learning, 2007
8. http://web-int.u-aizu.ac.jp/~pyshe/ : Evgeny Pyshkin's web page on the university web site.
9. https://www.programiz.com/c-programming : Learn C Programming. The definitive guide
10. http://www.cprogramming.com/ : C Programming and C++ Programming
11. http://web-ext.u-aizu.ac.jp/course/prog1/ (in Japanese) : University of Aizu "Programming C" course
12. home page.
13. http://kspt.icc.spbstu.ru/media/files/people/pyshkin/books/AlgDataStrA5_2009.pdf : "Data Structures and Algorithms: Implementation in C/C++" by Evgeny Pyshkin

Course Code	Course Name	L-T-P	Credits
CS109	Core Java	0-0-10	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 skills.

CLO.3 Demonstrate an understanding of Java Input and Output

CLO.4 Develop applications using multithreading concept of Java.

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

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

Course Outline:

Introduction: History and goals of Java, Fundamentals of OOPs, Overview of JDK, JVM, Garbage Collection, Working with Java Data Types, Using Operators

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.

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.

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.

Recommended Book(s):

1. Schildt, Herbert. (2016). Java: The Complete Reference. (9th Ed.). McGraw-Hill.
2. Bayross, Ivan (2016). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP (4th ed)., BPB Publications.
3. Robbins, Niederst.(2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript. and web graphics". (4th ed).Oreilly Publication.

Course Code	Course Name	L-T-P	Credits
CSL4349	Advanced Java	0-0-8	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Getting Started with Java, Conditionals and Loops, Operators and For Loop, Functions, Variables and their scope, Arrays, Searching and Sorting, Strings and 2D-Arrays, Object Oriented Programming, Recursion, Time and Space Complexity, Linked List, Stack and Queues, Trees (Binary Trees and Binary Search Trees), Hash Maps, Priority Queues, Tries and Huffman Coding, Dynamic Programing, Graphs.

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.

Course Code	Course Name	L-T-P	Credits
CS114	Data Structures	4-1-0	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, stacks & queues, implementation of recursive and non-recursive procedures, trees, binary trees, balanced binary tree, AVL tree, heap tree, graphs, directed and undirected graphs, graph traversals (DFS and BFS), searching & sorting, hashing.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP2210	Data Structures Lab	0-0-4	2

Course Learning Outcomes:

CLO.1 Implement algorithms and algorithm correctness.

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

CLO.3 Implement searching and sorting techniques.

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

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL3303	Design and Analysis of Algorithm	4-0-0	4

Course Learning Outcomes (CLO):

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP2303	Design & Analysis of Algorithm Lab	0-0-4	2

Course Learning Outcomes (CLO):

Students will be able to:

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

Course Outline:

Practical Implementation of Theoretical Concepts: divide & conquer, greedy method, Knapsack problem, dynamic programming, backtracking, branch & bound, B-trees, NP hard & NP complete problems, polynomial time approximation.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL5302	Web Programming	0-0-10	5

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.

CLO.2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.

CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.

CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.

CLO.5 Demonstrate and develop web-portals independently or in teams.

Course Outline:

Web programming: Introduction to web programming. HTML5: formatting tags, Lists, Linking between web pages, image in web page, Table tag with attributes, Frames, Form.
CSS3: Internal, external and Inline**,** Use of CSS in HTML document.
Bootstrap: Tables, Forms, Button, Images

JavaScript: Basics of javascript, expression, operator, control statement, functions, accessing HTML element using javasript, dialog box, Event handling, Form Validation.
JavaScript Objects: name, maths, string, date, array.

jQuery: Introduction to jQuery, jQuery Selectors, jQuery Events, jQuery Effects (Hide/Show, Fade, Slide, Animate, Stop), jquary element operation (Get, Set, Add, Remove, CSS)
AJAX: Basics, actions, XMLHttpRequest, Database operations

AngularJS: Introduction, Basic module, Directives, Model, Data Binding, Controllers, Scopes, Filters. Expressions, Data and HTTP Services, Tables, Events, Forms and Validation,File Structure, Animations, Testing. Development using GIT-clone, pull, push commands. Environment setup.
NodeJs: Basics, modules, Expressions, HTTP Module
File System, URL Module, NPM, Events Introduce Express - Express set up, Server Set up, Middleware Routing, Express Sessions, Templating, Passing Parameters, and Express APIs **MongoDB:** Introduction, Create database, Database operations (insert, find, query,Sort, Delete, Drop, Update, Join.

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.

Course Code	Course Name	L-T-P	Credits
CSL2347	Introduction to DevOps	2-0-0	2

Course Learning Outcomes (CLO):

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. Len Bass, Ingo Weber, Liming Zhu, DevOps: A Software Architect's Perspective, O'Reilly, Second editon.
2. Jennifer Davis, Ryn Daniels, "Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale", O'Reilly", Third editon.
3. Stephen Fleming, "Blockchain Technology & Microservices Architecture A Non-Programmer's Handbook, Createspace Independent Publishing Platform, Stephen Fleming, Second editon
4. Ingo M. Weber, Len Bass, and Liming Zhu, "DevOps: A Software Architect's Perspective", Addison-Wesley Professional,First edition.

Course Code	Course Name	L-T-P	Credits
CSL5356	Front-end Development	0-0-10	5

Course Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s) and References:

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

Course Code	Course Name	L-T-P	Credits
CSL5359	Back-end Development	0-0-10	5

Course Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s) and References:

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

Course Code	Course Name	L-T-P	Credits
CSL5357	User Interface Design	2-0-4	4

Course Learning Outcomes (CLO):

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4377	AWS-Introduction to Cloud Computing	0-0-8	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. Daniel Kirsch and Judith Hurwitz, "Cloud Computing for Dummies, Wiley, Second edition,
2. Rajkumar Buyya, James Broberg and Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, First edition.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud ", O'Reilly Media, Fist edition
4. Rajkumar Buyya, Cloud Computing Principles and Paradigms, Wiley, 1st edition

Course Code	Course Name	L-T-P	Credits
CSL4378	Dynamic Programming	4-0-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4381	PEGA(Computer Solution Architect)	0-0-8	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Expands students skills and knowledge on PEGA platform in developing applications .

CLO.2 Built as a structured one by well experienced IT professionals that covers PEGA certification topics.

CLO.3 Gain thorough expertise in the core fundamentals of PEGA advanced topics at the highest level from scratch .

Course Outline:

System Architect Essentials Overview: Exercise approach, business use case, completing the course exercise.

Introduction to PEGA: Introduction, situational layer cake, development studios, navigating pega platform, roles on a pega project.

Case Management: Designing a case life cycle, configuring a multi-step form, exercise, setting a service level, controlling the case workflow, routing work to user, configuring case hierarchy.

Data Modelling: Adding files to a case type, designing a data model, data in memory, manipulating case data, calculating case values

Validation: Validating case data, methods of validation, validate case data with controls, validate case data with validate rules, validating a flow action with a validate rule, configuring data validation

Information Exchange: Using the integration designer, creating data types, application data processing with data types, configure a data source, create externally sourced data types, configuring reference data, managing data pages and vies

User Interface: Customizing user view layout, adding dynamic content to user views, styling an application, designing a user interface

Reporting: Creating business reports, the role of reports, report browser, optimizing report data, designing a business report

Recommended Book(s):

1. Biz Tech, Certified Pega Business Architect (Cpba) Updated Exam Questions, August 17, 2017
2. PCSSA - Pega Certified Senior System Architect Exam Practice Questions & Dumps: Exam Practice Questions For PCSSA Exam Prep,Quantic Books; 1st edition

Course Code	Course Name	L-T-P	Credits
EP3001	Entrepreneurship	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Sell themselves and their ideas.

CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.

CLO.3 Find problems worth solving.

CLO.4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real- world problems and projects.

CLO.5 Increase their awareness and deliberately practice the 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:

Introduction: Entrepreneurship in Established Firms, Venture Creation's Role in Society, How Has Entrepreneurship Changed the World? What Is Entrepreneurship? Myths About Entrepreneur-ship, How Has Entrepreneurship Changed our Country? Our Local Heroes, Developing the Opportunity, Opportunity Analysis, Class Activity: Dream It, Do It, E-cell to Entrepreneurship - Shashank's Story. Class Activity: Idea Planes, Markets, Need-Finding and Planning, Defining the Focal Market: Market Segmentation, Understanding User Needs, Competitive Analysis, Generating Ideas with Individuals and Groups

Global Legends – Introduction and Instructions, Video: TED Talks, Story of Travis Kalanick and Uber, Video: TED Talks, Story of Mark Zuckerberg and Facebook, Video: TED Talks, Story of Danae Ringelmann and Indiegogo, Video: Your Own Heroes – Introduction and Instructions, Video: INKtalks, Story of Kunal Bahl and Snapdeal , Video: INKtalks, Story of Varun Agarwal and Alma Mater, Video: INKtalks, Story of Phanindra, Opportunities and Uncertainty, Customers as Sources of Opportunities, Opportunity/Problem Identification, Differentiating problem & symptoms, Defining problem.

Design Thinking for customer delight: What Is Design Thinking? Class Activity: Design Thinking - Myth Buster, Video: Understanding Design Thinking – Concept, Class Activity: Keep It, Junk It!

Making the right choice (Idea generation), Generating Ideas with Individuals and Groups, Idea presentation, Team formation, Understanding User Needs, Customer validation, testing your Idea: Surveys, Competitive Analysis, USP, Role of incubator, Visit to incubator

Characteristics of a Successful Entrepreneur: Video: Entrepreneurial Styles Introduction, Class Activity: Entrepreneurial Styles Quiz, Video: Different Entrepreneurial Styles – Concept. Class Activity: Build It, Class Activity: Everything Is Not What It Seems, Class Discussion: Barriers to Communication, Video: Barriers

to Communication Role-play –Class Activity: Tell-a-Story, Video: Active Listening , Class Discussion: Body Language Speaks Louder than Words, Video: All About Handshakes, Video: Body Language Speaks Louder than Words – Concept and Debrief, Video: Design Thinking Process, Class Activity: Backpack Redesign Activity.

Sales skills to become an effective Entrepreneur: Video: Customer Profiling – Introduction and Concept, Class Activity: Customer Pro-filing, Video: Types of Customers – Concept, Video: What is Wowing Your Customer? Class activity: Wowing your Customer, Video: Personal Selling – Concept and Process, Class Activity: Personal Selling, Video: Show and Tell – Concept, Class Activity: Show and Tell, Video: Elevator Pitch – Concept and Introduction, Class activity: Craft your Elevator Pitch, Video: Elevator Pitch – Debrief and Myths.

Managing risks and learning from Failure: Introduction to Risk-taking and Resilience, Class Activity: Managing Risks and Learning from Failure - Myth Buster, Video: Introduction to Risk and Resilience, Class Activity: Let's Discuss Risks, Video: Managing Risks, Class Activity: Understanding Risks Through Risk Takers, ARE YOU READY TO BE AN ENTREPRENEUR? Class Activity: The Big De-bate, Class Activity: Why Do I Do What I Do

Recommended Book(s):

1. Bart, Clarysse & Sabrina, Kiefer. (2009). The Smart Entrepreneur: How To Build For A Successful Business. Elliott & Thompson Publications.
2. Ryes, Eric. (2014). The Lean Startup: How Constant Innovation Creates Radically Successful Businesses. Penguin.
3. Bhaskar, Majumdar. (2016). Everything started as nothing: How to win startup battle.Rupa Publication.
4. Pizzonia, Felcia. (2010). Babes in Business suits Top women entrepreneurs.Ultimate Publishing Co.

Course Code	Course Name	L-T-P	Credits
CSL4336	Algorithm Design & Implementation	4-0-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4306	Designing Front End Using JavaScript	4-0-0	4

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: Introduction to web programming. HTML5: formatting tags, Lists, Linking between web pages, image in web page, Table tag with attributes, Frames, Form.
CSS3: Internal, external and Inline**,** Use of CSS in HTML document.
Bootstrap: Tables, Forms, Button, Images

JavaScript: Basics of javascript, expression, operator, control statement, functions, accessing HTML element using javasript, dialog box, Event handling, Form Validation.
JavaScript Objects: name, maths, string, date, array.

jQuery: Introduction to jQuery, jQuery Selectors, jQuery Events, jQuery Effects (Hide/Show, Fade, Slide, Animate, Stop), jquary element operation (Get, Set, Add, Remove, CSS)
AJAX: Basics, actions, XMLHttpRequest, Database operations

AngularJS: Introduction, Basic module, Directives, Model, Data Binding, Controllers, Scopes, Filters. Expressions, Data and HTTP Services, Tables, Events, Forms and Validation,File Structure, Animations, Testing. Development using GIT-clone, pull, push commands. Environment setup.

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. Norton, Ivor,"Beginning Java 2" Dreamtech Publication, Fifth Editon.

Course Code	Course Name	L-T-P	Credits
CSP2325	Essentials Operating System	0-0-4	2

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, Synchronization Hardware Test and Set swap Semaphores Deadlocks and Starvation Classic Synchronization Problems Readers/Writers Dining Philosophers, process management, I/O management, storage management, protection and security, OS services, process and threads, CPU scheduling, process synchronization, semaphores, deadlock, memory management, paging and segmentation, virtual memory, file system, case studies.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL4379	AWS-Module 1(APP Development)	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Deploy a web app to AWS.

CLO.2 Create and host a web app and set it up so users can easily access it.

CLO.3 Build a serverless backend. Create a serverless function to trigger based on custom inputs in a text field skills.

CLO.4 Store data in a database.

Course Outline:

This course prepares students on AWS Cloud Development. The students will learn about identifying key AWS storage options, Amazon EBS, Amazon S3 bucket creation, and sample code and libraries. This course is part-1 of the App Development using AWS Cloud.

Recommended Book(s):

1. Pradeep Kothari, Android Application Development (With Kitkat Support), Black Book Paperback, Kogent Learning Solutions Inc. , – 1 January 2014
2. Michael Burton, Android App Development for Dummies, Wiley; Third edition (1 January 2015)

Course Code	Course Name	L-T-P	Credits
CSL4380	AWS-Module 2(APP Development)	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Learn core AWS Concepts

CLO.2 Learn core AWS Knowledge

CLO.3 Learn core AWS Services skills

CLO.4 Gain skill to design AWS environment

Course Outline:

This course will help students learn about computing and networking services using Amazon EBS and EC2 instances. They will efficiently be able to manage services and databases using DynamoDB and understand the key aspects of Amazon RDS. This course is part-2 of the App Development using AWS Cloud.

Recommended Book(s) and and Related Links:

1. https://aws.amazon.com/mobile/mobile-application-development/
2. https://aws.amazon.com/startups/start-building/how-to-build-a-mobile-app/
3. https://d1.awsstatic.com/whitepapers/modern-application-development-on-aws.pdf

Course Code	Course Name	L-T-P	Credits
CS161	Java programming under wipro talent next	2-0-4	4

Course Learning Outcomes:

Students will be able to:
CLO.1 Implement the concept of object-oriented techniques and methodologies using Java.
CLO.2 Develop applications using multithreading concept of Java.
CLO.3 Use database connectivity for a complete Java application.
CLO.4 Design the website.
CLO.5 Develop project using Spring framework skill.
CLO.6 Implement several Data structures using Collection Framework.

Course Outline:

Introduction: Fundamentals of OOPs, Overview of JDK, JVM, Garbage Collection, Working with Java Data Types, Using Operators

Looping Constructs & Arrays: Decision Constructs, Using Loop Constructs, Creating and Using Arrays (1D, 2D, Multidimensional) Jagged Arrays, Command Line Arguments.

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.

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

IO Streams: Stream Classes: Byte Streams, Character Streams, StreamTokenizer. **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.

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

JDBC Connectivity Arrays, Searching and Sorting, Strings and 2D-Arrays, ObjectOriented Programming, Recursion, Time and Space Complexity, Linked List, Stack and Queues, Trees (Binary Trees and Binary Search Trees), Hash Maps, Priority Queues, Tries and Huffman Coding, Dynamic Programing, Graphs.

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.

Course Code	Course Name	L-T-P	Credits
CSL4341	Python Basics	4-0-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSA3103	Data Visualization and Query Language	0-0-4	2

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. Microsoft Business Intelligence Tools for Excel Analysts (WILEY)
2. Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software.
3. Ivan Bayross," Introduction to PL/SQL", BPB Publication , Third Edition.
4. Dr. Anil Maheshwari, Data Analytics - Made Accessible, 2016 Edition

Course Code	Course Name	L-T-P	Credits
CSL4348	Business Analytics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL5358	Industry Competitive Preparation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify the key environmental factors shaping an industry
CLO.2 Demonstrate ability to use tools and methodologies for performing analysis for various types of industries skills

CLO.3 Develop a detailed professional report of Industry Analysis conducted.

Course Outline:

This module is specifically created to prepare students on the latest trends and techniques used in the industry focused on technical as well as soft skills. This module is being organised in collaboration with industry experts.

Recommended Book(s):

1. Porter, M. E., Competitive strategy: Techniques for analyzing industries and competitors. Simon and Schuster.
2. Fleisher, C. S., &Bensoussan, B. E., Strategic and competitive analysis: methods and techniques for analyzing business competition (p. 457). Upper Saddle River, NJ: Prentice Hall.

Course Code	Course Name	L-T-P	Credits
CSQ3101	Cyber Security for under graduates-I	3-0-0	3

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 skill.
CLO.3 Install, configure, use and manage anti malware software on a working network.
CLO.4 Evaluate best practices in security concepts to maintain confidentiality, Integrity and availability of computer systems.
CLO.5 Articulate informed opinion about issues related to cyber security.

Course Outline:

Introduction of Cyber Security: Information Security, Basic networking and TCP/IP, Introduction of Malwares, Attacks and Offensive Security, DHCP Explanation and ICMP basics & Blocking.
Virtualization: Introduction, Virtual Machines Explanation, Key Properties of VM, The connection of VM on the physical network. TCP: TCP Headers, TCP Flags.
Debian Hands-on: Installation, Connection with putty, Apache server Setup, File transfer by using WinSCP, Backup of VM.
Wireshark: Introduction, Basic Keywords, Wireshark packet capturing, Packet Analysis. **Internet Information Service (IIS):** IIS enabling, IIS website and FTP server configuration. **TCP headers**: TCP headers, TCP header demonstration on Wireshark.

IPTABLES: Introduction and Installation, Configuration. **NORT:** Introduction, Configuration and error-handling. **SNORT (WINDOWS):** Configuration on with Syslog, Syslog Practical.
SNORT (Linux): Installation and configuration

SDLC: Phases of SDLC Testing: Security, VA/PT Phases, Objectives, Roe Sample Templets, Reconnaissance Google Dorking: Mysql, Cfg, Rds.
Security Tools and sites: Whois, Site safety checking, The harvester, Hyperlink extraction, Nslookup, Netcraft Cryptography: Introduction and Goals, Types of Cryptography
Fingerprinting: Nslookup practical: Mail server search, Nameserver search, Entry point search, Subnet search, Nmap scan with and without root, how to get header information of server, How to get Operating server details, Enumeration using nslookup
Cryptography: Symmetric-Key cryptography, Asymmetric-Key cryptography Hybrid, Key cryptography, Types of Cryptography, Asymmetric, Hashing Algorithms, Public Key Infrastructure (PKI), Digital Signature
System Vulnerability Test: Test by using, Nessus, CVE website.

Metasploit: Introduction, Payload creation, Exploit on windows, Metasploit commands demo

HTTP Basics: Versions of HTTP (1.1 & 1.0), HTTP response codes, HTTP authentication. Open Web Application Security Project (OWASP): OWASP Top 10, OWASP Testing guides

CTF Challenges: using SQL to solve a challenge, curl command in linux, WiFi Hacking.

Recommended Book(s):

1. Chwan-Hwa Wu & J David Irwin. (2017). Introduction to Computer Networks and &security. (2nd ed). CRC Press.
2. Brooks, J. (2016). Security Essentials,(2nd ed). Wiley.
3. Slavio, John. (2017). Hacking: A Beginners' Guide to Computer Hacking, Basic Security and Penetration Testing. (2nd ed). Addison Wiseley.
4. Mitnick, Kevin. (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. (2nd ed).IT Revolution Press.

Course Code	Course Name	L-T-P	Credits
CSQ3102	Cyber Security for Forensics & Investigation	3-0-2	4

Course Learning Outcomes:

Students will be able to:

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

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

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

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

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSQ3103	Malware and Reverse Engineering – I	3-0-0	3

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

Course Code	Course Name	L-T-P	Credits
CSQ3104	Malware and Reverse Engineering – II	3-0-0	3

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

Course Code	Course Name	L-T-P	Credits
CSQ3105	Introduction to Cyber Security	3-0-0	3

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. Laws, Standards, and Ethics in Cybersecurity Examine the laws, standards, and ethical issues related to cybersecurity.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSQ3106	Digital Security and Advanced Cryptography	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand basics of Cryptography and Network Security.

CLO.2 Secure a message over insecure channel by various means.

CLO.3 Learn skills about how to maintain the Confidentiality, Integrity and Availability of a data.

CLO.4 Understand various protocols for network security to protect against the threats

in the networks.

Course Outline:

This course will help students to take up the role of a cyber security specialist who will use a complex array of tools, methods and applications to investigate and protect information in computer systems. This course has been designed to introduce students to some cryptography techniques that allow different parties to securely transmit information. The course will introduce advanced concepts of digital security. The students will learn the differences between authentication and security protocols and how private keys are exchanged to establish secure communications.

Recommended Book(s):

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.
3. William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI.
4. Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.

Course Code	Course Name	L-T-P	Credits
CSQ3107	Secure Software Development	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Analyze issues related secure software development methodologies

CLO.2 Apply skills for thorough understanding of secure coding principles

CLO.3 Select the most appropriate approach to secure software development

CLO.4 Judge and craft appropriate adaptations to the development process to make sure a secure deployment

CLO.5 valuate the implications and impact of secure architecture design

Course Outline:

This course is specifically designed to prepare students on secure software development that provides the principles of Secure Software Development Life Cycle and practical methods to secure software requirements, software design, software implementation, software testing, software acceptance, software deployment and maintenance your software development.

Recommended Book(s):

1. Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw and Nancy Mead Software
2. Security Engineering: A Guide for Project Managers by. Addison-Wesley, (2004)
3. Gary McGraw ,Software Security: Building Security, Addison-Wesley (2006)
4. Threat Modelling: Designing for Security by Adam Shostack, John Wiley and Sons Inc, (2014).
5. Mano Paul ,7 Qualities of Highly secure Software Taylor and Francis, CRC Press (2012)

Course Code	Course Name	L-T-P	Credits
GID5356	Fundamentals of Game Programming	1-0-8	5

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
GID5357	Introduction to Game Engine	1-0-8	5

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

Scratch MIT: Introduction to Scratch, Scripts motion, looks, sounds, Pen, Data, Events, Control, Sensing, Operators, Costumes, Sounds .Adding a Background, Adding the Solid Ground Creating the Hero, Creating the Game's Final Target, Destroying the Hero and Resetting the Game, Moving to Layouts and Winning the Game, Adding Parallax, Creating Enemies with Basic AI, Shooting and Spawning Other Objects, Adding Scores and Energies, Adding Sounds and Music, Creating and Adding New Levels, Creating the AI of the Final Boss, Saving and Loading Your Game, Creating an Interactive Main Menu with Buttons.

Construct 2: Setting up the Stage, Adding a Background, Adding the Solid Ground, Creating the Hero, Creating the Game's Final Target, Destroying the Hero and Resetting the Game, Moving to Layouts and Winning the Game, Adding Parallax, Creating Enemies with Basic AI, Shooting and Spawning Other Objects, Adding Scores and Energies, Adding Sounds and Music, Creating and Adding New Levels, Creating the AI of the Final Boss, Saving and Loading Your Game, Creating an Interactive Main Menu with Buttons.

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
GID5358	Graphics Programming	1-0-4	3

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

1. David Wolff, OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++17, 3rd Edition, Paperback
2. Eric Lengyel, Foundations of Game Engine Development, Volume 1: Mathematics
3. John Kessenich, Graham Sellers, Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V (9th Edition) 9th Edition, Paperback.
4. Alan Thorn, John P.Doran, Alan Zucconi, Jorge Palacios. Complete Unity 2017 Game Development: Explore techniques to build 2D/3D application using real-world examples, Packt.

Course Code	Course Name	L-T-P	Credits
GID5352	Game Design	1-2-0	3

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:

The Early Days, Onward to Atari and Arcade Gaming, the Roots of Multiplayer Gaming, Dawn of the Home Console, the Video Game Crash, the First Console War, the Rise of 3D Gaming, Modern Age of Gaming
Introduction to the primary concepts of gaming, and an exploration of how these basic concepts affect the way gamers interact with our games. What defines a "game" and the mechanics and rules behind different types of games? Through four linked assignments you'll learn ways to create and describe a game concept, and specifically what makes a compelling game. Conceptual underpinnings of games, and all assignments can be completed with a pencil and paper
Introduction to the interdisciplinary study of video games, examining their cultural, educational, and social functions in contemporary settings. By playing, analyzing, and reading and writing about video games. Video game theory and the completion of a contemporary commercial video game.

What are the main Digital Game Genres and how they work, Game Design Thinking (Empathize, Define, Ideate, Prototype and test), Understand the evolution of the video game consoles, Understand how the Game Industry Works, how to apply good game design to your games, different types of controllers, Create different game Arcs and Loops, Create a good Progression in Level Design, Edit simple audio tracks with audacity, Organize game ideas, Find free assets for your projects.

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
GID5359	Game Design – 2D & 3D	2-2-0	4

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
GID5360	Game Design – BG	1-0-4	3

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
GID5361	Game Testing	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 List factors that influence the user's perception of a game
CLO.2 Recruit and guide individuals through a playtest of a game in accord with best practices
CLO.3 Prepare a report on the findings of a particular playtest with insights on potential solutions
CLO.4 Chose and implement testing skills appropriate for the development stage of a game

Course Outline:

Introduction to Game Testing, Two Rules of Game Testing, How to Put a Resume Together, How give Examples During Job Interview, Contacting Game Developers, Intro to testing Schultz, History/working conditions & demographics Levy, Game life cycle/bug categories, tools & documentation Levy, Defect typing, ways to categorize software bugs Schultz, Bug reporting, Bare bones bug hunting Levy, Bug reporting, Test trees Schultz, Intro to project, Bug reporting, Combinatorial testing Schultz, Intro to Mantis bug database, Bug reporting, Elite bug hunting Levy, Test flow diagrams Schultz, The test process- black box, white box testing Schultz, Moving up the game ladder Levy, Cleanroom testing, modeling player behavior Schultz, Quality standards Schultz, Future of game testing Levy, Steps to become a video game tester, Learn what a game tester does, and decide if a job testing games is right for you, Learn the basic skills and vocabulary of game testing, Complete your formal education or training (optional), Write your game testing resume and cover letter, Search for jobs and apply for the openings that fit your salary needs, location needs, and desired lifestyle.
1) Combinatorial Testing, 2) Clean Room Testing, 3) Functionality Testing, 4) Compatibility Testing,
5) Tree Testing, 6) Regression Testing, 7) Ad hoc Testing, 8) Load Testing, 9) Play Testing.

Recommended Book(s):

1. GAME TESTING ALL IN ONE By C. Schultz, R. Bryant, T. Langdell. Thomson Course Technology, ISBN 1-59200-373-7
2. GAME DEVELOPMENT ESSENTIALS: GAME QA & TESTING By Luis Levy, Jeannie Novak; Delmar Cengage Learning; ISBN-10: 1435439473 - ISBN-13: 978-1435439474
3. INTRODUCTION TO GAME DEVELOPMENT, Edited By Steve Rabin; Charles River Media; Second Edition, ISBN-13: 978-1-58450-679-9; ISBN-10: 1-58450-679-2
4. SECRETS OF THE GAME BUSINESS, Edited By François Dominic Laramée; Charles River Media; ISBN 1- 58450-282-7

Course Code	Course Name	L-T-P	Credits
GID5362	AI/ML	1-0-6	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstrate in-depth knowledge of methods and theories in the field of machine learning.
CLO.2 Demonstrate the use Bayesian perspective on machine learning, Artificial neural networks, back propagation algorithm
CLO.3 Assess the learning algorithms skills modelled after biological evolution, including genetic algorithms and genetic programming.
CLO.4 Demonstrate the ability to critically evaluate and compare different learning models and learning algorithms.
CLO.5 Design new algorithms after combining some of the key elements of existing machine learning algorithms

Course Outline:

Introduction to Mathematics: Vectors and Matrices, Linear Algebra, Probability Theory and Statistics, Stochastic, Statistical Modelling, Markov Hessian
Introduction and Basic Concepts, Supervised Learning Setup. Linear Regression ,Weighted Least Squares. Logistic Regression. Netwon's Method Perceptron. Exponential Family. Generalized Linear Models, Gaussian Discriminant Analysis, Naive Bayes. Laplace Smoothing. Kernel Methods, S.V.M. Kernels.
Neutral Networks, Bias/ Variance. Regularization. Feature/ Model selection, Practical Advice for ML projects, K-means. Mixture of Gaussians. Expectation Maximization, GMM(EM). Factor Analysis, Principal Component Analysis. Independent Component Analysis, MDPs. Bellman Equations. Value iteration and policy iteration, LQR. LQG. Monte Carlo Tree Search, LQR. LQG. Monte Carlo Tree Search, -QLearning. Value function approximation, Policy Search. REINFORCE. POMDPs, Adversarial Machine Learning. Reinforcement Learning: Belman, Markov Decision, Sensor Network, Google Dopamine, Bellman Advanced, Dynamic Programming, Value & Policy Iterations, Exploration vs Exploitation, Monte Carlo, Q Learning, Tensor Processing.
Deep Reinforcement: Deep RL, Deep Q Learning, Deuling DQN, Artificial Neural Network, Neuro- evolution, Meta-learning, Control Theory, Policy Gradient methods, Reinforce Policy Gradient, Artificial Curiosity, Actor Critic A3C, Proximal Policy Optimisation(PPO), Bayesian Actor Critic, Multi-Agent RL, Alphago

Recommended Book(s):

1. Erwin, Kreyszig .(2016). Advanced Engineering Mathematics. Wiley India Pvt. Ltd.
2. Srimanta Pal & Subodh C. Bhunia .(2017). Engineering Mathematics (2nd Ed). Oxford University Press.
3. The Engineering Mathematics (2nd Ed). Vol. I. Chitkara University Publication.
4. Ramana, B.V. (2016). Higher Engineering Mathematics. Tata McGraw-Hill Education.
5. Grewal, B.S. (2017). Higher Engineering Mathematics. Khanna Publications.

Course Code	Course Name	L-T-P	Credits
GID5363	Unity Game Development	1-0-8	5

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
GID5364	AR/VR	1-0-6	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Design, create, and integrate audio, visual, and interactive elements into a comprehensive immersive experience.
CLO.2 Develop content for successful delivery across multiple platforms, including PC, mobile devices and head-mounted displays.
CLO.3 Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR.
CLO.4 Evaluate various skill interaction schemes common to AR/VR experiences.
CLO.5 Use immersive effects of visual and audio assets to AR/VR experiences and evaluate implementation methods.

Course Outline:

Introduction to Augmented Reality**:** Concept, AR Device functions and Property, Framework, Marker-based AR, Marker-less AR, various software for developing AR applications. Taxonomy, Features, Applications, Difference between AR, VR and MR, Advantages, Challenges.
Marker Based AR: Vuforia, integrating Vuforia with Unity 3D, image target, uploading image target five-star image concept, adding android sdk, placing 3D model/virtual content over image target, building an apk for the developed application. Vuforia
Introduction EasyAR, MarkerLess AR (ARCore & ARKit): Motion Tracking, Environment understanding, Light estimation, Integration of ARKit in Xcode, ARFace Tracking Configuration, ARWorld Tracking Configuration.
Introduction to VR : Concept, History, What is VR (Principles of VR, Optics, Displays, Tracking), Platforms & Paradigms (VR platforms, 3-DOF vs 6-DOF, 6-DOF Tracking, Difference between mobile and desktop VR, VR Development platforms), Building first VR Camera, Implementing Head Rotation, Lighting (Four Unity Lights, Baking, Lighting Panel, Global Illumination).
VR Software Development and Interaction**:** Creating Scripts, UI Design, Changing scene using script, Physics & Audio (Unity physics, rays, adding audio in VR), Advance VR scripting (adding Waypoints) Stereo Vision, Gaze based interaction, Reticle, Point and Click, Point and Load, Developing basic interaction, Selecting, Grabbing Object's, Throwing etc
Implementing User Interface in VR, Developing Hybrid Application with combining AR and VR, 180-degree game's vs 360-degree game's, Difference between Inside out and Outside In tracking Locomotion development: Teleportation, Transportation, Perambulation
Introduction of WebVR: A-Frame, React VR
VR Design: What is design, VR app design walkthrough, design process and iteration, user testing, documentation (sketching)
Setting Scene: Establishing scale, building scene, scene setting, mood, lighting.

Movement Mechanics: Simulator sickness, mobile movement mechanics, special considerations when using movement mechanics
High Immersion VR: Desktop VR Benefits & Constraints (High Immersion VR, Modes of VR, Case studies, 6-DOF design mindset)
High-Immersion Engineering: Setting up SteamVR, using SteamVR SDK, input handling teleportation, dash and artificial walking, grabbing and throwing, menu systems and input axis, SteamVR level loading
Cross-Platform development: SDKs, setting up oculus SDK, using oculus SDK, cross platform architecture.

Recommended Book(s):

1. Chalmers, David J. (2017). Reality+: Virtual Worlds and the Problems of Philosophy. Allen Lane.
2. Shetty, Chetankumar G. (2017). Augmented Reality - Theory, Design and Development. McGraw Hill.
3. Greengard, Samuel. (2017). Virtual Reality (The MIT Press Essential Knowledge series). The MIT Press.
4. Tom, Jane. (2017). Presentation on Augmented Reality. TOM Press.

Course Code	Course Name	L-T-P	Credits
CSL3361	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand key concepts, and trends associated with Digital Marketing & Internet Technologies.

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

CLO.3 Conceptualize and do 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 and gain skills in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.

CLO.5 Interpret for entrepreneur development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL3362	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand key concepts and trends associated with Digital Marketing & Internet Technologies.

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

CLO.3 Perform practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills, entrepreneurship & Internet Technologies.

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

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL3363	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	3-0-0	3

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

Course Code	Course Name	L-T-P	Credits
CSL3364	Affiliate Marketing and Online Reputation Management (ORM)	3-0-0	3

Course Learning Outcomes:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSA4301	UX Design and Digitalization	4-0-0	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, Pro designer mindset - Design as a problem solving tool.Intro to design thinking ,UX vs UI ,Design process overview , How to organise a design file , The role of design in problem definition. manufacturing, retail, automotive, media, FMCG, logistics, oil & gas, understand industry specific problems, digitalization for the bottom of the pyramid, localization of experience, project.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSA3302	Empathy & its Tools	3-0-0	3

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. Empathy as a managerial tool, social intelligence tools

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSA2301	User Interface Design	0-0-4	2

Course Learning Outcomes:

Students will be able to:

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

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSA4302	User Research & Its Application	0-0-4	2

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 To 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. Interactive Design and usability — Place in the design process — Why this isn't just intuitive — Roots in research methods — Adjusting methods to user experience research and the reality of the design world

Recommended Book(s):

1. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, Observing the User Experience, A Practitioner's Guide to User Research, Morgan Kaufmann, 2nd edition
2. Jeff Sauro, James R Lewis, Quantifying the User Experience: Practical Statistics for User Research, Morgan Kaufmann; 2nd edition
3. Steve Portigal , Interviewing Users: How to Uncover Compelling Insights, Rosenfeld Media, 1st edition
4. Tomer Sharon, It's Our Research: Getting Stakeholder Buy-in for User Experience Research Projects, Morgan Kaufmann, Illustrated edition
5. William Albert, Thomas Tullis, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann, 2nd edition

Course Code	Course Name	L-T-P	Credits
CSA4303	Design Thinking & Its Applications	0-0-4	2

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. Introduction to Ideation and Prototyping Strategies. User Testing. Team work discussion + Launch of Service challenge. Design Research - tools for observation and immersion.

Recommended Book(s):

1. Christian Muller-Roterberg, Design Thinking for Dummies, For Dummies; 1st edition
2. Design Thinking in Play: An Action Guide for Educators
3. Design Thinking for Training and Development
4. Rethinking Design Thinking: Making Sense of the Future that has already arrived (NextD Futures)
5. The Design Thinking Quick Start Guide: A 6-Step Process for Generating and Implementing Creative Solutions, 1st edition

Course Code	Course Name	L-T-P	Credits
CSL3308	Software Quality Assurance and Testing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

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

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

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

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

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

Course Outline:

Software quality, role of testing, verification and validation, unit testing, control flow testing, system integration testing, regression tests, Test case selection ,Testing of object-oriented software, Performance testing ,Security testing, documentation, system test design, system test planning and automation, monitoring test execution, acceptance criteria, software quality, ISO 9126` quality characteristics, ISO 9000:2000 software quality standard.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP1308	Software Quality Assurance and Testing Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Specify various elements of object modelling to identify, analyse, visualize, specify, model and design
CLO.2 Apply analysis and design principles at various levels and various views in different domains of software systems.
CLO.3 Represent engineering problems graphically by drawing all UML diagrams.
CLO.4 Identify and apply concepts of software construction like Object Oriented Programming skills
CLO.5 Skilful use of Rational Rose tool for drawing all the UML diagrams in order to forward and reverse engineer the complex software engineering problems.

Course Outline:

Software quality, role of testing, verification and validation, unit testing, control flow testing, system integration testing, regression tests, Test case selection ,Testing of object-oriented software, Performance testing ,Security testing, 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. Object-Oriented Analysis and Design with Applications, Grady Booch (2007)
2. The Unified Modelling Language User Guide, Grady Booch, James Rumbaugh, Ivar Jacobson, Addison-Wesley Professional (2005)

Course Code	Course Name	L-T-P	Credits
CSL3310	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. Data warehousing architectures Multidimensional modeling, OLAP tools. Database physical desing for analytical queries. Extraction, Transformation and Load.Visualization and descriptive analytics

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP1310	Business Intelligence and Data Warehousing Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to

CLO.1 Comprehend techniques of Transaction Processing, Concurrency Control and Database Recovery Technique.
CLO.2 Design Distributed database and apply concurrency control and recovery of data on distributed database.
CLO.3 Comprehend the concept of Object-Oriented DBMS and NoSQL data models.
CLO.4 Comprehend the need of Data Warehousing Concepts, OLAP and Data mining.
CLO.5 Demonstrate skilful use of PL/SQL to develop database centric applications.

Course Outline:

Data warehouse design and management, business analytics and data warehousing, OLAP, cube, data mining for BI, knowledge management, KM strategies. Data warehousing architectures Multidimensional modeling, OLAP tools. Database physical desing for analytical queries. Extraction, Transformation and Load.Visualization and descriptive analytics

Recommended Book(s):

1. Thomas Connolly, Carolyn Begg, “Database Systems”, Pearson Education, (2005)
2. Pramod J Sadalage and Martin Fowler, “NoSQL Distilled”, Pearson, (2012)
3. Hoffer, Prescott, Mcfadden, “Modern Database Management”, Pearson Education Asia, (2007)
4. Ivan Bayross, “SQL and PL/SQL”, BPB Publication, (2010)

Course Code	Course Name	L-T-P	Credits
CSL3304	Artificial Intelligence and Expert System	3-0-0	3

Course Learning Outcomes:

Students will be able to

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

Course Outline:

Overview of artificial intelligence, knowledge, general concepts, knowledge manipulation, first order logic, knowledge engineering in first order logic, inference, forward chaining, backward chaining, propositional logic, predicate logic, conceptual dependencies, scripts, expert systems, neural networks, fuzzy expert system, TIERES, MYCIN, Genetic Algorithms. Data Science, AI & ML Ÿ Use Cases in Business and Scope Ÿ Scientific Method Ÿ Modeling Concepts Ÿ CRISP-DM Method

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSP1304	Artificial Intelligence and Expert System Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to

CLO.1 Implement basic concepts and skills of Artificial Intelligence.
CLO.2 Represent and use knowledge using propositional calculus and predicate calculus.
CLO.3 Implement 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:

Practical use 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. Commands and Syntax Ÿ Packages and Libraries Ÿ Introduction to Data Types Ÿ Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames Ÿ Importing and Exporting Data.

Recommended Book(s):

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

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

Course Learning Outcomes:

Students will be able to:

CLO.1 Become familiar with skills of basic automata theory of computer system.

CLO.2 Able to 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 Able to deal with the problems efficiently on a model of computation using an algorithm.

CLO.5 Describe unrecognizable languages and undecidable problems.

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CSL5407	Compiler Design	4-1-0	5

Course Learning Outcomes:

CLO.1 To 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, grammar, parsing, syntax directed translation, symbol table, code optimization, code generation intermediate code generation, Boolean expression, procedure calls, code optimization.

Recommended Book(s):

1. Compilers: Principles, Techniques and Tools by Alfred V. Aho, Ravi Sethi, and Jeffrey D. Ullman, Low Price Edition, Pearson Education.
2. Compilers: Principles and Practice by Parag H.Dave and Himanshu B.date, First edition, Pearson Education.
3. Compiler Design by Dr. O.G. Kakde, fourth edition, Laxmi Publications.
4. Compiler Construction principles and Practice by Kenneth C. Louden, India Edition, Cengage Learning
5. Compiler Design by K. Muneeswaran, Oxford Higher Education by Oxford University Press.

Course Code	Course Name	L-T-P	Credits
CSL5411	Network Security	4-1-0	5

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 tools, cryptography, system security, security concepts ,security attacks, Access control issues, communication security, authentication and authorization, overview of computer networking, basics of cryptography, symmetric and asymmetric cryptography, public key crypto system, hash function, MAC, SHA, HMAC, MD5, digital signatures, web security, secure socket layer, firewalls.

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CS162	Full Stack Development	0-0-8	4

Course Outcomes:

Students will be able to:

CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet

CLO.2 Apply basic design principles to present ideas, information, products, and services on websites

CLO.3 Apply basic programming principles to the construction of websites

CLO.4 Effectively manage website projects using available resources

CLO.5 Demonstrate communication skills, service management skills, and presentation skills

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
ER101	CAP Cohort-II(1)	2-0-0	2

CLO.1 Sell themselves and their ideas.

CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.

CLO.3 Find problems worth solving.

CLO.4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.

CLO.5 Increase their awareness and deliberately practice the 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:

Entrepreneurship and Opportunity: Basic of entrepreneurship, Identify gaps, problem statements, market opportunity

Idea Generation & Idea Validation: Ideation, idea generation, assessment, protection, product/ service to market journey

Consumer Research and Market Analysis for entrepreneurs: customer survey, customer Persona Design, competition analysis, catching value proposition, data analysis

Recommended Book(s):

1. Bart, Clarysse & Sabrina, Kiefer. (2009). The Smart Entrepreneur: How To Build For A Successful Business. Elliott & Thompson Publications.
2. Ryes, Eric. (2014). The Lean Startup: How Constant Innovation Creates Radically Successful Businesses. Penguin.
3. Bhaskar, Majumdar. (2016). Everything started as nothing: How to win startup battle.Rupa Publication.
4. Pizzonia, Felcia. (2010). Babes in Business suits Top women entrepreneurs.Ultimate Publishing Co.

Course Code	Course Name	L-T-P	Credits
ER102	CAP Cohort-II(2)	2-0-0	2

CLO.1 Sell themselves and their ideas.

CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.

CLO.3 Find problems worth solving.

CLO.4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.

CLO.5 Increase their awareness and deliberately practice the 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:

- **Prototype Development & Testing:** Tools-Paper & Digital Prototyping, Customer involvement & user testing
- **Finance for Entrepreneurs:** Preparing cost sheet, budget, balance sheet, forecasting
- **Raising Funds:** Incubator support, bootstrapping, seed money, angels investment & venture capital
- **New Venture Creation & Management:** Company formation, founder's agreement, team formation & assigning role

Recommended Book(s):

1. Bart, Clarysse & Sabrina, Kiefer. (2009). The Smart Entrepreneur: How To Build For A Successful Business. Elliott & Thompson Publications.
2. Ryes, Eric. (2014). The Lean Startup: How Constant Innovation Creates Radically Successful Businesses. Penguin.
3. Bhaskar, Majumdar. (2016). Everything started as nothing: How to win startup battle.Rupa Publication.
4. Pizzonia, Felcia. (2010). Babes in Business suits Top women entrepreneurs. Ultimate Publishing Co.

Course Code	Course Name	L-T-P	Credits
CS203	Integrated Project	0-0-4	2
CSP3203	Integrated Project – III	0-0-6	3
CLP2305	Industry Interface	0-0-4	2
CSP4401	Lab Oriented Project	0-0-8	4
CST9411	Co-op project at Industry (Module-1)	-	20
CST9412	Co-op project at Industry (Module-2)	-	20
CST9401	Industry Oriented Hands-on Course	-	25

Course Learning Outcomes:

CLO.1 To 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 To implement learning in real life problem for skill development

CLO.5 To propose multiple solution to any given problem and find best out of those.

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

Course Code	Course Name	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
ES101	Environmental Sciences	CLO.1 Understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.										H		
		CLO.2 Identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming).									H	H		
		CLO.3 Understand and hone skills to the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs.								H	M	H	M	
		CLO.4 Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and real-world issues.								M		H		H

		CLO.5 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.								H	M	M		H
HUL2401	Cyber Security	CLO.1 Acquire Information and risk models including confidentiality, integrity and availability				M								
		CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities									H			
		CLO.3 To gain knowledge on Cyber security architecture and operations						M						M
		CLO.4 Understand how Cyber security is conceptualized and carried out								H				
		CLO.5 Articulate informed opinion about issues related to cyber security			M									
HUL3301	Human Rights and Values	CLO.1 Get awareness on human values and professional ethics					H							
		CLO.2 Understand the core values that shape their ethical behaviour.				M							M	
		CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.	H							M				
		CLO.4 Gain thorough knowledge in the field of human rights and this will add to the academic qualification	H	M		M								

		CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.	H	H									M	
HUL2101	Disaster Management	CLO.1 Increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences	H	H							H	M		H
		CLO.2 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								H			M	
		CLO.3 Ensure skills and abilities to analyse potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects										M	H	
		CLO.4 Learn the role of institutions and also analyze the inter-relationship between disasters and developmental projects and their vulnerabilities.			M									
		CLO.5 Gain skills required for the safety of lives during the occurrence of disasters.					H							
CLP2305	Industry Interface	CLO.1 Acquire presentation and communication skills				M							M	
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H							M				

		CLO.3 Design engineering solutions to complex problems utilizing a systems approach	H	M		M								
		CLO.4 Implement learning in real life problem for skill development	H	H									M	
		CLO.5 Propose multiple solution to any given problem and find best out of those.	H	H							H	M		H
GTI4301	Numerical Ability and Logical Reasoning	CLO.1 Improve answers during the Aptitude test and develop an all-around personality with a mature outlook.								H			M	
		CLO.2 Enhance their logical thinking, verbal reasoning and numerical reasoning.										M	H	
		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.	H		M									H
		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.	H	H										M
		CLO.5 Enhance the Aptitude Round Clearing ability in interview process	H		H									M

AML5101	Engineering Mathematics - I	CLO.1 Introduce and form matrices to present mathematical skill solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.	H	H									H	
		CLO.2 Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.	H	H		M								
		CLO.3 Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.	H	H										
		CLO.4 Synthesize and apply multivariable vector-valued functions, their derivatives and integrals to live problems, graphically and analytically.	H	H		H								
AML4209	Discrete Structures	CLO.1 Apply skill and knowledge obtained to investigate and solve a variety of live problems related to Sets, Relations and Functions.		H		H								
		CLO.2 Solve real life problems using combinatorics.	H	H										

		CLO.3 Understand and apply the theory and techniques of Lattice, Logic and Boolean algebra	H	H										
		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.		H	M									
		CLO.5 Able to develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms	H	M	H									
PYL5101	Engineering Physics	CLO.1 Analyse and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.	H		H									
		CLO.2 Differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.	H	H					H					

		CLO.3 Differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.	H		H									
		CLO.4 Describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.	H		M									
		CLO.5 Develop skills for critical thinking and problem solving involving the various concepts of physics.	H	H										
PYP1101	Engineering Physics Lab	CLO.1 Possess an ability and skills to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.		H	M									
		CLO.2 Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.		H	M									
		CLO.3 Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.				M								

		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										
		CLO.5 Possess an ability to evaluate and analyze scientific measurement and error analysis.		H	M									
		CLO.6 Apply the fundamental concepts of physics to related engineering problems.			M									
CHL4101	Engineering Chemistry	CLO.1 Develop skills to innovative methods to produce soft water for industrial use and potable water at cheaper cost.			M									
		CLO.2 Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.		M	H									
		CLO.3 Design economically and new methods of synthesis nano materials.		H	M									
		CLO.4 Apply their knowledge for protection of different metals from corrosion.	H		H									

		CLO.5 Implement the knowledge of converting solar energy into most needy electrical energy efficiently and economically to reduce the environmental pollution.		H			M							
CHP1101	Engineering Chemistry Lab	CLO.1 Gain skills to determine the parameters like hardness and chloride content in water.		M			H						H	
		CLO.2 Estimate the rate constant of a reaction from concentration – time relationships.	H		M									
		CLO.3 Determine the physical properties like adsorption, surface tension and viscosity.	M	M	H									
MEW2101	Manufacturing Practice	CLO.1 Acquire skills in basic mechanical engineering practice.		M										
		CLO.2 Identify the hand tools and instrument	H		M									
		CLO.3 Acquire measuring skills			M								M	
		CLO.4 Implement knowledge of job materials in various shops	H											
		CLO.5 Posses the knowledge of core technical subjects for making and working of any type of projects		H	M									
CSL2378	Professional Practices	CLO.1 Identify a new technology that will solve a problem in an organization			H								M	

		CLO.2 Gain skillset to examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G technologies		M	H									
		CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field			H								M	
		CLO.4 Understand and contrast supervised and un-supervised learning algorithms.		H	H									
		CLO.5 Understand the context of information security with respect to social engineering and cyber security.			H	H							H	H
		CLO.6 Recognize the importance of ethical practices with new technologies			H	M					H			H
		CLO.7 Understand and review current literature on the selection, implementation, and evaluation of new and emerging technologies and their impacts		H	H						M		H	
MEL4102	Engineering Graphics	CLO.1 Improve skills of technical writing.			H	H								H
		CLO.2 Improve the basic sketching and drawing.		H	H		H						H	
		CLO.3 Use engineering scale effectively			H		H							
		CLO.4 Use dimensioning effectively.				H	H							
		CLO.5 Use development of surfaces.		H		H								

		CLO.6 Communicate through Engineering Graphics.		H	H		H						H	
MEP1102	Engineering Graphics Lab	CLO.1 Identify and implement skills of basic concepts of BIS conventions to sketch Engineering drawing.			H		H						H	M
		CLO.2 Create geometric constructions with hand tools.		H	H		H						H	
		CLO.3 Construct orthographic projection and sectional view of a machine part.			M									
		CLO.4 Create isometric projection from multiview drawings of an object.					H							
		CLO.5 Sketch projection of solids and development of lateral surfaces of solids				M							M	
EEL4103	Basics of Electrical Engineering	CLO.1 Recognize and analyse the skills and concepts of DC circuits	H							M				
		CLO.2 Realize AC circuits and their power measurements			M									
		CLO.3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.		H	H									
		CLO.4 Know the basic knowledge of transducers and measuring instruments		H	H									H
		CLO.5 Skilled to conduct experiments, understand the principle, construction and working of electrical devices		H	H		H						H	
EEP1103	Basics of Electrical Engineering Lab	CLO.1 Know the basics components of electrical elements, equipment and their functionality with applications.		H									H	

		CLO.2 Possess an ability and skills to analyze and characterize the electrical equipment's and instruments basics for their implementation.				M	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.			M									
		CLO.4 Possess an ability to perceive the concept of Fuse/MCB characteristics for different fault currents.					H							
		CLO.5 Conduct experiments, understand the principle, construction and working of electrical devices.	H		H									H
ECL5101	Basics of Electronics Engineering	CLO.1 Understand the basic concepts of semiconductor devices for use in electronic circuits.			M									
		CLO.2 Gain skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.					H							
		CLO.3 Acquire the knowledge of digital logic gates for implementing basic digital circuits.				M							M	
		CLO.4 Recognize the primary functions of integrated circuits such as timer and voltage regulator.	H							M				
		CLO.5 Familiarize with generic IoT device and applications using case studies.			M									

ECP1101	Basics of Electronics Engineering Lab	CLO.1 Know the basics of electronics elements, their functionality and applications.					H							
		CLO.2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.							M					
		CLO.3 Analyze and characterize the electronic circuits and have basic understanding for their implementation.		H	H		M							
		CLO.4 Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.		H	H	M								
		CLO.5 Gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.			H									M
ECL4207	Digital Electronics and Logic Design	CLO.1 Understand the underlying differences between analog and digital systems, and interconversion between the two.		H	H						M			
		CLO.2 Recognize and apply mathematical skills to solve digital design problems involving Boolean logic.		H	H						M		H	M
		CLO.3 Realize the underlying differences between combinational and sequential circuits.			M									

		CLO.4 Know and apply the design methodologies skills for implementing combinational and sequential circuits.					H							
		CLO.5 Understand the concept of memories and Programmable Logic Devices and their classification.				M							M	
		CLO.6 Comprehend the concept of memories and Programmable Logic Devices and their classification.	H							M				
ECP1207	Digital Electronics and Logic Design Lab	CLO.1 Understand the digital logic and create various systems by using these logics		M										
		CLO.2 Develop an understanding of design and simulation of digital logic circuits				H								
		CLO.3 Get a basic understanding of layout of electronic circuits			M							M		
		CLO.4 Practical implementation of design methodologies skills for implementing combinational and sequential circuits.							M					
		CLO.5 Implementation of the concept of memories and Programmable Logic Devices and their classification.		H	H		M							
	Introduction to C Programming	CLO.1 Analyse the problem statement.	H		H									H
		CLO.2 Choose the appropriate C programming constructs to solve the problems.	H	H		H						H		H
		CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.		H		H						H	M	

CS101		CLO.4 Differentiate between efficient and inefficient way of programming skills.	H	H		H						H		H
		CLO.5 Determine and demonstrate bugs in a program and recognize needed basic operations.				M								
		CLO.6 Formulate new solutions for programming problems or improve existing code to program effectively.						H						
CS102	Object Oriented Programming Using C++	CLO.1 Formulate problem solutions by incorporating advanced C programming skills.					M							M
		CLO.2 Choose the appropriate searching and sorting technique.		H							M			
		CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.	M			M								
		CLO.4 Develop programs using basic data structures like stack and queue.					M			H				
		CLO.5 Formulate new solutions for programming problems or improve existing code to program effectively.								M				

CSP3213	Introduction to Linux	CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.										M		
		CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.	H		H									H
		CLO.3 Monitor system performance and network activities.			M									
		CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.					H							
		CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.				M							M	
CSL4207	Operating Systems	CLO.1 Identify different types of Operating System and their components.	H							M				
		CLO.2 Design and implementation of new system calls for any open source operating system.			M									
		CLO.3 Implement existing resource management algorithms in Linux operating system.					H							

		CLO.4 Identify various system security and protection issues.			H		H						H	H
		CLO.5 Completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.	H		H		H							
CSL4208	Computer System Architecture	CLO.1 Understand Basic structure of computer		H	H									
		CLO.2 Perform Computer's Arithmetic Operations		M	H									
		CLO.3 Understand control unit operations			H								M	
		CLO.4 Learn the design skills of memory organization that uses different word size operations			M									
		CLO.5 Understand concept of cache memory technique.					H							
		CLO.6 Conceptualize instruction level parallelism.				M							M	
CSL3203	Computer Networks	CLO.1 Describe and analyze the hardware, software, components of a network and the interrelations.	H							M				
		CLO.2 Explain networking protocols and their hierarchical relationship hardware and software.			M									
		CLO.3 Compare protocol models and select appropriate protocols for a particular design.					H							

		CLO.4 Manage multiple operating systems, systems software, network services and security.				M							M	
		CLO.5 Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.	H							M				
		CLO.6 Impart skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure			M									
		CLO.7 Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.			H	H							H	H
		CLO.8 Effectively communicate technical information verbally, in writing, and in presentations.		M	H									
CSP2203	Computer Networks Lab	CLO.1 Understand the practical approach to network communication protocols.			M									
		CLO.2 Understand network layers, structure/format and role of each network layer.					H							
		CLO.3 Able to design and gain skills to implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.				M							M	

		CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.	H							M				
CSL4209	Client Side Technologies	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.			M									
		CLO.2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.			H	H								H
		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.			M									
		CLO.5 Demonstrate and develop web-portals independently or in teams.					H							
CSP3209	Client Side Technologies Lab	CLO.1 Apply the web application development skills to design the responsive website				M							M	
		CLO.2 Develop multi/ single page interactive website	H							M				
		CLO.3 Maintain and enhance existing web application			H	M					H			H
		CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.		H	H						M		H	
		CLO.5 Examine the adaptability of scripting languages in web development.		M	H									

CSL3307	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								M	
		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							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.			M									
		CLO.5 To learn and understand various object oriented concepts along with their applicability contexts					H							

CSP1307	Software Engineering Lab	CLO.1 Acquire strong practical knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.				M							M	
		CLO.2 Design and implement skills applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.	H							M				
		CLO.3 Implement 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									
		CLO.4 Learn and apply various object oriented concepts along with their applicability contexts			H								M	
CSL4206	Database Management System	CLO.1 Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.			M									
		CLO.2 Describe relational algebra expression and tuple relation expression from queries.					H							

		CLO.3 Implement the concept of normalization and functional dependency while designing the databases.				M							M	
		CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.		H	H						M		H	
		CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.			H	H								H
		CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.		H	H		H						H	
CSP2206	Database Management System Lab	CLO.1 Design and implement skills of database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities.		M	H									
		CLO.2 Describe relational algebra expression and tuple relation expression from queries.			M									
		CLO.3 Implement the concept of normalization and functional dependency while designing the databases.					H							
		CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.				M							M	

		CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming.	H							M				
		CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.		H	H						M		H	
CSL2301	Advanced Database Management System	CLO.1 Learn the basic concepts of advanced database concepts of advanced database management system and understanding database concepts and structures.			H	H								H
		CLO.2 Students would be able to understand the role and importance of ADBMS with the help of live database example.			M									
		CLO.3 Over this, entire course is designed for skill based that, students to understand data modelling and database development process, construct and normalize conceptual data models.					H							
		CLO.4 Implement a relational database into a database management system. Use of database management systems such as Oracle, SQL and PostGre SQL and become proficient in using PL / SQL.				M							M	

		CLO.5 Students will be able to design logic to automatically manage the database during any DML or DDL transaction and understand the issues related to database performance.	H							M				
CSP2301	Advanced Database Management System Lab	CLO.1 Make student familiar with basic concepts of advanced database concepts of PL/SQL skills			M									
		CLO.2 Able to understand the role and importance of Programming logic in databases					H							
		CLO.3 Understand the concepts of procedures, Triggers and cursors.				M							M	
		CLO.4 Implement a relational database into a database management system. Use of database management systems such as Oracle and become proficient in using PL / SQL.	H							M				
		CLO.5 Design logic to automatically manage the database during any DML event if occurred in database.			M									
CSL4318	Advanced Programming Concepts	CLO.1 Demonstrate high-level working knowledge skills and understanding of advanced programming concepts through consistent problem solving and program implementation		M	H									

		CLO.2 Investigate and design an interactive application that contains appropriate user interfaces and functional components			H								M	
		CLO.3 Develop an interactive application that exhibits effective user interfaces and efficient functional components			M									
		CLO.4 Critically evaluate data structures and algorithms relevant to a particular problem and choose appropriate ones for the stewardship of computing resources					H							
CS109	Core Java	CLO.1 Implement the concept of object-oriented techniques and methodologies using Java				M							M	
		CLO.2 Use Exception Handling concepts for a Robust Application in Java skills.	H							M				
		CLO.3 Demonstrate an understanding of Java Input and Output			M									
		CLO.4 Develop applications using multithreading concept of Java.					H							
		CLO.5 Use and Implement several Data structures using Collection Framework		M	H									

		CLO.6 Use database connectivity for a complete Java application.			H								M	
CSL4349	Advanced Java	CLO.1 Design the website.		H	H									
		CLO.2 Develop project using Spring framework skill.			M									
		CLO.3 Maintain and enhance existing web platform.					H							
		CLO.4 Implement several Data structures using Collection Framework.				M							M	
		CLO.5 Use database connectivity for a complete Java application.	H							M				
CS114	Data Structures	CLO.1 Analyse algorithms and algorithm correctness.			M									
		CLO.2 Analyse time complexities of algorithms using asymptotic analysis.		M	H									
		CLO.3 Summarize searching and sorting techniques.			H								M	
		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.			M									
		CLO.5 Gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.					H							
CSP2210	Data Structures Lab	CLO.1 Implement algorithms and algorithm correctness.				M							M	

		CLO.2 Identify time complexities of algorithms using asymptotic analysis.	H							M				
		CLO.3 Implement searching and sorting techniques.			H	H								H
		CLO.4 Implement stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.		H	H		H						H	
		CLO.5 Gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.		M	H									
CSL3303	Design and Analysis of Algorithm	CLO.1 Analyze algorithms and algorithm correctness.			H								M	
		CLO.2 Analyze time complexities of algorithms using asymptotic analysis.		H	H									
		CLO.3 Summarize searching and sorting techniques.			H	H							H	H
		CLO.4 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.			H	M					H			H
		CLO.5 Explain the major graph and tree algorithms and their analysis skills. Employ graphs to model engineering problems.			M									
CSP2303	Design & Analysis of	CLO.1 Analyze algorithms and algorithm correctness.					H							

	Algorithm Lab	CLO.2 Analyze time complexities of algorithms using asymptotic analysis.				M							M	
		CLO.3 Summarize searching and sorting techniques.		M	H									
		CLO.4 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.			H								M	
		CLO.5 Explain the major graph and tree algorithms and their analysis. Employ graphs to model engineering problems skills.			M									
CSL5302	Web Programming	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.					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	M					H			H
		CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.		H	H						M		H	
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.			M									
		CLO.5 Demonstrate and develop web-portals independently or in teams.					H							

CSL2347	Introduction to DevOps	CLO.1 Explain the need to do DevOps.				M							M	
		CLO.2 Understand the DevOps foundations, principles, and practices.	H							M				
		CLO.3 Understand, analyze, and map value streams.		H	H									
		CLO.4 Explain and implement the deployment pipeline skills.			H	H							H	H
		CLO.5 Illustrate the concept of Continuous Delivery.			H	M					H			H
		CLO.6 Create a problem-solving culture.			M									
CSL5356	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 to learn skills to use Javascript and successfully place it into webpages and also recognize the uses of Javascript.				M							M	
		CLO.3 Use Javascript to manipulate elements in the DOM to change appearance and visibility.	H							M				
		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									
CSL5359	Back-end Development	CLO.1 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.			H	H							H	H

		CLO.2 Understand the concept of full stack development and APIs.			H	M					H			H
		CLO.3 Learn debugging issues and end-to-end testing.		H	H						M		H	
		CLO.4 Deliver features in an agile development environment.			H	H								H
		CLO.5 Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.		H	H		H						H	
CSL5357	User Interface Design	CLO.1 Construct navigation that enables users to easily accomplish tasks.		M	H									
		CLO.2 Determine which data to display in order to meet user needs.					M							
		CLO.3 Enable users make social connections through their mobile devices.		H	H									
		CLO.4 Focus on patterns that bring clarity.			H	H							H	H
		CLO.5 Learn the skills of design strategy development that provides solutions to meet business and user goals.			H	M					H			H
CSL4377	AWS-Introduction to Cloud Computing	CLO.1 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.			M									
		CLO.2 Explain the core issues of cloud computing such as security, privacy, and interoperability.			H	H								H

		CLO.3 Identify problems, and explain, analyze, and evaluate various cloud computing solutions.		H	H		H						H	
		CLO.4 Provide the appropriate cloud computing solutions and recommendations according to the applications used.		M	H									
		CLO.5 Build skills to generate new ideas and innovations in cloud computing.			H								M	
CSL4378	Dynamic Programming	CLO.1 Write high quality code.		H	H									
		CLO.2 Understand the concept of scalability, security and extensible code for software applications.			H	H							H	H
		CLO.3 Learn debugging issues and end to end testing.			H	M					H			H
		CLO.4 Learn skills to deliver features in an agile development environment.		H	H						M		H	
		CLO.5 Solve problems iteratively and recursively and design both structured and object-oriented program.			H	H								H
CSL4381	PEGA(Computer Solution Architect)	CLO.1 Expands students skills and knowledge on PEGA platform in developing applications .			H	H							H	H
		CLO.2 Built as a structured one by well experienced IT professionals that covers PEGA certification topics.			H	M					H			H

		CLO.3 Gain thorough expertise in the core fundamentals of PEGA advanced topics at the highest level from scratch .			M									
EP3001	Entrepreneurship	CLO.1 Sell themselves and their ideas.					H							
		CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.				M							M	
		CLO.3 Find problems worth solving.		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								M	
		CLO.5 Increase their awareness and deliberately practice the 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									

CSL4336	Algorithm Design & Implementation	CLO.1 Well versed with Object Oriented Concepts and Java skills.			M									
		CLO.2 Have good idea of graph traversal algorithms and hashing techniques.					H							
		CLO.3 Write program in Java to solve graph-based problems.				M							M	
		CLO.4 Apply graph searching algorithms to real life problems.	H							M				
		CLO.5 Simulate real world problems to Java based software solutions.		H	H		H						H	
CSL4306	Designing Front End Using JavaScript	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.		M	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								M	
		CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.		H	H									
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.			H	H							H	H
		CLO.5 Demonstrate and develop web-portals independently or in teams.			H	M					H			H

CSP2325	Essentials Operating System	CLO.1 Identify different types of Operating System and their components.			M									
		CLO.2 Design and implementation of new system calls for any open source operating system.					H							
		CLO.3 Implementation of existing resource management algorithms in Linux operating system.				M							M	
		CLO.4 Identify various system security and protection issues.		M	H									
		CLO.5 Completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.			H								M	
CSL4379	AWS-Module 1(APP Development)	CLO.1 Deploy a web app to AWS.		H	H									
		CLO.2 Create and host a web app and set it up so users can easily access it.			H	H							H	H
		CLO.3 Build a serverless backend. Create a serverless function to trigger based on custom inputs in a text field skills.				M								
		CLO.4 Store data in a database.						H						
CSL4380	AWS-Module 2(APP Development)	CLO.1 Learn core AWS Concepts					M							M
		CLO.2 Learn core AWS Knowledge		H						M				

		CLO.3 Learn core AWS Services skills				M								
		CLO.4 Gain skill to design AWS environment			H								M	
CS161	Java programming under wipro talent next	CLO1: Implement the concept of object-oriented techniques and methodologies using Java.			H									
		CLO2: Develop applications using multithreading concept of Java.			M								H	
		CLO3: Use database connectivity for a complete Java application.		H		M								M
		CLO4: Design the website.			H								H	
		CLO5: Develop project using Spring framework skill.		H		H								M
CSL4341	Python Basics	CLO.1 Designing real life scenario problems, identifying and analysing solutions for it.		H	H									
		CLO.2 Accurately and efficiently designing the solutions in python.			H	H							H	H

		CLO.3 Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.			H	M					H			H
		CLO.4 Use indexing and slicing to access data in Python programs.		H	H						M		H	
		CLO.5 Design loops and decision statements in Python.					M							
CSA3103	Data Visualization and Query Language	CLO.1 Infer skills for various performance measures and benchmarking progress towards business goals.		H					H					
		CLO.2 Analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.		M				M						
		CLO.3 Create database and work on complex queries.			H								M	
		CLO.4 Differentiate various mapping tools.		H	H									
		CLO.5 Learn web mapping services requirements.			H	H							H	H
CSL4348	Business Analytics	CLO.1 Understand and critically apply the concepts and methods of business analytics			H	M					H			H
		CLO.2 To use basic functions and packages in Python.		H			M							
		CLO.3 To understand statistical concepts, skills and different hypothesis tests.							H					
		CLO.4 To learn how to prepare data using Python.		H				M						

		CLO.5 To learn how to prepare data using Python.		M	H							M		
CSL5358	Industry Competitive Preparation	CLO.1 Identify the key environmental factors shaping an industry			H								M	
		CLO.2 Demonstrate ability to use tools and methodologies for performing analysis for various types of industries skills		H	H									
		CLO.3 Develop a detailed professional report of Industry Analysis conducted.					M							
CSQ3101	Cyber Security for under graduates-I	CLO.1 Review and practice computer and network etiquette and ethics found in working environments.							H					
		CLO.2 Perform risk assessment skill.		H				M						
		CLO.3 Install, configure, use and manage anti malware software on a working network.			H	H								H
		CLO.4 Evaluate best practices in security concepts to maintain confidentiality, Integrity and availability of computer systems.		H	H		H						H	
		CLO.5 Articulate informed opinion about issues related to cyber security.		M	H									
CSQ3102	Cyber Security for Forensics & Investigation	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.					M							

		CLO.2 Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).		H					H					
		CLO.3 Use tools for faithful preservation of data on disks for analysis.						M						
		CLO.4 Find data that are hidden on a computer disk.			H							M		
		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.		H	H						M		H	
CSQ3103	Malware and Reverse Engineering – I	CLO.1 Apply malware analysis methodology and technology			H	H								H
		CLO.2 Apply static malware analysis skills.		H	H		H						H	
		CLO.3 Identify basic and some malware functionality				M								
		CLO.4 Identify known anti-reverse engineering techniques						H						
		CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.					M							M
CSQ3104	Malware and Reverse	CLO.1 Apply malware analysis methodology and technology skills.			H	H							H	H

	Engineering – II	CLO.2 Apply advanced static malware analysis.			H	M					H			H
		CLO.3 Identify basic and some advanced malware functionality					M							
		CLO.4 Identify known anti-reverse engineering techniques							H					
		CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.						M						
CSQ3105	Introduction to Cyber Security	CLO.1 Review and practice computer and network etiquette and ethics found in working environments	H		H							M		
		CLO.2 Perform risk assessment					M							
		CLO.3 Install, configure, use and manage anti malware software on a working network		H					H					
		CLO.4 Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems			H	H							H	H
		CLO.5 Articulate informed opinion about issues related to cyber security			H	M					H			H
CS130	Cyber Security for Forensics & Investigation	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.			M									

		CLO.2 Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).					H							
		CLO.3 Use tools for faithful preservation of data on disks for analysis.				M							M	
		CLO.4 Find data that are hidden on a computer disk.	H							M				
		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.				H							M	
CS131	Malware and Reverse Engineering – I	CLO.1 Apply malware analysis methodology and technology		H		H								
		CLO.2 Apply static malware analysis skills.				H	H						H	H
		CLO.3 Identify basic and some malware functionality				M								
		CLO.4 Identify known anti-reverse engineering techniques					H							
		CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.				M							M	
CS132	Malware and Reverse Engineering – II	CLO.1 Apply malware analysis methodology and technology skills.	H							M				

		CLO.2 Apply advanced static malware analysis.		M	H									
		CLO.3 Identify basic and some advanced malware functionality			H								M	
		CLO.4 Identify known anti-reverse engineering techniques		H	H									
		CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.			M									
CSQ3106	Digital Security and Advanced Cryptography	CLO.1 Understand basics of Cryptography and Network Security.					H							
		CLO.2 Secure a message over insecure channel by various means.				M							M	
		CLO.3 Learn skills about how to maintain the Confidentiality, Integrity and Availability of a data.	H							M				
		CLO.4 Understand various protocols for network security to protect against the threats		H	H		H						H	
CSQ3107	Secure Software Development	CLO.1 Analyze issues related secure software development methodologies		M	H									

		CLO.2 Apply skills for thorough understanding of secure coding principles			M									
		CLO.3 Select the most appropriate approach to secure software development				H								
		CLO.4 Judge and craft appropriate adaptations to the development process to make sure a secure deployment				M							M	
		CLO.5 valuate the implications and impact of secure architecture design	H							M				
GID5356	Fundamentals of Game Programming	CLO.1 Develop the skill to be able to program for a game.			M									
		CLO.2 Develop their own games.			H	H								H
		CLO.3 Perform their games on multiple platforms.			M									
		CLO.4 Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.					H							
		CLO.5 Seek new knowledge of games development through self-directed study.				M							M	
GID5357	Introduction to Game Engine	CLO.1 Develop the skill to be able to program for a game.	H							M				

		CLO.2 Develop their own games.			M									
		CLO.3 Perform their games on multiple platforms.					H							
		CLO.4 Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.				M							M	
		CLO.5 Seek new knowledge of games development through self-directed study.	H							M				
GID5358	Graphics Programming	CLO.1 Program computer graphics renderers.										H		
		CLO.2 Learn the skills to develop OpenGL applications.									H	H		
		CLO.3 Perform transformations on objects in graphics application.								H	M	H	M	
		CLO.4 Analyze, synthesize, and utilize design processes and strategy from concept to delivery to creatively solve communication problems.								M		H		H
		CLO.5 Create and develop skill in communication solutions that address audiences and contexts, by recognizing the human factors that determine design decisions.								H	M	M		H
GID5352	Game Design	CLO.1 Generate the skill of innovative ideas, and go beyond the obvious and predefined.				M								
		CLO.2 Listen to, evaluate, and respond critically to the ideas of others.									H			

		CLO.3 Identify steps, develop and manage a successful professional workflow.						M						M
		CLO.4 Synthesize trends, theories, and movements in the development of new ideas								H				
		CLO.5 Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work.				M								
GID5359	Game Design – 2D & 3D	CLO.1 Generate the skill of innovative ideas, and go beyond the obvious and predefined.					H							
		CLO.2 Listen to, evaluate, and respond critically to the ideas of others.				M							M	
		CLO.3 Identify steps, develop and manage a successful professional workflow.	H							M				
		CLO.4 Generate innovative ideas, and go beyond the obvious and predefined.	H	M		M								
		CLO.5 Synthesize trends, theories, and movements in the development of new ideas.	H	H									M	
GID5360	Game Design - BG	CLO.1 Generate the skill of innovative ideas, and go beyond the obvious and predefined.	H	H							H	M		H
		CLO.2 Listen to, evaluate, and respond critically to the ideas of others.								H			M	
		CLO.3 Identify steps, develop and manage a successful professional workflow.										M	H	

		CLO.4 Synthesize trends, theories, and movements in the development of new ideas			M									
		CLO.5 Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work.					H							
GID5361	Game Testing	1. List factors that influence the user's perception of a game				M							M	
		2. Recruit and guide individuals through a playtest of a game in accord with best practices	H							M				
		3. Prepare a report on the findings of a particular playtest with insights on potential solutions	H	M		M								
		4. Chose and implement testing skills appropriate for the development stage of a game	H	H									M	
GID5362	AI/ML	CLO.1 Demonstrate in-depth knowledge of methods and theories in the field of machine learning.	H	H							H	M		H
		CLO.2 Demonstrate the use Bayesian perspective on machine learning, Artificial neural networks, back propagation algorithm								H			M	

		CLO.3 Assess the learning algorithms skills modelled after biological evolution, including genetic algorithms and genetic programming.										M	H	
		CLO.4 Demonstrate the ability to critically evaluate and compare different learning models and learning algorithms.	H		M									H
		CLO.5 Design new algorithms after combining some of the key elements of existing machine learning algorithms	H	H										M
GID5363	Unity Game Development	CLO.1 Development of 2D & 3D games using the learned skills.	H		H									M
		CLO.2 Development of Special effects and Multiplayer games	H	H									H	
		CLO.3 Apply mathematical and game programming knowledge and skills to solve development tasks.	H	H		M								
		CLO.4 Build familiarity and appreciation of the programmatic components of an industry standard game development engine.	H	H										
		CLO.5 Seek new knowledge and skill development of games development through self-directed study.	H	H		H								

GID5364	AR/VR	CLO.1 Design, create, and integrate audio, visual, and interactive elements into a comprehensive immersive experience.		H		H								
		CLO.2 Develop content for successful delivery across multiple platforms, including PC, mobile devices and head-mounted displays.	H	H										
		CLO.3 Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR.	H	H										
		CLO.4 Evaluate various skill interaction schemes common to AR/VR experiences.		H	M									
		CLO.5 Use immersive effects of visual and audio assets to AR/VR experiences and evaluate implementation methods.	H	M	H									
CSL3361	Digital & Social Media Marketing Building Blocks	CLO.1 Understanding of the key concepts, and trends associated with Digital Marketing & Internet Technologies.	H		H									

	and Content Development & Marketing	CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.	H	H					H					
		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 & Internet Technologies.	H		H									
		CLO.4 Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.	H		M									
		CLO.5 Interpret for entrepreneur development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.	H	H										
CSL3362	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.		H	M									
		CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.		H	M									

		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.				M								
		CLO.4 Analyze the confluence of marketing, operations, and human resources in real-time delivery.		H										
		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.		H	M									
CSL3363	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.			M									
		CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.			M									
		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.		M	H									

		CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization		H	M									
		CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques for entrepreneurs.	H		H									
CSL3364	Affiliate Marketing and Online Reputation Management (ORM)	CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.		H			M							
		CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.		M			H						H	
		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.	H		M									
		CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization.	M	M	H									
		CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques useful for entrepreneurs.		M										

CSA4301	UX Design and Digitalization	CLO.1 Understand what interaction design is, the importance of user-centred design and methods of user information gathering.	H		M									
		CLO.2 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.			M								M	
		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	M									
		CLO.5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.			H								M	
CSA3302	Empathy & its Tools	CLO.1 Use empathy to change behaviour and build better relationship skills.		M	H									
		CLO.2 Develop empathy through role-play activities.			H								M	
		CLO.3 Explain what it means to have different perspectives.		H	H									
		CLO.4 Empathy prepares students to be leaders in their community.			H	H							H	H
		CLO.5 Understand the key difference(s) between empathy and sympathy.			H	M					H			H

CSA2301	User Interface Design	CLO.1 Construct navigation that enables users to easily accomplish tasks.		H	H						M		H	
		CLO.2 Determine which data to display in order to meet user needs.			H	H								H
		CLO.3 Enable users make social connections through their mobile devices.		H	H		H						H	
		CLO.4 Focus on patterns that bring clarity.			H		H							
		CLO.5 Learn the skills of design strategy development that provides solutions to meet business and user goals.				H	H							
CSA4302	User Research & Its Application	CLO.1 Understand group of usability experts evaluating website against a list of established guidelines.		H		H								
		CLO.2 To conduct moderated discussion with a group of users, allow to learn about user attitudes, ideas, and desires.		H	H		H						H	
		CLO.3 Perform testing method focused on navigation, which can be performed on a functioning website, a prototype, or a wireframe.			H		H						H	M
		CLO.4 Identifies user frustrations and problems with site through one-on-one sessions where a "real-life" user performs tasks on site.		H	H		H						H	
		CLO.5 Learn how to leverage various user research methods to meet user needs in product, website, or application.			M									

		CLO.6 Get hands-on experience with user experience exercises to practice user research skills.					H						
		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.				M						M	
CSA4303	Design Thinking & Its Applications	CLO.1 Better understand characteristics and processes, as well as the differences between novice and expert design thinkers.	H							M			
		CLO.2 Learn design thinking skills, focuses on the end-users and how to improve the user experience and make it more fulfilling.			M								
		CLO.3 To perform teams work collaboratively on a project, the joint advantage of experience, expertise and wisdom is available while developing solutions		H	H								
		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	H								H
		CLO.5 Assists in creating successful brands and generating ROI from these brands.		H	H		H					H	

CSL3308	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.				M	H							
		CLO.3 Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.			M									
		CLO.4 Make sure that the result meets the business and user requirements Software testing plays an instrumental role.					H							
		CLO.5 Satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.	H		H									H
CSP1308	Software Quality Assurance and Testing Lab	CLO.1 Specify various elements of object modelling to identify, analyse, visualize, specify, model and design			M									
		CLO.2 Apply analysis and design principles at various levels and various views in different domains of software systems.					H							

		CLO.3 Represent engineering problems graphically by drawing all UML diagrams.				M							M	
		CLO.4 Identify and apply concepts of software construction like Object Oriented Programming skills	H							M				
		CLO.5 Skilful use of Rational Rose tool for drawing all the UML diagrams in order to			M									
CSL3310	Business Intelligence and Data Warehousing	CLO.1 Speculate various models and algorithms in data warehousing.					H							
		CLO.2 Analyze various database problems and to find out the relevant information out of big data.							M					
		CLO.3 Implement major algorithms that generates frequent itemset.		H	H		M							
		CLO.4 Differentiate between OLAP AND OLTP.		H	H	M								
		CLO.5 Use clustering techniques for maintaining database integrity.			H									M
		CLO.6 Model an application's data requirements using conceptual model tools skills like BI tools and strategies		H	H						M			

CSP1310	Business Intelligence and Data Warehousing Lab	CLO.1 Comprehend techniques of Transaction Processing, Concurrency Control and Database Recovery Technique.		H	H						M		H	M
		CLO.2 Design Distributed database and apply concurrency control and recovery of data on distributed database.			M									
		CLO.3 Comprehend the concept of Object-Oriented DBMS and NoSQL data models.				H								
		CLO.4 Comprehend the need of Data Warehousing Concepts, OLAP and Data mining.				M							M	
		CLO.5 Demonstrate skilful use of PL/SQL to develop database centric applications.	H						M					
CSL3304	Artificial Intelligence and Expert System	CLO.1 Learning the basic concepts and skills of Artificial Intelligence.		M										
		CLO.2 Represent Knowledge using propositional calculus and predicate calculus.				H								
		CLO.3 Use inference rules to produce predicate calculus expression.			M							M		

		CLO.4 Demonstrate awareness of informed search and uninformed search techniques.							M					
		CLO.5 Explain about AI techniques for planning, knowledge representation and management.		H	H		M							
		CLO.6 Outline the process involved in Expert systems and in building such systems.	H		H									H
CSP1304	Artificial Intelligence and Expert System Lab	CLO.1 Implement basic concepts and skills of Artificial Intelligence.	H	H		H						H		H
		CLO.2 Represent and use knowledge using propositional calculus and predicate calculus.		H		H						H	M	
		CLO.3 Implement inference rules to produce predicate calculus expression.	H	H		H						H		H
		CLO.4 Demonstrate awareness of informed search and uninformed search techniques.				M								
		CLO.5 Explain about AI techniques for planning, knowledge representation and management.						H						
		CLO.6 Outline the process involved in Expert systems and in building such systems.					M							M
CSL4305	Theory of Computation	CLO.1 Become familiar with skills of basic automata theory of computer system.		H							M			

		CLO.2 Able to understand the working and data flow in computer components.	M			M								
		CLO.3 Understand the challenges for Theoretical Computer Science and its contribution to other sciences such as biology, economics, physics, and many other fields.					M			H				
		CLO.4 Able to deal with the problems efficiently on a model of computation using an algorithm.								M				
		CLO.5 Describe unrecognizable languages and undecidable problems.										M		
CSL5407	Compiler Design	CLO.1 To understand the context and use of a compiler.	H		H									H
		CLO.2 Skill to implement lexical analysis, parsing of the code and semantic analysis of the source csode.			M									
		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.				M							M	

		CLO.5 Knowledge and ability to devise, select, and use modern techniques and tools needed to design and implement compilers.	H							M				
CSL5411	Network Security	CLO.1 Identify common network security vulnerabilities/attacks			M									
		CLO.2 Explain the foundations of Cryptography and network security					H							
		CLO.3 Gain skills to critically evaluate the risks and threats to networked computers.			H		H						H	H
		CLO.4 Demonstrate detailed knowledge of the role of encryption to protect data.	H		H		H							
		CLO.5 Analyze security issues arising from the use of certain types of technologies.		H	H									
		CLO.6 Identify the appropriate procedures required to secure networks.		M	H									
CS162	Full Stack Development	CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet			H								M	
		CLO.2 Apply basic design principles to present ideas, information, products, and services on websites			M									
		CLO.3 Apply basic programming principles to the construction of websites					H							

		CLO.4 Effectively manage website projects using available resources				M							M	
		CLO.5 Demonstrate communication skills, service management skills, and presentation skills	H							M				
ER101	CAP Cohort-II(1)	LO.1 Sellthemselvesandtheirideas.				H	H							
		LO.2 Masteroralandvisualpresentationskillsandestablishafoundationofconfidenceintheskillsnecessarytocauseotherstoact.				M			H					
		LO.3 Findproblemsworthsolving.		M	H									M
		LO.4 Sellthemselvesandtheirideas.			H									
		LO.5 Masteroralandvisualpresentationskillsandestablishafoundationofconfidenceintheskillsnecessarytocauseotherstoact.		H	H									H
ER102	CAP Cohort-II(2)	CO.1 Sellthemselvesandtheirideas.				H	H							
		CO.2Masteroralandvisualpresentationskillsandestablishafoundationofconfidenceintheskillsnecessarytocauseotherstoact.				M			H					
		CO.3 Findproblemsworthsolving.		H	M									M
		CO.4 Sellthemselvesandtheirideas.					H							

		CO.5Masteroralandvisualpresentationskillsandestablishafoundationofconfidenceintheskillsnecessarytocauseotherstoact.		H	H									H
CS203	Integrated Project	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.												
CSP3203	Integrated Project – III													
CLP2305	Industry Interface													
CSP4401	Lab Oriented Project													
CST9411	Co-op project at Industry (Module-1)													
CST9412	Co-op project at Industry (Module-2)													
CST9401	Industry Oriented Hands-on Course													
CS203	Integrated Project													