

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Artificial Intelligence and Machine Learning**  
**Scheme of Teaching and Examinations 2021**  
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

III SEMESTER												
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and its Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KKBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
<b>Total</b>								<b>400</b>	<b>400</b>	<b>800</b>	<b>18</b>	
9	Scheduled activities for III to VIII semesters	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.							
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE								
		NMDC 21YO83	Yoga	Yoga								
<b>Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs</b>												
1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0
<p><b>Note:</b> BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, INT –Internship, HSMC: Humanity and Social Science &amp; Management Courses, AEC–Ability Enhancement Courses. UHV: Universal Human Value Course.  <b>L</b> –Lecture, <b>T</b> – Tutorial, <b>P</b>- Practical/ Drawing, <b>S</b> – Self Study Component, <b>CIE</b>: Continuous Internal Evaluation, <b>SEE</b>: Semester End Examination. <b>TD</b>-Teaching Department, <b>PSB</b>: Paper Setting department  <b>21KSK37/47</b> Samskrutika Kannada is for students who speak, read and write Kannada and <b>21KKBK37/47</b> Balake Kannada is for non-Kannada speaking, reading, and writing students.  <b>Integrated Professional Core Course (IPCC):</b> Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.</p>												

**21INT49 Inter/Intra Institutional Internship:** All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

**Non-credit mandatory courses (NCCM):**

**(A) Additional Mathematics I and II:**

**(1)** These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

**(2)** Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**(3)** Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

**(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

**(1)** Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

**(2)** In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

**(3)** In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

**(4)** Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

**(5)** These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**Ability Enhancement Course - III**

21CSL381	Mastering Office	21CS383	
21CS382	Programming in C++	21CS384	

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Artificial Intelligence and Machine Learning**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

IV SEMESTER												
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question and Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded Systems		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating Systems		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Sanskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KKB37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21C SL48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
<b>Total</b>								<b>550</b>	<b>450</b>	<b>1000</b>	<b>22</b>	

**Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs**

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0
---	-----------------	-----------------------------	-------	----	----	----	----	----	-----	----	-----	---

**Note:** BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Sanskrutika Kannada is for students who speak, read and write Kannada and 21KKB37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

**Non – credit mandatory course (NCCM):****Additional Mathematics - II:**

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

**Ability Enhancement Course - IV**

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

**Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.**

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Artificial Intelligence and Machine Learning**  
**Scheme of Teaching and Examinations 2021**  
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

V SEMESTER													
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits	
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks		
				L	T	P	S						
1	BSC 21CS51	Automata Theory and compiler Design	Any CS Board Department	3	0	0		03	50	50	100	3	
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4	
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3	
4	PCC 21AI54	Principles of Artificial Intelligence		3	0	0		03	50	50	100	3	
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1	
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2	
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1	
8	AEC 21CS58X/21 CSL58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1	
				1	0	0							
				If offered as lab. courses				02					
				0	0	2							
<b>Total</b>								<b>400</b>	<b>400</b>	<b>800</b>	<b>18</b>		
<b>Ability Enhancement Course - IV</b>													
21CSL581	Angular JS and Node JS		21CS583										
21CS582	C# and .Net Framework		21CS584										
<p>Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science &amp; Management Courses.  L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.</p> <p><b>Integrated Professional Core Course (IPCC):</b> refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.</p>													

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Artificial Intelligence and Machine Learning**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

**VI SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering and Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21AD62	Data Science and its Applications		3	0	2		03	50	50	100	4
3	PCC 21AI63	Machine Learning		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21AIL66	Machine Learning Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21AIMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.				--	100	--	100	3	
<b>Total</b>								<b>500</b>	<b>300</b>	<b>800</b>	<b>22</b>	

**Professional Elective - I**

21AI641	Business Intelligence	21AI643	Natural Language Processing
21CS642	Advanced JAVA Programming	21AI644	Computer Graphics and Fundamentals of Image Processing

**Open Electives – I offered by the Department to other Department students**

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

**Note: HSMC:** Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **MP**–Mini Project, **INT**–Internship.

L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

**Professional Elective Courses (PEC):**

A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

**Open Elective Courses:**

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall **not be allowed** if,

- (i) The candidate has studied the same course during the previous semesters of the program.
- (ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- (iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by

submitting a copy of the syllabus along with the details of expertise available to teach the same in the college. The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

**Mini-project work:** Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**No SEE component for Mini-Project.**

### VII semester Classwork and Research Internship /Industry Internship (21INT82)

#### Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.

**(2)** Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

#### Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

#### INT21INT82 Research Internship/ Industry Internship/Rural Internship

**Research internship:** A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

**Industry internship:** Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

**Rural internship:** A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Artificial Intelligence and Machine Learning**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

**Swappable VII and VIII SEMESTER****VII SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks		Total Marks
				L	T	P	S					
1	PCC 21AI71	Advanced AI and ML	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21AIP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
<b>Total</b>								<b>350</b>	<b>350</b>	<b>700</b>	<b>24</b>	

**VIII SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department	Teaching Hours /Week				Examination			Credits		
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks		Total Marks	
				L	T	P	S						
1	Seminar 21AI81	Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01	
2	INT 21INT82	Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise )	100	100	200	15	
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
<b>Total</b>								<b>250</b>	<b>150</b>	<b>400</b>	<b>16</b>		

**Professional Elective - II**

21AI731	Social Network Analysis	21CS734	Blockchain Technology
21CS732	Digital Image Processing	21CS735	Internet of Things
21AI733	Fullstack Development		

**Professional Elective - III**

21AI741	Augmented Reality	21CS744	Robotic Process Automation Design and Development
21CS742	Multiagent Systems	21CS745	NoSQL Data Base
21AI743	Predictive Analytics		



**Open Electives - II offered by the Department to other Department students**

21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to Big Data		

**Note:** PCC: Professional Core Course, PEC: Professional Elective Courses, OEC–Open Elective Course, AEC–Ability Enhancement Courses.  
L–Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Note: VII and VIII semesters of IV year of the programme**

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

**PROJECT WORK (21XXP76):** The objective of the Project work is

- (i) To encourage independent learning and the innovative attitude of the students.
- (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- (iii) To impart flexibility and adaptability.
- (iv) To inspire team working.
- (v) To expand intellectual capacity, credibility, judgment and intuition.
- (vi) To adhere to punctuality, setting and meeting deadlines.
- (vii) To instil responsibilities to oneself and others.
- (viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

**TECHNICAL SEMINAR (21XXS81):** The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

- (i) Carry out literature survey, systematically organize the content.
- (ii) Prepare the report with own sentences, avoiding a cut and paste act.
- (iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- (iv) Present the seminar topic orally and/or through PowerPoint slides.
- (v) Answer the queries and involve in debate/discussion.
- (vi) Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Evaluation Procedure:**

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

**Marks distribution for CIE of the course:**

Seminar Report:50 marks

Presentation skill:25 marks

Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

**Non – credit mandatory courses (NCMC):**

**National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

### III Semester

<b>DATA STRUCTURES AND APPLICATIONS</b>			
Course Code:	<b>21CS32</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Explain the fundamentals of data structures and their applications essential for implementing solutions to problems. CLO 2. Illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs. CLO 3. Design and Develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists. CLO 4. Explore usage of Trees and Graph for application development. CLO 5. Apply the Hashing techniques in mapping key value pairs.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"><li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li><li>2. Use of Video/Animation to explain functioning of various concepts.</li><li>3. Encourage collaborative (Group Learning) Learning in the class.</li><li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li><li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li><li>6. Introduce Topics in manifold representations.</li><li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li><li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li></ol>			
<b>Module-1</b>			
<b>Introduction:</b> Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures. Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays and Multidimensional Arrays. Demonstration of representation of Polynomials and Sparse Matrices with arrays.			
<b>Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7, Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Textbook 3: Chapter 1: 1.3</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"><li>1. Design, Develop and Implement a menu driven Program in C for the following Array Operations<ol style="list-style-type: none"><li>a. Creating an Array of N Integer Elements</li><li>b. Display of Array Elements with Suitable Headings</li><li>c. Exit.</li></ol>Support the program with functions for each of the above operations.</li><li>2. Design, Develop and Implement a menu driven Program in C for the following Array operations<ol style="list-style-type: none"><li>a. Inserting an Element (ELEM) at a given valid Position (POS)</li><li>b. Deleting an Element at a given valid Position POS)</li><li>c. Display of Array Elements</li></ol></li></ol>			

<p>d. Exit. Support the program with functions for each of the above operations.</p>	
<p><b>Teaching-Learning Process</b></p>	<p>Problem based learning (Implementation of different programs to illustrate application of arrays and structures. <a href="https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s">https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s</a>  <a href="https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html">https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html</a> <a href="https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html</a></p>
<p><b>Module-2</b></p>	
<p><b>Stacks:</b> Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.</p> <p><b>Queues:</b> Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues.</p> <p><b>Textbook 1: Chapter 3: 3.1 -3.4, 3.6 Textbook 2: Chapter 6: 6.1 -6.4, 6.5, 6.7-6.13</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>1. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) <ol style="list-style-type: none"> <li>a. <i>Push</i> an Element on to Stack</li> <li>b. <i>Pop</i> an Element from Stack</li> <li>c. Demonstrate <i>Overflow</i> and <i>Underflow</i> situations on Stack</li> <li>d. Display the status of Stack</li> <li>e. Exit</li> </ol> <p style="margin-left: 20px;">Support the program with appropriate functions for each of the above operations</p> </li> <li>2. Design, Develop and Implement a Program in C for the following Stack Applications <ol style="list-style-type: none"> <li>a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^</li> <li>b. Solving Tower of Hanoi problem with n disks</li> </ol> </li> </ol>	
<p><b>Teaching-Learning Process</b></p>	<p>Active Learning, Problem based learning <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html">https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html</a></p>
<p><b>Module-3</b></p>	
<p><b>Linked Lists:</b> Definition, classification of linked lists. Representation of different types of linked lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.</p> <p><b>Textbook 1: Chapter 4: 4.1 – 4.4, 4.5.2, 4.7, 4.8, Textbook 2: Chapter 5: 5.1 – 5.9</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>1. Singly Linked List (SLL) of Integer Data <ol style="list-style-type: none"> <li>a. Create a SLL stack of N integer.</li> <li>b. Display of SLL</li> <li>c. Linear search. Create a SLL queue of N Students Data Concatenation of two SLL of integers.</li> </ol> </li> <li>2. Design, Develop and Implement a menu driven Program in C for the following operationson Doubly Linked List (DLL) of Professor Data with the fields: ID, Name, Branch, Area of specialization <ol style="list-style-type: none"> <li>a. Create a DLL stack of N Professor's Data.</li> </ol> </li> </ol>	

<p>b. Create a DLL queue of N Professor's Data Display the status of DLL and count the number of nodes in it.</p>	
<p><b>Teaching-Learning Process</b></p>	<p>MOOC, Active Learning, Problem solving based on linked lists.  <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a></p>
<p><b>Module-4</b></p>	
<p><b>Trees 1:</b> Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression.</p>	
<p><b>Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Given an array of elements, construct a complete binary tree from this array in level order fashion. That is, elements from left in the array will be filled in the tree level wise starting from level 0. Ex: Input : arr[] = {1, 2, 3, 4, 5, 6} Output : Root of the following tree <pre> 1  / \ 2   3  / \ / \ 4  5 6 </pre> </li> <li>Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers <ol style="list-style-type: none"> <li>Create a BST of N Integers</li> <li>Traverse the BST in Inorder, Preorder and Post Order</li> </ol> </li> </ol>	
<p><b>Teaching-Learning Process</b></p>	<p>Problem based learning  <a href="http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html">http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html</a></p>
<p><b>Module-5</b></p>	
<p><b>Trees 2:</b> AVL tree, Red-black tree, Splay tree, B-tree.</p>	
<p><b>Graphs:</b> Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth FirstSearch.</p>	
<p><b>Hashing:</b> Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.</p>	
<p><b>Textbook 1: Chapter 10:10.2, 10.3, 10.4, Textbook 2:7.10 – 7.12, 7.15 Chapter 11: 11.2, Textbook 1: Chapter 6 : 6.1–6.2, Chapter 8 : 8.1-8.3, Textbook 2: 8.1 – 8.3, 8.5, 8.7</b></p>	
<p><b>Textbook 3: Chapter 15:15.1, 15.2,15.3, 15.4,15.5 and 15.7</b></p>	

**Laboratory Component:**

1. Design, Develop and implement a program in C for the following operations on Graph (G) of cities
  - a. Create a Graph of N cities using Adjacency Matrix.
  - b. Print all the nodes reachable from a given starting node in a diagraph using DFS/BFS method.
2. Design and develop a program in C that uses Hash Function  $H:K \rightarrow L$  as  $H(K)=K \bmod m$ (remainder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

**Teaching-Learning Process**

NPTL, MOOC etc. courses on trees and graphs.  
<http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Course Outcomes (Course Skill Set)**

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

- CO 1. Identify different data structures and their applications.
- CO 2. Apply stack and queues in solving problems.
- CO 3. Demonstrate applications of linked list.
- CO 4. Explore the applications of trees and graphs to model and solve the real-world problem.
- CO 5. Make use of Hashing techniques and resolve collisions during mapping of key value pairs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.

**Reference Books:**

1. Gilberg and Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.
2. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
3. A M Tenenbaum, Data Structures using C, PHI, 1989
4. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

**Weblinks and Video Lectures (e-Resources):**

1. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html>
2. <https://nptel.ac.in/courses/106/105/106105171/>
3. <http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Back/Forward stacks on browsers.
- Undo/Redo stacks in Excel or Word.
- Linked list representation of real-world queues -Music player, image viewer

### III Semester

<b>DATA STRUCTURES AND APPLICATIONS</b>			
Course Code:	<b>21CS32</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Objectives:</b>			
CLO 6. Explain the fundamentals of data structures and their applications essential for implementing solutions to problems.			
CLO 7. Illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.			
CLO 8. Design and Develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists.			
CLO 9. Explore usage of Trees and Graph for application development.			
CLO 10. Apply the Hashing techniques in mapping key value pairs.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
9. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.			
10. Use of Video/Animation to explain functioning of various concepts.			
11. Encourage collaborative (Group Learning) Learning in the class.			
12. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.			
13. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.			
14. Introduce Topics in manifold representations.			
15. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.			
16. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
<b>Module-1</b>			
<b>Introduction:</b> Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures. Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays and Multidimensional Arrays. Demonstration of representation of Polynomials and Sparse Matrices with arrays.			
<b>Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7, Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Textbook 3: Chapter 1: 1.3</b>			
<b>Laboratory Component:</b>			
3. Design, Develop and Implement a menu driven Program in C for the following Array Operations			
a. Creating an Array of N Integer Elements			
b. Display of Array Elements with Suitable Headings			
c. Exit.			
Support the program with functions for each of the above operations.			
4. Design, Develop and Implement a menu driven Program in C for the following Array operations			
a. Inserting an Element (ELEM) at a given valid Position (POS)			
b. Deleting an Element at a given valid Position POS)			
c. Display of Array Elements			

<p>d. Exit. Support the program with functions for each of the above operations.</p>	
<p><b>Teaching-Learning Process</b></p>	<p>Problem based learning (Implementation of different programs to illustrate application of arrays and structures.  <a href="https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s">https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s</a>  <a href="https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html">https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html</a></p>
<p><b>Module-2</b></p>	
<p><b>Stacks:</b> Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.</p> <p><b>Queues:</b> Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues.</p> <p><b>Textbook 1: Chapter 3: 3.1 -3.4, 3.6 Textbook 2: Chapter 6: 6.1 -6.4, 6.5, 6.7-6.13</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>3. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) <ol style="list-style-type: none"> <li>a. <i>Push</i> an Element on to Stack</li> <li>b. <i>Pop</i> an Element from Stack</li> <li>c. Demonstrate <i>Overflow</i> and <i>Underflow</i> situations on Stack</li> <li>d. Display the status of Stack</li> <li>e. Exit</li> </ol> <p style="margin-left: 20px;">Support the program with appropriate functions for each of the above operations</p> </li> <li>4. Design, Develop and Implement a Program in C for the following Stack Applications <ol style="list-style-type: none"> <li>a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^</li> </ol> </li> </ol>	
<p><b>Teaching-Learning Process</b></p>	<p>Active Learning, Problem based learning  <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html">https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html</a></p>
<p><b>Module-3</b></p>	
<p><b>Linked Lists:</b> Definition, classification of linked lists. Representation of different types of linked lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.</p> <p><b>Textbook 1: Chapter 4: 4.1 – 4.4, 4.5.2, 4.7, 4.8, Textbook 2: Chapter 5: 5.1 – 5.9</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>3. Singly Linked List (SLL) of Integer Data <ol style="list-style-type: none"> <li>a. Create a SLL stack of N integer.</li> <li>b. Display of SLL</li> <li>c. Linear search. Create a SLL queue of N Students Data Concatenation of two SLL of integers.</li> </ol> </li> <li>4. Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Professor Data with the fields: ID, Name, Branch, Area of specialization <ol style="list-style-type: none"> <li>a. Create a DLL stack of N Students Data.</li> <li>b. Create a DLL queue of N Students Data</li> </ol> </li> </ol>	



Display the status of DLL and count the number of nodes in it.	
<b>Teaching-Learning Process</b>	MOOC, Active Learning, Problem solving based on linked lists. <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a> <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a> <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a>
<b>Module-4</b>	
<b>Trees 1:</b> Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression.	
<b>Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9</b>	
<b>Laboratory Component:</b>	
<p>3. Given an array of elements, construct a complete binary tree from this array in level order fashion. That is, elements from left in the array will be filled in the tree level wise starting from level 0. Ex: Input :</p> <p>arr[] = {1, 2, 3, 4, 5, 6}</p> <p>Output : Root of the following tree</p> <pre style="margin-left: 40px;"> 1  / \ 2   3  / \ / \ 5  5 6 </pre> <p>4. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers</p> <ol style="list-style-type: none"> <li>a. Create a BST of N Integers</li> <li>b. Traverse the BST in Inorder, Preorder and Post Order</li> </ol>	
<b>Teaching-Learning Process</b>	Problem based learning <a href="http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html">http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html</a>
<b>Module-5</b>	
<b>Trees 2:</b> AVL tree, Red-black tree, Splay tree, B-tree.	
<b>Graphs:</b> Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth FirstSearch.	
<b>Hashing:</b> Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.	
<b>Textbook 1: Chapter 10:10.2, 10.3, 10.4, Textbook 2:7.10 – 7.12, 7.15 Chapter 11: 11.2, Textbook 1: Chapter 6 : 6.1–6.2, Chapter 8 : 8.1-8.3, Textbook 2: 8.1 – 8.3, 8.5, 8.7</b>	
<b>Textbook 3: Chapter 15:15.1, 15.2,15.3, 15.4,15.5 and 15.7</b>	
<b>Laboratory Component:</b>	

3. Design, Develop and implement a program in C for the following operations on Graph (G) of cities
  - a. Create a Graph of N cities using Adjacency Matrix.
  - b. Print all the nodes reachable from a given starting node in a diagraph using DFS/BFS method.
4. Design and develop a program in C that uses Hash Function  $H:K \rightarrow L$  as  $H(K)=K \bmod m$ (remainder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

**Teaching-Learning Process**

NPTL, MOOC etc. courses on trees and graphs.  
<http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Course Outcomes (Course Skill Set)**

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

- CO 6. Identify different data structures and their applications.
- CO 7. Apply stack and queues in solving problems.
- CO 8. Demonstrate applications of linked list.
- CO 9. Explore the applications of trees and graphs to model and solve the real-world problem.
- CO 10. Make use of Hashing techniques and resolve collisions during mapping of key value pairs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

6. First test at the end of 5<sup>th</sup> week of the semester
7. Second test at the end of the 10<sup>th</sup> week of the semester
8. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

9. First assignment at the end of 4<sup>th</sup> week of the semester
10. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

3. The question paper will have ten questions. Each question is set for 20 marks.
4. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

4. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
5. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
6. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.

**Reference Books:**

5. Gilberg and Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.
6. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
7. A M Tenenbaum, Data Structures using C, PHI, 1989
8. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

**Weblinks and Video Lectures (e-Resources):**

4. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html>
5. <https://nptel.ac.in/courses/106/105/106105171/>
6. <http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Back/Forward stacks on browsers.
- Undo/Redo stacks in Excel or Word.
- Linked list representation of real-world queues -Music player, image viewer

### III Semester

<b>ANALOG AND DIGITAL ELECTRONICS</b>			
Course Code	<b>21CS33</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<p><b>Course Learning Objectives:</b></p> <p>CLO 1. Explain the use of photo electronics devices, 555 timer IC, Regulator ICs and uA741</p> <p>CLO 2. Make use of simplifying techniques in the design of combinational circuits.</p> <p>CLO 3. Illustrate combinational and sequential digital circuits</p> <p>CLO 4. Demonstrate the use of flipflops and apply for registers</p> <p>CLO 5. Design and test counters, Analog-to-Digital and Digital-to-Analog conversion techniques.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p>BJT Biasing: Fixed bias, Collector to base Bias, voltage divider bias</p> <p>Operational Amplifier Application Circuits: Peak Detector, Schmitt trigger, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage and Voltage-to-Current Converter, Regulated Power Supply Parameters, adjustable voltage regulator, D to A and A to D converter.</p> <p><b>Textbook 1: Part A: Chapter 4 (Sections 4.2, 4.3, 4.4), Chapter 7 (Sections 7.4, 7.6 to 7.11), Chapter 8 (Sections 8.1 and 8.5), Chapter 9.</b></p>			
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Simulate BJT CE voltage divider biased voltage amplifier using any suitable circuit simulator.</li> <li>Using ua 741 Opamp, design a 1 kHz Relaxation Oscillator with 50% duty cycle</li> <li>Design an astable multivibrator circuit for three cases of duty cycle (50%, &lt;50% and &gt;50%) using NE 555 timer IC.</li> <li>Using ua 741 opamp, design a window comparator for any given UTP and LTP.</li> </ol>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration of circuits using simulation.</li> <li>Project work: Design a integrated power supply and function generator operating at audio frequency. Sine, square and triangular functions are to be generated.</li> <li>Chalk and Board for numerical</li> </ol>		
<b>Module-2</b>			

Karnaugh maps: minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants, the prime implicant chart, Petricks method, simplification of incompletely specified functions, simplification using map-entered variables

**Textbook 1: Part B: Chapter 5 (Sections 5.1 to 5.4) Chapter 6 (Sections 6.1 to 6.5)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and implement the same using basic gates.

**Teaching-Learning Process**

1. Chalk and Board for numerical
2. Laboratory Demonstration

**Module-3**

Combinational circuit design and simulation using gates: Review of Combinational circuit design, design of circuits with limited Gate Fan-in, Gate delays and Timing diagrams, Hazards in combinational Logic, simulation and testing of logic circuits

Multiplexers, Decoders and Programmable Logic Devices: Multiplexers, three state buffers, decoders and encoders, Programmable Logic devices.

**Textbook 1: Part B: Chapter 8, Chapter 9 (Sections 9.1 to 9.6)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.
2. Design and implement code converter I) Binary to Gray (II) Gray to Binary Code

**Teaching-Learning Process**

1. Demonstration using simulator
2. Case study: Applications of Programmable Logic device
3. Chalk and Board for numerical

**Module-4**

Introduction to VHDL: VHDL description of combinational circuits, VHDL Models for multiplexers, VHDL Modules.

Latches and Flip-Flops: Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3,SR Flip Flop, J K Flip Flop, T Flip Flop.

**Textbook 1: Part B: Chapter 10(Sections 10.1 to 10.3), Chapter 11 (Sections 11.1 to 11.7)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same in HDL simulator
2. Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table. And implement the same in HDL.

**Teaching-Learning Process**

1. Demonstration using simulator
2. Case study: Arithmetic and Logic unit in VHDL
3. Chalk and Board for numerical

**Module-5**

Registers and Counters: Registers and Register Transfers, Parallel Adder with accumulator, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.

**Textbook 1: Part B: Chapter 12 (Sections 12.1 to 12.5)**

<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>Design and implement a mod-n (<math>n &lt; 8</math>) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.</li> <li>Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (<math>n \leq 9</math>) and demonstrate on 7-segment display (using IC-7447)</li> </ol>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration using simulator</li> <li>Project Work: Designing any counter, use LED / Seven-segment display to display the output</li> <li>Chalk and Board for numerical</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp.	
CO 2. Explain the basic principles of A/D and D/A conversion circuits and develop the same.	
CO 3. Simplify digital circuits using Karnaugh Map, and Quine-McClusky Methods	
CO 4. Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types.	
CO 5. Develop simple HDL programs	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>First test at the end of 5<sup>th</sup> week of the semester</li> <li>Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to <b>20 marks</b> .	
<i>Note: Minimum of 80% of the laboratory components have to be covered.</i>	
<ul style="list-style-type: none"> <li>Rubrics for each Experiment taken average for all Lab components – 15 Marks.</li> <li>Viva-Voce– 5 Marks (more emphasized on demonstration topics)</li> </ul>	
The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question	

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Charles H Roth and Larry L Kinney, Analog and Digital Electronics, Cengage Learning, 2019

**Reference Books**

1. Anil K Maini, Varsha Agarwal, Electronic Devices and Circuits, Wiley, 2012.
2. Donald P Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.
3. M. Morris Mani, Digital Design, 4th Edition, Pearson Prentice Hall, 2008.
4. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

**Weblinks and Video Lectures (e-Resources):**

1. Analog Electronic Circuits: <https://nptel.ac.in/courses/108/102/108102112/>
2. Digital Electronic Circuits: <https://nptel.ac.in/courses/108/105/108105132/>
3. Analog Electronics Lab: <http://vlabs.iitkgp.ac.in/be/>
4. Digital Electronics Lab: <http://vlabs.iitkgp.ac.in/dec>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the design concepts of oscillator, amplifier, switch, Digital circuits using Opamps, 555 timer, transistor, Digital ICs and design a application like tone generator, temperature sensor, digital clock, dancing lights etc.

### III Semester

<b>COMPUTER ORGANIZATION AND ARCHITECTURE</b>			
Course Code	<b>21CS34</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand the organization and architecture of computer systems, their structure and operation</p> <p>CLO 2. Illustrate the concept of machine instructions and programs</p> <p>CLO 3. Demonstrate different ways of communicating with I/O devices</p> <p>CLO 4. Describe different types memory devices and their functions</p> <p>CLO 5. Explain arithmetic and logical operations with different data types</p> <p>CLO 6. Demonstrate processing unit with parallel processing and pipeline architecture</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Basic Structure of Computers:</b> Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.			
<b>Machine Instructions and Programs:</b> Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes			
<b>Textbook 1: Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Input/Output Organization:</b> Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits			
<b>Textbook 1: Chapter4 – 4.1, 4.2, 4.4, 4.5, 4.6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Memory System:</b> Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Virtual memories			
<b>Textbook 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		



<b>Module-4</b>	
<b>Arithmetic:</b> Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers	
<b>Basic Processing Unit:</b> Fundamental Concepts, Execution of a Complete Instruction, Hardwired control, Microprogrammed control	
<b>Textbook 1: Chapter2-2.1, Chapter6 – 6.1 to 6.3</b>	
<b>Textbook 1: Chapter7 – 7.1, 7.2,7.4, 7.5</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<b>Pipeline and Vector Processing:</b> Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing, Array Processors	
<b>Textbook 2: Chapter 9 – 9.1, 9.2, 9.3, 9.4, 9.6, 9.7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Explain the organization and architecture of computer systems with machine instructions and programs	
CO 2. Analyze the input/output devices communicating with computer system	
CO 3. Demonstrate the functions of different types of memory devices	
CO 4. Apply different data types on simple arithmetic and logical unit	
CO 5. Analyze the functions of basic processing unit, Parallel processing and pipelining	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks.	

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5<sup>th</sup> Edition, Tata McGraw Hill
2. M. Morris Mano, Computer System Architecture, PHI, 3<sup>rd</sup> Edition

**Reference:**

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/103/106103068/>
2. <https://nptel.ac.in/content/storage2/courses/106103068/pdf/coa.pdf>
3. <https://nptel.ac.in/courses/106/105/106105163/>
4. <https://nptel.ac.in/courses/106/106/106106092/>
5. <https://nptel.ac.in/courses/106/106/106106166/>
6. <http://www.nptelvideos.in/2012/11/computer-organization.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Discussion and literature survey on real world use cases
- Quizzes

### III Semester

<b>OBJECT ORIENTED PROGRAMMING WITH JAVA LABORATORY</b>			
Course Code	<b>21CSL35</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Demonstrate the use of Eclipse/Netbeans IDE to create Java Applications.			
CLO 2. Using java programming to develop programs for solving real-world problems.			
CLO 3. Reinforce the understanding of basic object-oriented programming concepts.			
<b>Note: two hours tutorial is suggested for each laboratory sessions.</b>			
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>• Students should be familiarized about java installation and setting the java environment.</li> <li>• Usage of IDEs like Eclipse/Netbeans should be introduced.</li> </ul>			
<b>Sl. No.</b>	<b><i>PART A – List of problems for which student should develop program and execute in the Laboratory</i></b>		
1	Aim: Introduce the java fundamentals, data types, operators in java  Program: Write a java program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$ . Read in a, b, c and use the quadratic formula.		
2	Aim: Demonstrating creation of java classes, objects, constructors, declaration and initialization of variables.  Program: Create a Java class called <b>Student</b> with the following details as variables within it. USN Name Branch Phone Write a Java program to create n Student objects and print the USN, Name, Branch, and Phone of these objects with suitable headings.		
3	Aim: Discuss the various Decision-making statements, loop constructs in java  Program: A. Write a program to check prime number B. Write a program for Arithmetic calculator using switch case menu		
4	Aim: Demonstrate the core object-oriented concept of Inheritance, polymorphism  Design a super class called <b>Staff</b> with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a Java program to read and display at least 3 staff objects of all three categories.		
5	Aim: Introduce concepts of method overloading, constructor overloading, overriding.  Program: Write a java program demonstrating Method overloading and Constructor overloading.		
6	Aim: Introduce the concept of Abstraction, packages.  Program: Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.		
7	Aim: Introduction to abstract classes, abstract methods, and Interface in java		

	Program: Write a program to generate the resume. Create 2 Java classes Teacher (data: personal information, qualification, experience, achievements) and Student (data: personal information, result, discipline) which implements the java interface Resume with the method biodata().
8	Aim: Demonstrate creation of threads using Thread class and Runnable interface, multi-threaded programming.  Program: Write a Java program that implements a <b>multi-thread</b> application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number.
9	Aim: Introduce java Collections.  Program: Write a program to perform string operations using ArrayList. Write functions for the following a. Append - add at end b. Insert – add at particular index c. Search d. List all string starts with given letter.
10	Aim: Exception handling in java, introduction to throwable class, throw, throws, finally.  Program: Write a Java program to read two integers a and b. <b>Compute</b> a/b and print, when b is not zero. Raise an exception when b is equal to zero.
11	Aim: Introduce File operations in java.  Program: Write a java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes
12	Aim: Introduce java Applet, awt, swings.  Programs: Develop an applet that displays a simple message in center of the screen. Develop a simple calculator using Swings.
<b>PART B – Practical Based Learning</b>	
01	A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.
<b>Course Outcome (Course Skill Set)</b> At the end of the course the student will be able to:	
CO 1. Use Eclipse/NetBeans IDE to design, develop, debug Java Projects. CO 2. Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP. CO 3. Demonstrate the ability to design and develop java programs, analyze, and interpret object-oriented data and document results. CO 4. Apply the concepts of multiprogramming, exception/event handling, abstraction to develop robust programs. CO 5. Develop user friendly applications using File I/O and GUI concepts.	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . • Each experiment to be evaluated for conduction with observation sheet and record write-up.	

Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

#### **Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*
- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours
- Rubrics suggested in Annexure-II of Regulation book

#### **Suggested Learning Resources:**

1. E Balagurusamy, Programming with Java, Graw Hill, 6<sup>th</sup> Edition, 2019.
2. Herbert Schildt, C: Java the Complete Reference, McGraw Hill, 11<sup>th</sup> Edition, 2020

### III Semester

<b>MASTERING OFFICE (Practical based)</b>			
Course Code	<b>21CSL381</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
<p>CLO 1. Understand the basics of computers and prepare documents and small presentations.</p> <p>CLO 2. Attain the knowledge about spreadsheet/worksheet with various options.</p> <p>CLO 3. Create simple presentations using templates various options available.</p> <p>CLO 4. Demonstrate the ability to apply application software in an office environment.</p> <p>CLO 5. Use MS Office to create projects, applications.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>MS-Word</b> -Working with Files, Text – Formatting, Moving, copying and pasting text, Styles – Lists – Bulleted and numbered lists, Nested lists, Formatting lists. Table Manipulations. Graphics – Adding clip Art, add an image from a file, editing graphics, Page formatting - Header and footers, page numbers, Protect the Document, Mail Merge, Macros – Creating &amp; Saving web pages, Hyperlinks.</p>			
<b>Textbook 1: Chapter 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<p><b>MS-Excel-</b> Modifying a Worksheet – Moving through cells, adding worksheets, rows and columns, Resizing rows and columns, selecting cells, Moving and copying cells, freezing panes - Macros – recording and running. Linking worksheets - Sorting and Filling, Alternating text and numbers with Auto fill, Auto filling functions. Graphics – Adding clip art, add an image from a file, Charts – Using chart Wizard, Copy a chart to Microsoft Word.</p>			
<b>Textbook 1: Chapter 3</b>			
<b>Teaching-Learning Process</b>	Active Learning, Demonstration, presentation,		
<b>Module-3</b>			
<p><b>MS-Power Point</b> -Create a Presentation from a template- Working with Slides – Insert a new slide, applying a design template, changing slide layouts – Resizing a text box, Text box properties, delete a text box - Video and Audio effects, Color Schemes &amp; Backgrounds Adding clip art, adding an image from a file, Save as a web page.</p>			

<b>Textbook 1: Chapter 5</b>	
<b>Teaching-Learning Process</b>	Demonstration, presentation preparation for case studies
<b>Module-4</b>	
<b>MS-Access</b> - Using Access database wizard, pages and projects. Creating Tables – Create a Table in design view. Datasheet Records – Adding, Editing, deleting records, Adding and deleting columns Resizing rows and columns, finding data in a table & replacing, Print a datasheet. Queries - MS-Access.	
<b>Textbook 1: Chapter 4</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Practical based learning.
<b>Module-5</b>	
<b>Microsoft Outlook-</b> Introduction, Starting Microsoft Outlook, Outlook Today, Different Views In Outlook, Outlook Data Files	
<b>Textbook 1: Chapter 7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. Know the basics of computers and prepare documents, spreadsheets, make small presentations with audio, video and graphs and would be acquainted with internet. CO 2. Create, edit, save and print documents with list tables, header, footer, graphic, spellchecker, mail merge and grammar checker CO 3. Attain the knowledge about spreadsheet with formula, macros spell checker etc. CO 4. Demonstrate the ability to apply application software in an office environment. CO 5. Use Google Suite for office data management tasks	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> <b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . <ul style="list-style-type: none"> <li>Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>Weightage to be given for neatness and submission of record/write-up on time.</li> <li>Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul> The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b>	

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

**Weblinks and Video Lectures (e-Resources):**

1. <https://youtu.be/9VRmgC2GRFE>
2. <https://youtu.be/rJPWi5x0g3I>
3. <https://youtu.be/tcj2BhhCMN4>
4. <https://youtu.be/ubmwp8kbfPc>
5. <https://youtu.be/i6eNvfQ8fTw>
6. <http://office.microsoft.com/en-us/training/CR010047968.aspx>
7. <https://gsuite.google.com/learning-center>
8. <http://spoken-tutorial.org>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Real world examples of Windows Framework.



### III Semester

<b>PROGRAMMING IN C++</b>			
Course Code	<b>21CS382</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
<p>CLO 1. Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.</p> <p>CLO 2. Understand the capability of a class to rely upon another class and functions.</p> <p>CLO 3. Understand about constructors which are special type of functions.</p> <p>CLO 4. Create and process data in files using file I/O functions</p> <p>CLO 5. Use the generic programming features of C++ including Exception handling.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Object Oriented Programming:</b> Computer programming background- C++ overview- First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.			
<b>Textbook 1: Chapter 1(1.1 to 1.8)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Functions in C++:</b> Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.			
<b>Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) , chapter 4(4.3,4.4,4.5,4.6,4.7,4.9)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Inheritance &amp; Polymorphism:</b> Derived class Constructors, destructors-Types of Inheritance- Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.			
<b>Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8)</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving
<b>Module-4</b>	
<b>I/O Streams:</b> C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations.	
<b>Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
<b>Module-5</b>	
<b>Exception Handling:</b> Introduction to Exception - Benefits of Exception handling- Try and catch block- Throw statement- Pre-defined exceptions in C++ .	
<b>Textbook 2: Chapter 13 (13.2 to13.6)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. Able to understand and design the solution to a problem using object-oriented programming concepts. CO 2. Able to reuse the code with extensible Class types, User-defined operators and function Overloading. CO 3. Achieve code reusability and extensibility by means of Inheritance and Polymorphism CO 4. Identify and explore the Performance analysis of I/O Streams. CO 5. Implement the features of C++ including templates, exceptions and file handling for providing programmed solutions to complex problems.	
<b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together <b>Continuous Internal Evaluation:</b> Three Unit Tests each of <b>20 Marks (duration 01 hour)</b> 1. First test at the end of 5 <sup>th</sup> week of the semester 2. Second test at the end of the 10 <sup>th</sup> week of the semester 3. Third test at the end of the 15 <sup>th</sup> week of the semester Two assignments each of <b>10 Marks</b> 4. First assignment at the end of 4 <sup>th</sup> week of the semester 5. Second assignment at the end of 9 <sup>th</sup> week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b> 6. At the end of the 13 <sup>th</sup> week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b> (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). <b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b> <b>Semester End Examination:</b> Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 01 hours</b> ) SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours	

**Textbooks**

1. Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , Fourth Edition 2010.

**Reference Books**

1. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
2. Ray Lischner, "Exploring C++ : The programmer's introduction to C++" , apress, 2010
3. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004

**Weblinks and Video Lectures (e-Resources):**

1. Basics of C++ - <https://www.youtube.com/watch?v=BCIS40yzssA>
2. Functions of C++ - <https://www.youtube.com/watch?v=p8ehAjZWjPw>

**Tutorial Link:**

1. [https://www.w3schools.com/cpp/cpp\\_intro.asp](https://www.w3schools.com/cpp/cpp_intro.asp)
2. <https://www.edx.org/course/introduction-to-c-3>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- **Demonstration of simple projects**

## IV Semester

<b>MATHEMATICAL FOUNDATIONS FOR COMPUTING</b>			
Course Code:	<b>21CS41</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Understand an intense foundational introduction to fundamental concepts in discrete mathematics.</p> <p>CLO 2. Interpret, identify, and solve the language associated with logical structure, sets, relations and functions, modular arithmetic.</p> <p>CLO 3. To develop probability distribution of discrete and continuous random variables. Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> </ol> <p>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</p>			
<b>Module-1</b>			
<p><b>Fundamentals of Logic:</b> Basic Connectives and Truth Tables, Logical Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Fundamentals of Logic contd.: The Use of Quantifiers, Quantifiers, Definitions, and the Proofs of Theorems.</p> <p><b>Self-study:</b> Problems on Logical equivalence.</p>			
<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning		
<b>Module-2</b>			
<p><b>Relations and Functions:</b> Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. Function Composition, and Inverse Functions.</p> <p><b>Relations:</b> Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.</p> <p><b>Introduction to Graph Theory:</b> Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits.</p> <p><b>Self-study:</b> The Pigeon-hole Principle, problems and its applications</p>			
<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning		
<b>Module-3</b>			
<p><b>Statistical Methods:</b> Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.</p>			

**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form-  
 $y = ax + b$ ,  $y = ax^b$  and  $y = ax^2 + bx + c$

**Self-study:** Angle between two regression lines, problems. Fitting of the curve  $y = a b^x$

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Module-4**

**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)- Illustrative examples.

**Self-study:** exponential distribution.

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Module-5**

**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

**Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

**Self-Study:** Point estimation and interval estimation.

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Course Outcomes (Course Skill Set)**

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

- CO 1. Apply the concepts of logic for effective computation and relating problems in the Engineering domain.
- CO 2. Analyze the concepts of functions and relations to various fields of Engineering. Comprehend the concepts of Graph Theory for various applications of Computational sciences.
- CO 3. Apply discrete and continuous probability distributions in analysing the probability models arising in the engineering field.
- CO 4. Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO 5. Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

**Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Books**

1. Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition – 2007. ISBN 978-81-7758-424-0.
2. Higher Engineering Mathematics B. S. Grewal Khanna Publishers 44th Edition, 2017

**Reference Books:**

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, Sixth Edition, Sixth reprint 2008. ISBN-(13):978-0-07-064824-1.
2. C. L. Liu and D P Mohapatra, Elementary Discrete Mathematics, Tata- McGraw Hill, Sixth Edition, ISBN:10:0-07-066913-9.
3. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 35TH reprint 2008. ISBN 13:978-0-07-463113-3.
4. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995
5. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010
6. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014
7. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=9AUCdsmBGmA&list=PL0862D1A947252D20&index=10>
2. <https://www.youtube.com/watch?v=oU60TuGHxe0&list=PL0862D1A947252D20&index=11>
3. [https://www.youtube.com/watch?v=\\_BIKq9Xo\\_5A&list=PL0862D1A947252D20&index=13](https://www.youtube.com/watch?v=_BIKq9Xo_5A&list=PL0862D1A947252D20&index=13)
4. <https://www.youtube.com/watch?v=RMLR2JHHeWo&list=PL0862D1A947252D20&index=14>
5. [https://www.youtube.com/watch?v=nf9e0\\_ylGdc&list=PL0862D1A947252D20&index=15](https://www.youtube.com/watch?v=nf9e0_ylGdc&list=PL0862D1A947252D20&index=15)
6. <https://www.youtube.com/watch?v=7cTWea9YAJE&list=PL0862D1A947252D20&index=24>
7. <https://www.youtube.com/watch?v=695iAm935cY&list=PL0862D1A947252D20&index=25>
8. <https://www.youtube.com/watch?v=ZECJHfsf4Vs&list=PL0862D1A947252D20&index=26>
9. <https://www.youtube.com/watch?v=Dsi7x-A89Mw&list=PL0862D1A947252D20&index=28>
10. <https://www.youtube.com/watch?v=xlUFkMKS3Y&list=PL0862D1A947252D20>
11. <https://www.youtube.com/watch?v=0uTE24o3q-o&list=PL0862D1A947252D20&index=2>
12. <https://www.youtube.com/watch?v=DmClft8ypks&list=PL0862D1A947252D20&index=3>
13. <https://www.youtube.com/watch?v=jNeISigUCo0&list=PL0862D1A947252D20&index=4>
14. <http://nptel.ac.in/courses.php?disciplineID=111>
15. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
16. <http://academicearth.org/>
17. VTU EDUSAT PROGRAMME - 20

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**



## IV Semester

<b>DESIGN AND ANALYSIS OF ALGORITHMS</b>			
Course Code	<b>21CS42</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Explain the methods of analysing the algorithms and to analyze performance of algorithms.</p> <p>CLO 2. State algorithm's efficiencies using asymptotic notations.</p> <p>CLO 3. Solve problems using algorithm design methods such as the brute force method, greedy method, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking and branch and bound.</p> <p>CLO 4. Choose the appropriate data structure and algorithm design method for a specified application.</p> <p>CLO 5. Introduce P and NP classes.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Topics will be introduced in a multiple representation.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction:</b> What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework-Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency.</p> <p><b>Performance Analysis:</b> Estimating Space complexity and Time complexity of algorithms.</p> <p><b>Asymptotic Notations:</b> Big-Oh notation (<math>O</math>), Omega notation (<math>\Omega</math>), Theta notation (<math>\Theta</math>) with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples.</p> <p><b>Brute force design technique:</b> Selection sort, sequential search, string matching algorithm with complexity Analysis.</p> <p><b>Textbook 1:</b> Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)</p> <p><b>Textbook 2:</b> Chapter 1(section 1.1,1.2,1.3)</p>			
<b>Laboratory Component:</b>			



<p>1. Sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the brute force method works along with its time complexity analysis: worst case, average case and best case.</p>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Problem based Learning.</li> <li>2. Chalk &amp; board, Active Learning.</li> <li>3. Laboratory Demonstration.</li> </ol>
<b>Module-2</b>	
<p><b>Divide and Conquer:</b> General method, Recurrence equation for divide and conquer, solving it using Master's theorem. , Divide and Conquer algorithms and complexity Analysis of Finding the maximum &amp; minimum, Binary search, Merge sort, Quick sort.</p> <p><b>Decrease and Conquer Approach:</b> Introduction, Insertion sort, Graph searching algorithms, Topological Sorting. It's efficiency analysis.</p> <p><b>Textbook 2: Chapter 3(Sections 3.1,3.3,3.4,3.5,3.6)</b></p> <p><b>Textbook 1: Chapter 4 (Sections 4.1,4.2,4.3), Chapter 5(Section 5.1,5.2,5.3)</b></p>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.</li> <li>2. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.</li> </ol>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk &amp; board, Active Learning, MOOC, Problem based Learning.</li> <li>2. Laboratory Demonstration.</li> </ol>
<b>Module-3</b>	
<p><b>Greedy Method:</b> General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems.</p> <p><b>Minimum cost spanning trees:</b> Prim's Algorithm, Kruskal's Algorithm with performance analysis.</p> <p><b>Single source shortest paths:</b> Dijkstra's Algorithm.</p> <p><b>Optimal Tree problem:</b> Huffman Trees and Codes.</p> <p><b>Transform and Conquer Approach:</b> Introduction, Heaps and Heap Sort.</p> <p><b>Textbook 2: Chapter 4(Sections 4.1,4.3,4.5)</b></p> <p><b>Textbook 1: Chapter 9(Section 9.1,9.2,9.3,9.4), Chapter 6( section 6.4)</b></p>	
<b>Laboratory Component:</b>	

Write & Execute C++/Java Program

1. To solve Knapsack problem using Greedy method.
2. To find shortest paths to other vertices from a given vertex in a weighted connected graph, using Dijkstra's algorithm.
3. To find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
4. To find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.

**Teaching-Learning Process**

1. Chalk & board, Active Learning, MOOC, Problem based Learning.
2. Laboratory Demonstration.

#### **Module-4**

**Dynamic Programming:** General method with Examples, Multistage Graphs.

**Transitive Closure:** Warshall's Algorithm. **All Pairs Shortest Paths:** Floyd's Algorithm, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem.

**Space-Time Tradeoffs:** Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm.

**Textbook 2: Chapter 5 (Sections 5.1,5.2,5.4,5.9)**

**Textbook 1: Chapter 8(Sections 8.2,8.4), Chapter 7 (Sections 7.1,7.2)**

**Laboratory Component:**

Write C++/ Java programs to

1. Solve All-Pairs Shortest Paths problem using Floyd's algorithm.
2. Solve Travelling Sales Person problem using Dynamic programming.
3. Solve 0/1 Knapsack problem using Dynamic Programming method.

**Teaching-Learning Process**

1. Chalk & board, Active Learning, MOOC, Problem based Learning.
2. Laboratory Demonstration.

#### **Module-5**

**Backtracking:** General method, solution using back tracking to N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Problems.

**Branch and Bound:** Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem

**NP-Complete and NP-Hard problems:** Basic concepts, non- deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.

**Textbook 1: Chapter 12 (Sections 12.1,12.2) Chapter 11(11.3)**

**Textbook 2: Chapter 7 (Sections 7.1,7.2,7.3,7.4,7.5) Chapter 11 (Section 11.1)**

**Laboratory Component:**

1. Design and implement C++/Java Program to find a subset of a given set  $S = \{S_1, S_2, \dots, S_n\}$  of  $n$  positive integers whose SUM is equal to a given positive integer  $d$ . For example, if  $S = \{1, 2, 5, 6, 8\}$  and  $d = 9$ , there are two solutions  $\{1, 2, 6\}$  and  $\{1, 8\}$ . Display a suitable message, if the given problem instance doesn't have a solution.

2. Design and implement C++/Java Program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

**Teaching-Learning Process**

1. Chalk & board, Active Learning, MOOC, Problem based learning.
2. Laboratory Demonstration.

**Course outcome (Course Skill Set)**

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

- CO 1. Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze mathematically the complexity of the algorithm.
- CO 2. Apply divide and conquer approaches and decrease and conquer approaches in solving the problems analyze the same
- CO 3. Apply the appropriate algorithmic design technique like greedy method, transform and conquer approaches and compare the efficiency of algorithms to solve the given problem.
- CO 4. Apply and analyze dynamic programming approaches to solve some problems. and improve an algorithm time efficiency by sacrificing space.
- CO 5. Apply and analyze backtracking, branch and bound methods and to describe P, NP and NP-Complete problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

#### **Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

#### **Suggested Learning Resources:**

##### **Textbooks**

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

##### **Reference Books**

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

#### **Weblinks and Video Lectures (e-Resources):**

1. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html>
2. <https://nptel.ac.in/courses/106/101/106101060/>
3. <http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html>
4. <http://cse01-iiith.vlabs.ac.in/>
5. <http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification, Peasant, wolf, goat, cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solution to a problem through programming.

## IV Semester

<b>MICROCONTROLLER AND EMBEDDED SYSTEMS</b>			
Course Code	<b>21CS43</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<p><b>Course Learning Objectives:</b></p> <p>CLO 1: Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.</p> <p>CLO 2: Use the various instructions to program the ARM controller.</p> <p>CLO 3: Program various embedded components using the embedded C program.</p> <p>CLO 4: Identify various components, their purpose, and their application to the embedded system's applicability.</p> <p>CLO 5: Understand the embedded system's real-time operating system and its application in IoT.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>The lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to develop the outcomes.</li> <li>Show video/animation films to explain the functioning of various concepts.</li> <li>Encourage collaborative (group learning) learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in multiple representations.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world, and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p>Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.</p> <p><b>ARM Processor Fundamentals:</b> Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions</p> <p><b>Textbook 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5</b></p>			
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Using Keil software, observe the various registers, dump, CPSR, with a simple ALP programme.</li> </ol>			
<b>Teaching-Learning Process</b>		<ol style="list-style-type: none"> <li>Demonstration of registers, memory access, and CPSR in a programme module.</li> <li>For concepts, numerical, and discussion, use chalk and a whiteboard, as well as a PowerPoint presentation.</li> </ol>	
<b>Module-2</b>			
<p><b>Introduction to the ARM Instruction Set:</b> Data Processing Instructions , Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants</p> <p><b>C Compilers and Optimization :</b>Basic C Data Types, C Looping Structures, Register Allocation, Function</p>			

Calls, Pointer Aliasing,

**Textbook 1: Chapter 3: Sections 3.1 to 3.6 (Excluding 3.5.2), Chapter 5**

**Laboratory Component:**

2. Write a program to find the sum of the first 10 integer numbers.
3. Write a program to find the factorial of a number.
4. Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM.
5. Write a program to find the square of a number (1 to 10) using a look-up table.
6. Write a program to find the largest or smallest number in an array of 32 numbers.

**Teaching-Learning Process**

1. Demonstration of sample code using Keil software.
2. Laboratory Demonstration

**Module-3**

**C Compilers and Optimization :**Structure Arrangement, Bit-fields, Unaligned Data and Endianness, Division, Floating Point, Inline Functions and Inline Assembly, Portability Issues.

**ARM programming using Assembly language:** Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs

**Textbook 1: Chapter-5,6**

**Laboratory Component:**

1. Write a program to arrange a series of 32 bit numbers in ascending/descending order.
2. Write a program to count the number of ones and zeros in two consecutive memory locations.
3. Display "Hello World" message using Internal UART.

**Teaching-Learning Process**

1. Demonstration of sample code using Keil software.
2. Chalk and Board for numerical

**Module-4**

**Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems.

Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.

**Textbook 2: Chapter 1 (Sections 1.2 to 1.6), Chapter 2 (Sections 2.1 to 2.6)**

**Laboratory Component:**

1. Interface and Control a DC Motor.
2. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
3. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
4. Interface a DAC and generate Triangular and Square waveforms.
5. Interface a 4x4 keyboard and display the key code on an LCD.
6. Demonstrate the use of an external interrupt to toggle an LED On/Off.
7. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

**Teaching-Learning Process**

1. Demonstration of sample code for various embedded components using keil.
2. Chalk and Board for numerical and discussion

**Module-5**

**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization

issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.

**Textbook 2: Chapter-10 (Sections 10.1, 10.2, 10.3, 10.4 , 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Chapter 12, Chapter-13 ( block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)**

**Laboratory Component:**

1. Demonstration of IoT applications by using Arduino and Raspberry Pi

**Teaching-Learning Process**

1. Chalk and Board for numerical and discussion
2. Significance of real time operating system[RTOS] using raspberry pi

**Course outcome (Course Skill Set)**

At the end of the course, the student will be able to:

- CO 1. Explain C-Compilers and optimization
- CO 2. Describe the ARM microcontroller's architectural features and program module.
- CO 3. Apply the knowledge gained from programming on ARM to different applications.
- CO 4. Program the basic hardware components and their application selection method.
- CO 5. Demonstrate the need for a real-time operating system for embedded system applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2<sup>nd</sup> Edition.

**Reference Books**

1. Raghunandan. G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

**Weblinks and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**



## IV Semester

<b>OPERATING SYSTEMS</b>			
Course Code:	<b>21CS44</b>	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Demonstrate the need for OS and different types of OS</p> <p>CLO 2. Apply suitable techniques for management of different resources</p> <p>CLO 3. Use processor, memory, storage and file system commands</p> <p>CLO 4. Realize the different concepts of OS in platform of usage through case studies</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction to operating systems, System structures:</b> What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.</p> <p><b>Operating System Services:</b> User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot.</p> <p><b>Process Management:</b> Process concept; Process scheduling; Operations on processes; Inter process communication</p>			
<b>Textbook 1: Chapter - 1,2,3</b>			
<b>Teaching-Learning Process</b>	<p>Active learning and problem solving</p> <ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=vBURTt97EkA&amp;list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2Q">https://www.youtube.com/watch?v=vBURTt97EkA&amp;list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2Q</a></li> <li><a href="https://www.youtube.com/watch?v=a2B69vCtjOU&amp;list=PL3-wYxht4yCjpcfUDz-TgD_ainZ2K3MUZ&amp;index=2">https://www.youtube.com/watch?v=a2B69vCtjOU&amp;list=PL3-wYxht4yCjpcfUDz-TgD_ainZ2K3MUZ&amp;index=2</a></li> </ol>		
<b>Module-2</b>			
<p><b>Multi-threaded Programming:</b> Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor</p>			

scheduling; Thread scheduling.	
<b>Process Synchronization:</b> Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	
<b>Textbook 1: Chapter - 4,5</b>	
<b>Teaching-Learning Process</b>	Active Learning and problem solving 1. <a href="https://www.youtube.com/watch?v=HW2Wcx-ktsc">https://www.youtube.com/watch?v=HW2Wcx-ktsc</a> 2. <a href="https://www.youtube.com/watch?v=9YRxlvt9Zo">https://www.youtube.com/watch?v=9YRxlvt9Zo</a>
<b>Module-3</b>	
<b>Deadlocks:</b> Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	
<b>Memory Management:</b> Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.	
<b>Textbook 1: Chapter - 7,8</b>	
<b>Teaching-Learning Process</b>	Active Learning, Problem solving based on deadlock with animation 1. <a href="https://www.youtube.com/watch?v=MYgmmJJfdBg">https://www.youtube.com/watch?v=MYgmmJJfdBg</a> 2. <a href="https://www.youtube.com/watch?v=Y14b7_T3AEw&amp;list=PLEJxKK7AcSEGPOCFtQTJhOEIU44J_JAun&amp;index=30">https://www.youtube.com/watch?v=Y14b7_T3AEw&amp;list=PLEJxKK7AcSEGPOCFtQTJhOEIU44J_JAun&amp;index=30</a>
<b>Module-4</b>	
<b>Virtual Memory Management:</b> Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.	
<b>File System, Implementation of File System:</b> File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.	
<b>Textbook 1: Chapter - 9,10,11</b>	
<b>Teaching-Learning Process</b>	Active learning about memory management and File system 1. <a href="https://www.youtube.com/watch?v=pl6qrCB8pDw&amp;list=PLIY8eNdw5tW-BxRY0yK3fTYVqytw8qhp">https://www.youtube.com/watch?v=pl6qrCB8pDw&amp;list=PLIY8eNdw5tW-BxRY0yK3fTYVqytw8qhp</a> 2. <a href="https://www.youtube.com/watch?v=-orfHvNBzY">https://www.youtube.com/watch?v=-orfHvNBzY</a>
<b>Module-5</b>	
<b>Secondary Storage Structures, Protection:</b> Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems.	
<b>Case Study: The Linux Operating System:</b> Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.	
<b>Textbook 1: Chapter - 2,21</b>	
<b>Teaching-Learning Process</b>	Active learning about case studies 1. <a href="https://www.youtube.com/watch?v=TTBkc5eiju4">https://www.youtube.com/watch?v=TTBkc5eiju4</a> 2. <a href="https://www.youtube.com/watch?v=8hkvMRGTzCM&amp;list=PLEAYkSg4uSQ2PAch478muxnoeTNz_QeUJ&amp;index=36">https://www.youtube.com/watch?v=8hkvMRGTzCM&amp;list=PLEAYkSg4uSQ2PAch478muxnoeTNz_QeUJ&amp;index=36</a> 3. <a href="https://www.youtube.com/watch?v=mX1FEur4VCw">https://www.youtube.com/watch?v=mX1FEur4VCw</a>
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Identify the structure of an operating system and its scheduling mechanism.	

- CO 2. Demonstrate the allocation of resources for a process using scheduling algorithm.
- CO 3. Identify root causes of deadlock and provide the solution for deadlock elimination
- CO 4. Explore about the storage structures and learn about the Linux Operating system.
- CO 5. Analyze Storage Structures and Implement Customized Case study

### Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

#### Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

#### Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

### Suggested Learning Resources:

#### Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006

#### Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhare, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

#### Weblinks and Video Lectures (e-Resources):

1. [https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEygRiVhbXDGLXDk\\_OQAeuVcp2O](https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEygRiVhbXDGLXDk_OQAeuVcp2O)
2. <https://www.youtube.com/watch?v=783KAB->

- tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMROYE\_f
3. <https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeR-n6mk0>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Role play for process scheduling.
- Present animation for Deadlock.
- Real world examples of memory management concepts

#### IV Semester

PYTHON PROGRAMMING LABORATORY			
Course Code	21CSL46	CIE Marks	50
Teaching Hours/Weeks (L: T: P: S)	0: 0: 2: 0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	01	Exam Hours	03
<b>Course Objectives:</b> CLO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications CLO 2. Using Python programming language to develop programs for solving real-world problems CLO 3. Implement the Object-Oriented Programming concepts in Python. CLO 4. Appraise the need for working with various documents like Excel, PDF, Word and Others CLO 5. Demonstrate regular expression using python programming			
<b>Note: two hours tutorial is suggested for each laboratory sessions.</b>			
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>• Students should be familiarized about Python installation and setting Python environment</li> <li>• Usage of IDLE or IDE like PyCharm should be introduced                Python Installation: <a href="https://www.youtube.com/watch?v=Kn1HF3oD19c">https://www.youtube.com/watch?v=Kn1HF3oD19c</a>                PyCharm Installation: <a href="https://www.youtube.com/watch?v=SZUNUB6nz3g">https://www.youtube.com/watch?v=SZUNUB6nz3g</a> </li> </ul>			
<b>Sl. No.</b>	<b>PART A – List of problems for which student should develop program and execute in the Laboratory</b>		
1	<b>Aim:</b> Introduce the Python fundamentals, data types, operators, flow control and exception handling in Python  a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user. b) Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.  Datatypes: <a href="https://www.youtube.com/watch?v=gCCVsvgR2KU">https://www.youtube.com/watch?v=gCCVsvgR2KU</a> Operators: <a href="https://www.youtube.com/watch?v=v5MR5JnKcZI">https://www.youtube.com/watch?v=v5MR5JnKcZI</a> Flow Control: <a href="https://www.youtube.com/watch?v=PqFKRqpHrjw">https://www.youtube.com/watch?v=PqFKRqpHrjw</a> For loop: <a href="https://www.youtube.com/watch?v=0ZvaDa8eT5s">https://www.youtube.com/watch?v=0ZvaDa8eT5s</a> While loop: <a href="https://www.youtube.com/watch?v=HZARlmviDxg">https://www.youtube.com/watch?v=HZARlmviDxg</a> Exceptions: <a href="https://www.youtube.com/watch?v=6SPDvPK38tw">https://www.youtube.com/watch?v=6SPDvPK38tw</a>		
2	<b>Aim:</b> Demonstrating creation of functions, passing parameters and return values  a) Defined as a function F as $F_n = F_{n-1} + F_{n-2}$ . Write a Python program which accepts a value for N (where $N > 0$ ) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed. b) Develop a python program to convert binary to decimal, octal to hexadecimal using functions.  Functions: <a href="https://www.youtube.com/watch?v=BVfCWuca9nw">https://www.youtube.com/watch?v=BVfCWuca9nw</a> Arguments: <a href="https://www.youtube.com/watch?v=ijXMGpoMkhQ">https://www.youtube.com/watch?v=ijXMGpoMkhQ</a> Return value: <a href="https://www.youtube.com/watch?v=nuNXiEDnM44">https://www.youtube.com/watch?v=nuNXiEDnM44</a>		
3	<b>Aim:</b> Demonstration of manipulation of strings using string methods  a) Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.		

	<p>b) Write a Python program to find the string similarity between two given strings</p> <p><b>Sample Output:</b>  Original string:  Python Exercises  Python Exercises  Similarity between two said strings:  1.0</p> <p><b>Sample Output:</b>  Original string:  Python Exercises  Python Exercise  Similarity between two said strings:  0.967741935483871</p> <p>Strings: <a href="https://www.youtube.com/watch?v=ISItwlnF0eU">https://www.youtube.com/watch?v=ISItwlnF0eU</a>  String functions: <a href="https://www.youtube.com/watch?v=9a3CxJyTq00">https://www.youtube.com/watch?v=9a3CxJyTq00</a></p>
4	<p><b>Aim:</b> Discuss different collections like list, tuple and dictionary</p> <p>a) Write a python program to implement insertion sort and merge sort using lists  b) Write a program to convert roman numbers in to integer values using dictionaries.</p> <p>Lists: <a href="https://www.youtube.com/watch?v=Eaz5e6M8tL4">https://www.youtube.com/watch?v=Eaz5e6M8tL4</a>  List methods: <a href="https://www.youtube.com/watch?v=8-RDVWGktuI">https://www.youtube.com/watch?v=8-RDVWGktuI</a>  Tuples: <a href="https://www.youtube.com/watch?v=bdS4dHIJGbc">https://www.youtube.com/watch?v=bdS4dHIJGbc</a>  Tuple operations: <a href="https://www.youtube.com/watch?v=TItKabcTTQ4">https://www.youtube.com/watch?v=TItKabcTTQ4</a>  Dictionary: <a href="https://www.youtube.com/watch?v=4Q0pW8XB0kc">https://www.youtube.com/watch?v=4Q0pW8XB0kc</a>  Dictionary methods: <a href="https://www.youtube.com/watch?v=oLeNHuORpNY">https://www.youtube.com/watch?v=oLeNHuORpNY</a></p>
5	<p><b>Aim:</b> Demonstration of pattern recognition with and without using regular expressions</p> <p>a) Write a function called isphonenumber () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression.  b) Develop a python program that could search the text in a file for phone numbers (+919900889977) and email addresses (<a href="mailto:sample@gmail.com">sample@gmail.com</a>)</p> <p>Regular expressions: <a href="https://www.youtube.com/watch?v=LnzFnZfHLS4">https://www.youtube.com/watch?v=LnzFnZfHLS4</a></p>
6	<p><b>Aim:</b> Demonstration of reading, writing and organizing files.</p> <p>a) Write a python program to accept a file name from the user and perform the following operations</p> <ol style="list-style-type: none"> <li>1. Display the first N line of the file</li> <li>2. Find the frequency of occurrence of the word accepted from the user in the file</li> </ol> <p>b) Write a python program to create a ZIP file of a particular folder which contains several files inside it.</p> <p>Files: <a href="https://www.youtube.com/watch?v=vuyb7CxZgbU">https://www.youtube.com/watch?v=vuyb7CxZgbU</a>  <a href="https://www.youtube.com/watch?v=FqcjKewJTQ0">https://www.youtube.com/watch?v=FqcjKewJTQ0</a></p> <p>File organization: <a href="https://www.youtube.com/watch?v=MRuq3SRXses">https://www.youtube.com/watch?v=MRuq3SRXses</a></p>
7	<p><b>Aim:</b> Demonstration of the concepts of classes, methods, objects and inheritance</p>

	<p>a) By using the concept of inheritance write a python program to find the area of triangle, circle and rectangle.</p> <p>b) Write a python program by creating a class called Employee to store the details of Name, Employee_ID, Department and Salary, and implement a method to update salary of employees belonging to a given department.</p> <p>OOP's concepts: <a href="https://www.youtube.com/watch?v=qiSCMNBIP2g">https://www.youtube.com/watch?v=qiSCMNBIP2g</a>  Inheritance: <a href="https://www.youtube.com/watch?v=Cn7AkDb4pIU">https://www.youtube.com/watch?v=Cn7AkDb4pIU</a></p>
8	<p><b>Aim:</b> Demonstration of classes and methods with polymorphism and overriding</p> <p>a) Write a python program to find the whether the given input is palindrome or not (for both string and integer) using the concept of polymorphism and inheritance.</p> <p>Overriding: <a href="https://www.youtube.com/watch?v=CcTzTuIsoFk">https://www.youtube.com/watch?v=CcTzTuIsoFk</a></p>
9	<p><b>Aim:</b> Demonstration of working with excel spreadsheets and web scraping</p> <p>a) Write a python program to download the all XKCD comics</p> <p>b) Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet</p> <p>Web scraping: <a href="https://www.youtube.com/watch?v=ng2o98k983k">https://www.youtube.com/watch?v=ng2o98k983k</a></p> <p>Excel: <a href="https://www.youtube.com/watch?v=nsKNPHJ9iPc">https://www.youtube.com/watch?v=nsKNPHJ9iPc</a></p>
10	<p><b>Aim:</b> Demonstration of working with PDF, word and JSON files</p> <p>a) Write a python program to combine select pages from many PDFs</p> <p>b) Write a python program to fetch current weather data from the JSON file</p> <p>PDFs: <a href="https://www.youtube.com/watch?v=q70xzDG6nls">https://www.youtube.com/watch?v=q70xzDG6nls</a>  <a href="https://www.youtube.com/watch?v=JhQVD7Y1bsA">https://www.youtube.com/watch?v=JhQVD7Y1bsA</a>  <a href="https://www.youtube.com/watch?v=FcrW-ESdY-A">https://www.youtube.com/watch?v=FcrW-ESdY-A</a></p> <p>Word files: <a href="https://www.youtube.com/watch?v=ZU3cSl51jWE">https://www.youtube.com/watch?v=ZU3cSl51jWE</a></p> <p>JSON files: <a href="https://www.youtube.com/watch?v=9N6a-VLba2I">https://www.youtube.com/watch?v=9N6a-VLba2I</a></p>
<b>Python (Full Course):</b> <a href="https://www.youtube.com/watch?v=_uQrJ0TkZlc">https://www.youtube.com/watch?v=_uQrJ0TkZlc</a>	
<b>Pedagogy</b>	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk
<b>PART B – Practical Based Learning</b>	
A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.	
<b>Course Outcomes:</b>	
CO 1. Demonstrate proficiency in handling of loops and creation of functions. CO 2. Identify the methods to create and manipulate lists, tuples and dictionaries. CO 3. Discover the commonly used operations involving regular expressions and file system. CO 4. Interpret the concepts of Object-Oriented Programming as used in Python. CO 5. Determine the need for scraping websites and working with PDF, JSON and other file formats.	

### **Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

### **Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

### **Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*



- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks:**

1. Al Sweigart, "**Automate the Boring Stuff with Python**", 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>)
2. Reema Thareja "**Python Programming Using Problem Solving Approach**" Oxford University Press.
3. Allen B. Downey, "**Think Python: How to Think Like a Computer Scientist**", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>)

## IV Semester

<b>WEB PROGRAMMING (Practical based)</b>			
Course Code	<b>21CSL481</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
CLO 1. Learn Web tool box and history of web browsers.			
CLO 2. Learn HTML, XHTML tags with utilizations.			
CLO 3. Know CSS with dynamic document utilizations.			
CLO 4. Learn JavaScript with Element access in JavaScript.			
CLO 5. Logically plan and develop web pages..			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to WEB Programming:</b> Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security, The Web Programmers Toolbox.			
<b>Textbook 1: Chapter 1(1.1 to 1.9)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>HTML and XHTML:</b> Origins of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links, Lists, Tables. Forms, Frames in HTML and XHTML, Syntactic differences between HTML and XHTML.			
<b>Textbook 1: Chapter 2(2.1 to 2.10)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>CSS:</b> Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, Background images, tags.			
<b>Textbook 1: Chapter 3(3.1 to 3.12)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Java Script - I:</b> Object orientation and JavaScript; General syntactic characteristics; Primitives,			

Operations, and expressions; Screen output and keyboard input.

**Textbook 1: Chapter 4(4.1 to 4.5)**

<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
----------------------------------	--

**Module-5**

**Java Script – II:** Control statements, Object creation and Modification; Arrays; Functions; Constructor; Pattern matching using expressions; Errors, Element access in JavaScript.

**Textbook 1: Chapter 4(4.6 to 4.14)**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes (Course Skill Set):**

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

- CO 1. Describe the fundamentals of web and concept of HTML.
- CO 2. Use the concepts of HTML, XHTML to construct the web pages.
- CO 3. Interpret CSS for dynamic documents.
- CO 4. Evaluate different concepts of JavaScript & Construct dynamic documents.
- CO 5. Design a small project with JavaScript and XHTML.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation (CIE):**

**NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

#### **Textbooks**

1. Robert W Sebesta, "Programming the World Wide Web", 6th Edition, Pearson Education, 2008.

#### **Reference Books**

1. M.Deitel, P.J.Deitel, A.B.Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education / PHI, 2004.
2. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006.
3. Xue Bai et al, "The Web Warrior Guide to Web Programming", Thomson, 2003.
4. Sklar, "The Web Warrior Guide to Web Design Technologies", 1st Edition, Cengage Learning India

#### **Weblinks and Video Lectures (e-Resources):**

1. Fundamentals of WEB Programming: <https://www.youtube.com/watch?v=DR9dr6gxhDM>
2. HTML and XHTML: <https://www.youtube.com/watch?v=A1XIIDDXgwg>
3. CSS: <https://www.youtube.com/watch?v=J35jug1uHzE>
4. Java Script and HTML Documents: <https://www.youtube.com/watch?v=Gd0RBdFRvF0>
5. Dynamic Documents with JavaScript: <https://www.youtube.com/watch?v=HTFSIJALNKc>

#### **Tutorial Link:**

1. <http://www.tutorialspoint.com>
2. <http://www.w3schools.com>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects

## IV Semester

<b>UNIX SHELL PROGRAMMING</b>			
Course Code	<b>21CS482</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
CLO 1. To help the students to understand effective use of Unix concepts, commands and terminology.			
CLO 2. Identify, access, and evaluate UNIX file system.			
CLO 3. Understand UNIX command syntax and semantics.			
CLO 4. Ability to read and understand specifications, scripts and programs.			
CLO 5. Analyze Facility with UNIX Process.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction of UNIX</b> - Introduction, History, Architecture, Experience the Unix environment, Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, and bc.			
<b>Textbook 1: Chapter 1(1.1 to 1.4) , Chapter 2- 2.1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>UNIX File System-</b> The file, what's in a filename? The parent-child relationship, pwd, the Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames, The UNIX file system.			
<b>Textbook 1: Chapter 4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Basic File Attributes - Is - l, the -d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find.</b>			
<b>Textbook 1: Chapter 6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Introduction to the Shell Scripting</b> - Introduction to Shell Scripting, Shell Scripts, read, Command Line			

Arguments, Exit Status of a Command, The Logical Operators && and ||, exit, if, and case conditions, expr, sleep and wait, while, until, for, \$, @, redirection. The here document, set, trap, Sample Validation and Data Entry Scripts.

**Textbook 1: Chapter 11,12,14**

<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
----------------------------------	--

**Module-5**

**Introduction to UNIX System process:** Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file.. Signals.

**Textbook 1: Chapter 9,19**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes (Course Skill Set):**

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

- CO 1. Know the basics of Unix concepts and commands.
- CO 2. Evaluate the UNIX file system.
- CO 3. Apply Changes in file system.
- CO 4. Understand scripts and programs.
- CO 5. Analyze Facility with UNIX system process

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

**Theory SEE** will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours**)

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours

**Textbooks**

- 1. Unix Concepts & Applications 4rth Edition, Sumitabha Das, Tata McGraw Hill

References:

2. Unix Shell Programming, Yashwant Kanetkar
3. Introduction to UNIX by M G Venkatesh Murthy.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=ffYUfAqEamY>
2. <https://www.youtube.com/watch?v=Q05NZiYFcD0>
3. <https://www.youtube.com/watch?v=8GdT53KDIyY>
4. <https://www.youtube.com/watch?app=desktop&v=3Pga3y7rCgo>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Real world examples of Linux operating system Utilizations.

## IV Semester

<b>R PROGRAMMING (Practical based)</b>			
Course Code	<b>21CSL483</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
CLO 1. Explore and understand how R and R Studio interactive environment.			
CLO 2. To learn and practice programming techniques using R programming.			
CLO 3. Read Structured Data into R from various sources.			
CLO 4. Understand the different data Structures, data types in R.			
CLO 5. To develop small applications using R Programming			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Numeric, Arithmetic, Assignment, and Vectors:</b> R for Basic Math, Arithmetic, Variables, Functions, Vectors, Expressions and assignments Logical expressions.			
<b>Textbook 1: Chapter 2(2.1 to 2.7)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Matrices and Arrays:</b> Defining a Matrix, Sub-setting, Matrix Operations, <b>Conditions and Looping:</b> if statements, looping with for, looping with while, vector based programming.			
<b>Textbook 1: Chapter 2- 2.8, chapter 3- 3.2 to 3.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Lists and Data Frames:</b> Data Frames, <b>Lists</b> , Special values, The apply family.			
<b>Textbook 1: Chapter 6- 6.2 to 6.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Functions:</b> Calling functions, scoping, Arguments matching, writing functions: The function command, Arguments, specialized function.			
<b>Textbook 1: Chapter 5- 5.1 to 5.6</b>			



<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
<b>Module-5</b>	
Pointers: packages, frames, de bugging, manipulation of code, compilation of the code.	
<b>Textbook 1: Chapter 8- 8.1 to 8.8</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. To understand the fundamental syntax of R through readings, practice exercises, CO 2. To demonstrations, and writing R code. CO 3. To apply critical programming language concepts such as data types, iteration, CO 4. To understand control structures, functions, and Boolean operators by writing R programs and through examples CO 5. To import a variety of data formats into R using R-Studio CO 6. To prepare or tidy data for in preparation for analyze.	
<b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> <b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . <ul style="list-style-type: none"> <li>Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>Weightage to be given for neatness and submission of record/write-up on time.</li> <li>Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul> The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b> <ul style="list-style-type: none"> <li>SEE marks for the practical course is 50 Marks.</li> <li>SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University</li> <li>All laboratory experiments are to be included for practical examination.</li> <li>(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. <b>OR</b> based on the course requirement evaluation rubrics shall be decided jointly by examiners.</li> <li>Students can pick one question (experiment) from the questions lot prepared by the internal</li> </ul>	

/external examiners jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks**

1. Jones, O., Maillardet. R. and Robinson, A. (2014). Introduction to Scientific Programming and Simulation Using R. Chapman & Hall/CRC, The R Series.

**References:**

1. Michael J. Crawley, "Statistics: An Introduction using R", Second edition, Wiley,2015

**Weblinks and Video Lectures (e-Resources):**

1. Wickham, H. & Grolemund, G. (2018). for Data Science. O'Reilly: New York. Available for free at <http://r4ds.had.co.nz>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects

## V Semester

<b>AUTOMATA THEORY AND COMPILER DESIGN</b>			
Course Code	<b>21CS51</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design</p> <p>CLO 2. Principles Demonstrate Application of Automata Theory and Formal Languages in the field of compiler design</p> <p>CLO 3. Develop understanding of computation through Push Down Automata and Turing Machines</p> <p>CLO 4. Introduce activities carried out in different phases of Phases compiler</p> <p>CLO 5. Identify the undecidability problems.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different approaches and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction to Automata Theory:</b> Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA</p> <p><b>Introduction to Compiler Design:</b> Language Processors, Phases of Compilers</p> <p><b>Textbook 1: Chapter1 – 1.5, Chapter2 – 2.2,2.3,2.5 Chapter4 –4.4</b></p> <p><b>Textbook 2: Chapter1 – 1.1 and 1.2</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<p><b>Regular Expressions and Languages:</b> Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular</p> <p><b>Lexical Analysis Phase of compiler Design:</b> Role of Lexical Analyzer, Input Buffering , Specification of Token, Recognition of Token.</p> <p><b>Textbook 1: Chapter3 – 3.1, 3.2, Chapter4- 4.1</b></p>			

<b>Textbook 2: Chapter3- 3.1 to 3.4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<b>Context Free Grammars:</b> Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring.	
<b>Syntax Analysis Phase of Compilers: part-1:</b> Role of Parser , Top-Down Parsing	
<b>Textbook 1: Chapter 5 – 5.1.1 to 5.1.6, 5.2 (5.2.1, 5.2.2), 5.4</b>	
<b>Textbook 2: Chapter 4 – 4.1, 4.2, 4.3 (4.3.2 to 4.3.4) ,4.4</b>	
<b>Teaching-Learning Process</b>	<b>Chalk and board, Problem based learning, Demonstration</b>
<b>Module-4</b>	
<b>Push Down Automata:</b> Definition of the Pushdown Automata, The Languages of a PDA.	
<b>Syntax Analysis Phase of Compilers: Part-2:</b> Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers	
<b>Textbook1: Chapter 6 – 6.1, 6.2</b>	
<b>Textbook2: Chapter 4 – 4.5, 4.6, 4.7 (Up to 4.7.4)</b>	
<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning
<b>Module-5</b>	
<b>Introduction to Turing Machine:</b> Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine	
<b>Undecidability :</b> A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE.	
<b>Other Phases of Compilers: Syntax Directed Translation-</b> Syntax-Directed Definitions, Evaluation Orders for SDD's. <b>Intermediate-Code Generation-</b> Variants of Syntax Trees, Three-Address Code.	
<b>Code Generation-</b> Issues in the Design of a Code Generator	
<b>Textbook1: Chapter 8 – 8.1, 8.2,8.3,8.4 Chapter 9 – 9.1,9.2</b>	
<b>Textbook2: Chapter 5 – 5.1, 5.2, Chapter 6- 6.1,6.2 Chapter 8- 8.1</b>	
<b>Teaching-Learning Process</b>	<b>Chalk and board, MOOC</b>
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation	
CO 2. Design and develop lexical analyzers, parsers and code generators	
CO 3. Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.	
CO 4. Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers	
CO 5. Design computations models for problems in Automata theory and adaptation of such model in the field of compilers	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination	

(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4<sup>th</sup> week of the semester
2. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

1. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, " Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson.
2. Alfred V.Aho, Monica S.Lam,Ravi Sethi, Jeffrey D. Ullman, " Compilers Principles, Techniques and Tools", Second Edition,Perason.

**Reference:**

1. Elain Rich, "Automata,Computability and complexity", 1st Edition, Pearson Education,2018.
2. K.L.P Mishra, N Chandrashekar, 3rd Edition, "Theory of Computer Science",PHI,2012.
3. Peter Linz, "An introduction to Formal Languages and Automata ", 3rd Edition, Narosa Publishers,1998.
4. K Muneeswaran, "Compiler Design", Oxford University Press 2013.

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/106/106106049/#>
2. <https://nptel.ac.in/courses/106/104/106104123/>
3. <https://www.jflap.org/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Group Activities, quizzes, Puzzles and presentations

**V Semester**

<b>COMPUTER NETWORKS</b>			
Course Code:	21CS52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40T + 20P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Fundamentals of data communication networks.  CLO 2. Software and hardware interfaces  CLO 3. Application of various physical components and protocols  CLO 4. Communication challenges and remedies in the networks.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to networks:</b> Network hardware, Network software, Reference models,			
<b>Physical Layer:</b> Guided transmission media, Wireless transmission			
<b>Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>Implement Three nodes point - to - point network with duplex links between them for different topologies. 1Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations.</li> </ol>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-2</b>			
<b>The Data link layer:</b> Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols.			
<b>The medium access control sublayer:</b> The channel allocation problem, Multiple access protocols.			
<b>Textbook 1: Ch.3.1 to 3.4, Ch.4.1 and 4.2</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the throughput with respect to transmission of packets</li> <li>Write a program for error detecting code using CRC-CCITT (16- bits).</li> </ol>			

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-3</b>	
<b>The Network Layer:</b> Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS.	
<b>Textbook 1: Ch 5.1 to 5.4</b>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network.</li> <li>2. Write a program to find the shortest path between vertices using bellman-ford algorithm.</li> </ol>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>The Transport Layer:</b> The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols.	
<b>Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7</b>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.</li> <li>2. Write a program for congestion control using leaky bucket algorithm.</li> </ol>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-5</b>	
<b>Application Layer:</b> Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.	
<b>Textbook 2: Ch 2.1 to 2.4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
<ol style="list-style-type: none"> <li>CO 1. Learn the basic needs of communication system.</li> <li>CO 2. Interpret the communication challenges and its solution.</li> <li>CO 3. Identify and organize the communication system network components</li> <li>CO 4. Design communication networks for user requirements.</li> </ol>	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to <b>20 marks</b> .	
<i>Note: Minimum of 80% of the laboratory components have to be covered.</i>	

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Computer-Networks- Andrew S. Tanenbaum and David J. Wetherall, Pearson Education, 5th-Edition. ([www.pearsonhighered.com/tanenbaum](http://www.pearsonhighered.com/tanenbaum))
2. Computer Networking A Top-Down Approach -James F. Kurose and Keith W. RossPearson Education 7<sup>th</sup> Edition.

**Reference Books:**

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill,Indian Edition
2. Larry L Peterson and Bruce S Davie, Computer Networks, fifth edition, ELSEVIER

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.digimat.in/nptel/courses/video/106105183/L01.html>
2. <http://www.digimat.in/nptel/courses/video/106105081/L25.html>
3. <https://nptel.ac.in/courses/106105081>
4. VTU e-Shikshana Program

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Simulation of Personal area network, Home area network, achieve QoS etc.

**Note:** For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and conclude using NS2. Installation procedure of the required software must be demonstrated, carried out in groups, and documented in the report. Non simulation programs can be implemented using Java



## V Semester

<b>DATA BASE MANAGEMENT SYSTEMS</b>			
Course Code	21CS53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. Provide a strong foundation in database concepts, technology, and practice. CLO 2. Practice SQL programming through a variety of database problems. CLO 3. Demonstrate the use of concurrency and transactions in database CLO 4. Design and build database applications for real world problems.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Databases:</b> Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.			
<b>Overview of Database Languages and Architectures:</b> Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.			
<b>Conceptual Data Modelling using Entities and Relationships:</b> Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples			
<b>Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Relational Model:</b> Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.			
<b>Relational Algebra:</b> Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.			
<b>Mapping Conceptual Design into a Logical Design:</b> Relational Database Design using ER-to-Relational			

mapping.

**Textbook 1:, Ch 5.1 to 5.3, 8.1 to 8.5, 9.1;**

**Teaching-Learning Process**

Chalk and board, Active Learning, Demonstration

**Module-3**

**SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

**Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.

Database

**Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

**Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;**

**Teaching-Learning Process**

Chalk and board, Problem based learning, Demonstration

**Module-4**

**Normalization: Database Design Theory** – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.

**Normalization Algorithms:** Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

**Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6**

**Teaching-Learning Process**

Chalk& board, Problem based learning

**Module-5**

**Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

**Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

**Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;**

**Teaching-Learning Process**

Chalk and board, MOOC

**Course Outcomes**

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

- CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS
- CO 2. Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.
- CO 3. Design and build simple database systems and *relate* the concept of transaction, concurrency control and recovery in database
- CO 4. Develop application to interact with databases, relational algebra expression.
- CO 5. Develop applications using tuple and domain relation expression from queries.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Reference Books:**

NIL

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=Hl4NZB1XR9c>
7. [https://www.youtube.com/watch?v=EGEwkad\\_lIA](https://www.youtube.com/watch?v=EGEwkad_lIA)
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Demonstration of real time Database projects** - E-commerce Platform, Inventory Management, Railway System, College Data Management, Library Data Management, Solution for Saving Student Records, Hospital Data Management, Blood Donation Management.

<b>PRINCIPLES OF ARTIFICIAL INTELLIGENCE</b>			
Course Code	21AI54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Gain a historical perspective of AI and its foundations</p> <p>CLO 2. Become familiar with basic principles of AI toward problem solving</p> <p>CLO 3. Get to know approaches of inference, perception, Uncertain Knowledge and Reasoning</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Topics will be introduced in a multiple representation.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b> What is AI? Foundations and History of AI			
<b>Intelligent Agents:</b> Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.			
<b>Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning.		
<b>Module-2</b>			
<b>Problem-solving:</b> Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search;			
<b>Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Informed Search Strategies:</b> Heuristic functions, Greedy best first search, A*search. Heuristic Functions			
<b>Logical Agents:</b> Knowledge-based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic			
<b>Text book 1: Chapter 4 - 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		

<b>Process</b>	
<b>Module-4</b>	
<b>First Order Logic:</b> Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic.	
<b>Inference in First Order Logic :</b> Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution	
<b>Text book 1: Chapter 8- 8.1, 8.2, 8.3 Chapter 9- 9.1, 9.2, 9.3, 9.4, 9.5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-5</b>	
<b>Uncertain Knowledge and Reasoning: Quantifying Uncertainty:</b> Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye’s Rule and its use. Wumpus World Revisited	
<b>Text Book 1: Chapter 13-13.1, 13.2, 13.3, 13.4, 13.5, 13.6</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning.
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Apply knowledge of agent architecture, searching and reasoning techniques for different applications.	
CO 2. Analyse Searching and Inferencing Techniques.	
CO 3. Develop knowledge base sentences using propositional logic and first order logic	
CO 4. Demonstrating agents, searching and inferencing	
CO 5. Illustrate the application of probability in uncertain reasoning.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours) OR</b> Suitable Programming experiments based on the syllabus contents can be given to the students to submit the same as laboratory work( for example; Implementation of concept learning, implementation of decision tree learning algorithm for suitable data set, etc...)	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and	

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3<sup>rd</sup> Edition, Pearson,2015

**Reference:**

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3<sup>rd</sup> edition,Tata McGraw Hill,2013
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

**Web links and Video Lectures (e-Resources):**

1. <https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html>
2. <https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409>
3. <https://nptel.ac.in/courses/106/105/106105077/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Role play for strategies - DFS & BFS, Reasoning and Uncertainty problems - reliability of sensor used to detect pedestrians using Bayes Rule , A teacher does not know exactly what a student understand etc.

## V Semester

<b>DATABASE MANAGEMENT SYSTEMS LABORATORY WITH MINI PROJECT</b>			
Course Code	<b>21CSL55</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	01	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 1. Foundation knowledge in database concepts, technology and practice to groom students into well-informed database application developers.			
CLO 2. Strong practice in SQL programming through a variety of database problems.			
CLO 3. Develop database applications using front-end tools and back-end DBMS..			
<b>Sl. No.</b>	<b>PART-A: SQL Programming (Max. Exam Marks. 50)</b>		
	Design, develop, and implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment. Create Schema and insert at least 5 records for each table. Add appropriate database constraints.		
1	<p>Aim: Demonstrating creation of tables, applying the view concepts on the tables.</p> <p>Program Consider the following schema for a Library Database:  <b>BOOK(Book_id, Title, Publisher_Name, Pub_Year)</b>  <b>BOOK_AUTHORS(Book_id, Author_Name)</b>  <b>PUBLISHER(Name, Address, Phone)</b>  <b>BOOK_COPIES(Book_id, Programme_id, No-of_Copies)</b>  <b>BOOK_LENDING(Book_id, Programme_id, Card_No, Date_Out, Due_Date)</b>  <b>LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Programme, etc.</li> <li>2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017.</li> <li>3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.</li> <li>4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.</li> <li>5. Create a view of all books and its number of copies that are currently available in the Library.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=AaSU-AOguls">https://www.youtube.com/watch?v=AaSU-AOguls</a>  <a href="https://www.youtube.com/watch?v=-EwEvJxS-Fw">https://www.youtube.com/watch?v=-EwEvJxS-Fw</a></p>		
2	<p>Aim: Discuss the various concepts on constraints and update operations.</p> <p>Program: Consider the following schema for Order Database:  <b>SALESMAN(Salesman_id, Name, City, Commission)</b>  <b>CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id)</b>  <b>ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id)</b></p> <p>Write SQL queries to</p> <p>Count the customers with grades above Bangalore’s average.</p> <ol style="list-style-type: none"> <li>2. Find the name and numbers of all salesman who had more than one customer.</li> <li>3. List all the salesman and indicate those who have and don’t have customers in their cities (Use UNION operation.)</li> <li>4. Create a view that finds the salesman who has the customer with the highest order of a day.</li> <li>5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=AA-KL1jbMeY">https://www.youtube.com/watch?v=AA-KL1jbMeY</a></p>		



	<p><a href="https://www.youtube.com/watch?v=7S_tz1z_5bA">https://www.youtube.com/watch?v=7S_tz1z_5bA</a></p>
3	<p>Aim: Demonstrate the concepts of JOIN operations.</p> <p>Program: Consider the schema for Movie Database:  <b>ACTOR(Act_id, Act_Name, Act_Gender)</b>  <b>DIRECTOR(Dir_id, Dir_Name, Dir_Phone)</b>  <b>MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id)</b>  <b>MOVIE_CAST(Act_id, Mov_id, Role)</b>  <b>RATING(Mov_id, Rev_Stars)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>List the titles of all movies directed by 'Hitchcock'.</li> <li>Find the movie names where one or more actors acted in two or more movies.</li> <li>List all actors who acted in a movie before 2000 and also in a movie after 2015(use JOIN operation).</li> <li>Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title.</li> <li>Update rating of all movies directed by 'Steven Spielberg' to 5.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=hSiCUNVKIAo">https://www.youtube.com/watch?v=hSiCUNVKIAo</a>  <a href="https://www.youtube.com/watch?v=Eod3aQkFz84">https://www.youtube.com/watch?v=Eod3aQkFz84</a></p>
4	<p>Aim: Introduce concepts of PLSQL and usage on the table.</p> <p>Program: Consider the schema for College Database:  <b>STUDENT(USN, SName, Address, Phone, Gender)</b>  <b>SEMSEC(SSID, Sem, Sec)</b>  <b>CLASS(USN, SSID)</b>  <b>COURSE(Subcode, Title, Sem, Credits)</b>  <b>IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>List all the student details studying in fourth semester 'C' section.</li> <li>Compute the total number of male and female students in each semester and in each section.</li> <li>Create a view of Test1 marks of student USN '1BI15CS101' in all Courses.</li> <li>Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.</li> <li>Categorize students based on the following criterion:  If FinalIA = 17 to 20 then CAT = 'Outstanding'  If FinalIA = 12 to 16 then CAT = 'Average'  If FinalIA &lt; 12 then CAT = 'Weak'</li> </ol> <p>Give these details only for 8th semester A, B, and C section students.</p> <p>Reference:  <a href="https://www.youtube.com/watch?v=horURQewW9c">https://www.youtube.com/watch?v=horURQewW9c</a>  <a href="https://www.youtube.com/watch?v=P7-wKbKrAhk">https://www.youtube.com/watch?v=P7-wKbKrAhk</a></p>
5	<p>Aim: Demonstrate the core concepts on table like nested and correlated nesting queries and also EXISTS and NOT EXISTS keywords.</p> <p>Program: Consider the schema for Company Database:  <b>EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo)</b>  <b>DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate)</b>  <b>DLOCATION(DNo,DLoc)</b>  <b>PROJECT(PNo, PName, PLocation, DNo)</b>  <b>WORKS_ON(SSN, PNo, Hours)</b></p> <p>Write SQL queries to</p> <p>Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.</p>

	<p>Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.</p> <p>Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department</p> <p>Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).</p> <p>For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs.6,00,000.</p> <p><b>Reference:</b>  <a href="https://www.youtube.com/watch?v=Dk8f3ejqKts">https://www.youtube.com/watch?v=Dk8f3ejqKts</a></p>
<b>Pedagogy</b>	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk
<b>PART B</b>	
	<b>Mini project:</b> For any problem selected, make sure that the application should have five or more tables. Indicative areas include: Organization, health care, Ecommerce etc.
<p><b>Course Outcomes:</b></p> <p>At the end of the course the student will be able to:</p> <p>CO 1. Create, Update and query on the database.</p> <p>CO 2. Demonstrate the working of different concepts of DBMS</p> <p>CO 3. Implement, analyze and evaluate the project developed for an application.</p>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).</p> <p><b>Continuous Internal Evaluation (CIE):</b></p> <p>CIE marks for the practical course is <b>50 Marks</b>.</p> <p>The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b>.</p> <p>Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</p> <p>Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</p> <p>Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</p> <p>Weightage to be given for neatness and submission of record/write-up on time.</p> <p>Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.</p> <p>In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</p> <p>The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</p> <p>The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).</p> <p>The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.</p>	
<b>Semester End Evaluation (SEE):</b>	

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with an equal choice to all the students in a batch. For PART B, the project group (Maximum of 4 students per batch) should demonstrate the mini-project.*
- *Weightage of marks for PART A is 60% and for PART B is 40%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks:**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Suggested Weblinks/ E Resource**

<https://www.tutorialspoint.com/sql/index.htm>

## V Semester

<b>ANGULAR JS AND NODE JS (Practical based)</b>			
Course Code:	<b>21CSL581</b>	CIE Marks	50
Teaching Hours/Week	0:1:1:0	SEE Marks	50
Total No. of Hours	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<p><b>Course Objectives:</b> The student should be made to:</p> <p>CLO 1. To learn the basics of Angular JS.</p> <p>CLO 2. To understand the Angular JS Modules.</p> <p>CLO 3. To implement Forms, inputs and Services</p> <p>CLO 4. To implement Directives and Databases</p> <p>CLO 5. To understand basics of Node JS.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction To Angular JS:</b> Introduction – Features – Angular JSModel-View-Controller – Expression - Directives and Controllers.			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Angular JS Modules:</b> Arrays –Working with ng-model – Working with Forms – Form Validation – Error Handling with Forms – Nested Forms with ng-form – Other Form Controls.			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-3</b>			
<b>Directives&amp; Building Databases:</b>			
<b>Part I-</b> Filters – Using Filters in Controllers and Services – Angular JS Services – Internal Angular JS Services – Custom Angular JS Services			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-4</b>			
<b>Directives&amp; Building Databases:</b>			
<b>Part-II-</b> Directives – Alternatives to Custom Directives – Understanding the Basic options – Interacting with Server –HTTP Services – Building Database, Front End and BackEnd			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-5</b>			
<b>Introduction to NODE JS:</b> Introduction –Using the Terminals – Editors –Building a Webserver with Node – The HTTPModule – Views and Layouts.			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Describe the features of Angular JS.	
CO 2. Recognize the form validations and controls.	
CO 3. Implement Directives and Controllers.	
CO 4. Evaluate and create database for simple application.	
CO 5. Plan and build webservers with node using Node .JS.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).	
<b>Continuous Internal Evaluation (CIE):</b>	
<b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b>	
CIE marks for the practical course is <b>50 Marks</b> .	
The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> .	
<ul style="list-style-type: none"> <li>• Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>• Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>• Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>• Weightage to be given for neatness and submission of record/write-up on time.</li> <li>• Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>• In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>• The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>• The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul>	
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b>	
<ul style="list-style-type: none"> <li>• SEE marks for the practical course is 50 Marks.</li> <li>• SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University</li> <li>• All laboratory experiments are to be included for practical examination.</li> <li>• (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. <b>OR</b> based on the course requirement evaluation rubrics shall be decided jointly by examiners.</li> <li>• Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.</li> <li>• Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.</li> </ul>	

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

### **Suggested Learning Resources:**

#### **Textbooks**

1. Adam Freeman - ProAngular JS, Apress, First Edition, 2014.
2. ShyamSeshadri, Brad Green –“AngularJS: Up and Running: Enhanced Productivity with Structured Web Apps”, Apress, O'Reilly Media, Inc.
3. AgusKurniawan–“AngularJS Programming by Example”, First Edition, PE Press, 2014.

#### **Reference Books**

1. Brad Dayley, “Learning Angular JS”, Addison-Wesley Professional, First Edition, 2014.
2. Steve Hoberman, “Data Modeling for MongoDB”, Technics Publication, First Edition, 2014..

#### **Weblinks and Video Lectures (e-Resources):**

1. Introduction to Angular JS : <https://www.youtube.com/watch?v=HEbphzK-0xE>
2. Angular JS Modules : <https://www.youtube.com/watch?v=gWmOKmgnQkU>
3. Directives& Building Databases: [https://www.youtube.com/watch?v=R\\_okHflzgm0](https://www.youtube.com/watch?v=R_okHflzgm0)
4. Introduction to NODE .JS: <https://www.youtube.com/watch?v=8u1o-OmOeGQ>
5. <https://www.youtube.com/watch?v=7F1nLajs4Eo>
6. <https://www.youtube.com/watch?v=t7x7c-x90FU>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects

## V Semester

<b>C# AND .NET FRAMEWORK</b>			
Course Code:	<b>21CS582</b>	CIE Marks	50
Teaching Hours/Week	1:0:0:0	SEE Marks	50
Total No. of Hours	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
<p>CLO 1. Understand the basics of C# and .NET</p> <p>CLO 2. Learn the variables and constants of C#</p> <p>CLO 3. Know the object-oriented aspects and applications.</p> <p>CLO 4. Learn the basic structure of .NET framework.</p> <p>CLO 5. Learn to create a simple project of .NET Core</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to C#</b>			
<b>Part-I:</b> Understanding C#, .NET, overview of C#, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, implicit and explicit casting.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-2</b>			
<b>Part-II:</b> Constants, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-3</b>			
<b>Object Oriented Concepts-I:</b>			
Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-4</b>			
<b>Object Oriented Concepts-II:</b>			

Sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.

<b>Teaching-Learning Process</b>	Active learning
----------------------------------	-----------------

**Module-5**

**Introduction to .NET FRAMEWORK:**

Assemblies, Versioning, Attributes, reflection, viewing meta data, remoting, security in .NET, Environment Setup of .NET Core and create a small project.

<b>Teaching-Learning Process</b>	Active learning
----------------------------------	-----------------

**Course Outcomes (Course Skill Set)**

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

- CO 1. Able to explain how C# fits into the .NET platform.
- CO 2. Describe the utilization of variables and constants of C#
- CO 3. Use the implementation of object-oriented aspects in applications.
- CO 4. Analyze and Set up Environment of .NET Core.
- CO 5. Evaluate and create a simple project application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

**Theory SEE** will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours**)

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours



**Suggested Learning Resources:****Textbooks**

1. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.
2. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.

**Reference Books**

1. Andrew Troelsen, "Pro C# 2010 and the .NET 4 Platform, Fifth edition, A Press, 2010.
2. Ian Griffiths, Matthew Adams, Jesse Liberty, "Programming C# 4.0", Sixth Edition, O'Reilly, 2010.

**Weblinks and Video Lectures (e-Resources):**

1. Introduction to C# : <https://www.youtube.com/watch?v=ItoIFCT9P90>
2. Object Oriented Concepts : <https://www.youtube.com/watch?v=LP3llcExPK0>
3. .NET FRAMEWORK : <https://www.youtube.com/watch?v=h7huHkvPoEE>

**Tutorial Link:**

1. <https://www.tutorialsteacher.com/csharp>
2. <https://www.w3schools.com/cs/index.php>
3. <https://www.javatpoint.com/net-framework>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using group discussion.

## VI Semester

<b>SOFTWARE ENGINEERING &amp; PROJECT MANAGEMENT</b>			
Course Code	<b>21CS61</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.</p> <p>CLO 2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.</p> <p>CLO 3. Infer the fundamentals of object oriented concepts, differentiate system models, use UML diagrams and apply design patterns.</p> <p>CLO 4. Explain the role of DevOps in Agile Implementation.</p> <p>CLO 5. Discuss various types of software testing practices and software evolution processes.</p> <p>CLO 6. Recognize the importance Project Management with its methods and methodologies.</p> <p>CLO 7. Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction:</b> The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.</p> <p><b>Textbook 1: Chapter 1: 1.1 to 1.3</b></p> <p><b>Process Models:</b> Prescriptive models, Waterfall model, Incremental process models, Evolutionary process models, Specialized process models.</p> <p><b>Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7</b></p> <p><b>Requirements Engineering:</b> Requirements Engineering Task, Initiating the Requirements Engineering process, Eliciting Requirements, Developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document (<b>Sec 4.2</b>)</p> <p><b>Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2</b></p>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Module-2</b>	
<p><b>Introduction, Modelling Concepts and Class Modelling:</b> What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling, abstraction, The Three models. Class Modelling: Object and Class Concept, Link and associations concepts, Generalization and Inheritance, A sample class model, Navigation of class models, Introduction to RUP(<b>Textbook: 5 Sec 2.4</b>) and UML diagrams</p> <p><b>Textbook 2: Chapter 1,2,3</b></p> <p><b>Building the Analysis Models:</b> Requirement Analysis, Analysis Model Approaches, Data modeling Concepts, Object Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, class Based Modeling, Creating a Behavioral Model.</p> <p><b>Textbook 1: Chapter 8: 8.1 to 8.8</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<p><b>Software Testing:</b> A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging.</p> <p><b>Textbook 1: Chapter 13: 13.1 to 13.7</b></p> <p><b>Agile Methodology &amp; DevOps:</b> Before Agile – Waterfall, Agile Development,</p> <p><b>Self-Learning Section:</b> What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility, DevOps and Continuous Testing, How to Choose Right DevOps Tools?, Challenges with DevOps Implementation.</p> <p><b>Textbook 4: Chapter 2: 2.1 to 2.9</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-4</b>	
<p><b>Introduction to Project Management:</b> Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.</p> <p><b>Textbook 3: Chapter 1: 1.1 to 1.17</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-5</b>	
<p><b>Activity Planning:</b> Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, Identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks.</p> <p><b>Textbook 3: Chapter 6: 6.1 to 6.16</b></p> <p><b>Software Quality:</b> Introduction, The place of software quality in project planning, Importance of software quality, software quality models, ISO 9126, quality management systems, process capability models, techniques to enhance software quality, quality plans.</p> <p><b>Textbook 3: Chapter 13: (13.1 to 13.6 , 13.9, 13.11, 13.14),</b></p>	

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<p><b>Course Outcomes</b></p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. Understand the activities involved in software engineering and analyze the role of various process models</li> <li>CO 2. Explain the basics of object-oriented concepts and build a suitable class model using modelling techniques</li> <li>CO 3. Describe various software testing methods and to understand the importance of agile methodology and DevOps</li> <li>CO 4. Illustrate the role of project planning and quality management in software development</li> <li>CO 5. Understand the importance of activity planning and different planning models</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b></p> <p>Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ul style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ul> <p>Two assignments each of <b>10 Marks</b></p> <ul style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ul> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p> <ul style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ul> <p>The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b></p> <p>(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).</p> <p><b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b></p> <p><b>Semester End Examination:</b></p> <p>Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (<b>duration 03 hours</b>)</p> <ul style="list-style-type: none"> <li>1. The question paper will have ten questions. Each question is set for 20 marks.</li> <li>2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), <b>should have a mix of topics</b> under that module.</li> </ul> <p>The students have to answer 5 full questions, selecting one full question from each module</p>	
<p><b>Suggested Learning Resources:</b></p> <p><b>Textbooks</b></p> <ul style="list-style-type: none"> <li>1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.</li> <li>2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.</li> <li>3. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6<sup>th</sup> Edition, McGraw Hill Education, 2018.</li> </ul>	

4. Deepak Gaikwad, Viral Thakkar, DevOps Tools From Practitioner's Viewpoint, Wiley.
5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.

**Reference:**

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

**Weblinks and Video Lectures (e-Resources):**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc20_cs68/preview)
2. [https://www.youtube.com/watch?v=WxkP5KR\\_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFJ](https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFJ)
3. <http://elearning.vtu.ac.in/econtent/CSE.php>
4. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/15CS42.html>
5. <https://nptel.ac.in/courses/128/106/128106012/> (DevOps)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Case study, Field visit

## VI Semester

<b>DATA SCIENCE AND ITS APPLICATIONS</b>			
Course Code	21AD62	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Demonstrate the proficiency with statistical analysis of data to derive insight from results and interpret the data findings visually</p> <p>CLO 2. Utilize the</p> <p>CLO 3. skills in data management by obtaining, cleaning and transforming the data.</p> <p>CLO 4. Make use of machine learning models to solve the business-related challenges</p> <p>CLO 5. Experiment with decision trees, neural network layers and data partition.</p> <p>CLO 6. Demonstrate how social clustering shape individuals and groups in contemporary society.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1: Introduction</b>			
<p><b>What is Data Science? Visualizing Data</b>, matplotlib, Bar Charts, Line Charts, Scatterplots, <b>Linear Algebra</b>, Vectors, Matrices, <b>Statistics</b>, Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation, <b>Probability</b>, Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.</p> <p><b>Chapters 1, 3, 4, 5 and 6</b></p>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>Installation of Python/R language, Visual Studio code editors can be demonstrated along with Kaggle data set usage.</li> <li>Write programs in Python/R and Execute them in either Visual Studio Code or PyCharm Community Edition or any other suitable environment.</li> <li>A study was conducted to understand the effect of number of hours the students spent studying on their performance in the final exams. Write a code to plot line chart with number of hours spent studying on x-axis and score in final exam on y-axis. Use a red '*' as the point character, label the axes and give the plot a title.</li> </ol>			

Number of hrs spent studying (x)	10	9	2	15	10	16	11	16
Score in the final exam (0 - 100) (y)	95	80	10	50	45	98	38	93

4. For the given dataset mtcars.csv ([www.kaggle.com/ruiromanini/mtcars](http://www.kaggle.com/ruiromanini/mtcars)), plot a histogram to check the frequency distribution of the variable 'mpg' (Miles per gallon)

<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration of different charts</li> <li>2. PPT Presentation for Theorems and different distributions</li> <li>3. Live coding and execution for visualization with simple examples</li> </ol>
----------------------------------	---

### Module-2: Hypothesis and Inference

Statistical Hypothesis Testing, Example: Flipping a Coin, p-Values, Confidence Intervals, p-Hacking, Example: Running an A/B Test, Bayesian Inference, **Gradient Descent**, The Idea Behind Gradient Descent Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent, **Getting Data**, stdin and stdout, Reading Files, Scraping the Web, Using APIs, Example: Using the Twitter APIs, **Working with Data**, Exploring Your Data, Using NamedTuples, Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, An Aside: tqdm, Dimensionality Reduction.

### Chapters 7, 8, 9 and 10

#### Laboratory Component:

1. Consider the books dataset BL-Flickr-Images-Book.csv from Kaggle (<https://www.kaggle.com/adeyoyintemidayo/publication-of-books>) which contains information about books. Write a program to demonstrate the following.
  - Import the data into a DataFrame
  - Find and drop the columns which are irrelevant for the book information.
  - Change the Index of the DataFrame
  - Tidy up fields in the data such as date of publication with the help of simple regular expression.
  - Combine str methods with NumPy to clean columns

<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration of Hypothesis test.</li> <li>2. PPT Presentation to explore and manipulate data.</li> <li>3. Live coding of concepts with simple examples</li> <li>4. Case Study: Extraction of data from Books dataset</li> </ol>
----------------------------------	--

### Module-3: Machine Learning

Modeling, What Is Machine Learning?, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, **k-Nearest Neighbors**, The Model, Example: The Iris Dataset, The Curse of Dimensionality, **Naive Bayes**, A Really Dumb Spam Filter, A More Sophisticated Spam Filter, Implementation, Testing Our Model, Using Our Model, **Simple Linear Regression**, The Model, Using

Gradient Descent, Maximum Likelihood Estimation, **Multiple Regression**, The Model, Further Assumptions of the Least Squares Model, Fitting the Model, Interpreting the Model, Goodness of Fit, Digression: The Bootstrap, Standard Errors of Regression Coefficients, Regularization, **Logistic Regression**, The Problem, The Logistic Function, Applying the Model, Goodness of Fit, Support Vector Machines.

**Chapters 11, 12, 13, 14, 15 and 16**

**Laboratory Component:**

1. Train a regularized logistic regression classifier on the iris dataset (<https://archive.ics.uci.edu/ml/machine-learning-databases/iris/> or the inbuilt iris dataset) using sklearn. Train the model with the following hyperparameter  $C = 1e4$  and report the best classification accuracy.
2. Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBF-kernel,  $\gamma=0.5$ , one-vs-rest classifier, no-feature-normalization. Also try  $C=0.01, 1, 10, C=0.01, 1, 10$ . For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data

**Teaching-Learning Process**

1. Demonstration of Models
2. PPT Presentation for techniques
3. Live coding of all concepts with simple examples

**Module-4: Decision Trees**

What Is a Decision Tree?, Entropy, The Entropy of a Partition, Creating a Decision Tree, Putting It All Together, Random Forests, **Neural Networks**, Perceptrons, Feed-Forward Neural Networks, Backpropagation, Example: Fizz Buzz, **Deep Learning**, The Tensor, The Layer Abstraction, The Linear Layer, Neural Networks as a Sequence of Layers, Loss and Optimization, Example: XOR Revisited, Other Activation Functions, Example: Fizz Buzz Revisited, Softmaxes and Cross-Entropy, Dropout, Example: MNIST, Saving and Loading Models, **Clustering**, The Idea, The Model, Example: Meetups, Choosing k, Example: Clustering Colors, Bottom-Up Hierarchical Clustering

**Chapters 17, 18, 19 and 20**

**Laboratory Component:**

1. Consider the following dataset. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

Price	Maintenance	Capacity	Airbag	Profitable
Low	Low	2	No	Yes
Low	Med	4	Yes	Yes
Low	Low	4	No	Yes
Low	Med	4	No	No
Low	High	4	No	No
Med	Med	4	No	No
Med	Med	4	Yes	Yes
Med	High	2	Yes	No
Med	High	5	No	Yes
High	Med	4	Yes	Yes
high	Med	2	Yes	Yes
High	High	2	Yes	No
high	High	5	yes	Yes

2. Consider the dataset spiral.txt (<https://bit.ly/2Lm75Ly>). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:



	<ul style="list-style-type: none"> <li>• K – means Clustering</li> <li>• Single – link Hierarchical Clustering</li> <li>• Complete link hierarchical clustering.</li> <li>• Also visualize the dataset and which algorithm will be able to recover the true clusters.</li> </ul>
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration using Python/ R Language</li> <li>2. PPT Presentation for decision tree, Neural Network, Deep learning and clustering</li> <li>3. Live coding for the concepts with simple examples</li> <li>4. Project Work: Algorithm implementation</li> </ol>
<b>Module-5: Natural Language Processing</b>	
<p>Word Clouds, n-Gram Language Models, Grammars, An Aside: Gibbs Sampling, Topic Modeling, Word Vectors, Recurrent Neural Networks, Example: Using a Character-Level RNN, <b>Network Analysis</b>, Betweenness Centrality, Eigenvector Centrality, Directed Graphs and PageRank, <b>Recommender Systems</b>, Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization.</p> <p><b>Chapters 21, 22 and 23</b></p>	
<b>Laboratory Component:</b>	
Mini Project – Simple web scrapping in social media	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration of models</li> <li>2. PPT Presentation for network analysis and Recommender systems</li> <li>3. Live coding with simple examples</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
<p>At the end of the course the student will be able to:</p> <p>CO 1. Identify and demonstrate data using visualization tools.</p> <p>CO 2. Make use of Statistical hypothesis tests to choose the properties of data, curate and manipulate data.</p> <p>CO 3. Utilize the skills of machine learning algorithms and techniques and develop models.</p> <p>CO 4. Demonstrate the construction of decision tree and data partition using clustering.</p> <p>CO 5. Experiment with social network analysis and make use of natural language processing skills to develop data driven applications.</p>	
<b>Assessment Details (both CIE and SEE)</b>	
<p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b></p> <p>Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> <p>Two assignments each of <b>10 Marks</b></p> <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

#### **Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

#### **Suggested Learning Resources:**

##### **Text Books**

1. Joel Grus, “Data Science from Scratch”, 2<sup>nd</sup> Edition, O’Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-9352138326

##### **Reference Books**

1. Emily Robinson and Jacqueline Nolis, “Build a Career in Data Science”, 1<sup>st</sup> Edition, Manning Publications, 2020. ISBN: 978-1617296246.
2. Aurélien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, 2<sup>nd</sup> Edition, O’Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-1492032649.
3. François Chollet, “Deep Learning with Python”, 1<sup>st</sup> Edition, Manning Publications, 2017. ISBN-13: 978-1617294433
4. Jeremy Howard and Sylvain Gugger, “Deep Learning for Coders with fastai and PyTorch”, 1<sup>st</sup> Edition, O’Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2020. ISBN-13: 978-1492045526
5. Sebastian Raschka and Vahid Mirjalili, “Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2”, 3<sup>rd</sup> Edition, Packt Publishing Limited, 2019. ISBN-13: 978-1789955750

#### **Web links and Video Lectures (e-Resources):**

1. Using Python : <https://www.python.org>
2. R Programming : <https://www.r-project.org/>
3. Python for Natural Language Processing : <https://www.nltk.org/book/>
4. Data set: <https://bit.ly/2Lm75Ly>
5. Data set: <https://archive.ics.uci.edu/ml/datasets.html>

6. Data set : [www.kaggle.com/ruiromanini/mtcars](http://www.kaggle.com/ruiromanini/mtcars)
7. Pycharm : <https://www.jetbrains.com/pycharm/>
8. <https://nptel.ac.in/courses/106/106/106106179/>
9. <https://nptel.ac.in/courses/106/106/106106212/>
10. <http://nlp-iiith.vlabs.ac.in/List%20of%20experiments.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - Applying the machine learning techniques and developing models

## VI Semester

<b>MACHINE LEARNING</b>			
Course Code	21AI63	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Define machine learning and understand the basic theory underlying machine learning.</p> <p>CLO 2. Differentiate supervised, unsupervised and reinforcement learning</p> <p>CLO 3. Understand the basic concepts of learning and decision trees.</p> <p>CLO 4. Understand Bayesian techniques for problems appear in machine learning</p> <p>CLO 5. Perform statistical analysis of machine learning techniques.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b>			
Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML			
<b>Concept learning and Learning Problems</b> – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS- Inductive bias.			
<b>Text book 2: Chapter 1, Text book 1:Chapter 1 and 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>End to end Machine learning Project:</b> Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model.			
<b>Classification</b> : MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification			
<b>Text book 2: Chapter 2, Chapter 3</b>			
<b>Teaching-Learning</b>	Chalk and board, Active Learning		

<b>Process</b>	
<b>Module-3</b>	
<b>Training Models:</b> Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression	
<b>Support Vector Machine:</b> linear, Nonlinear , SVM regression and under the hood	
<b>Text book 2: Chapter 4, Chapter 5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>Decision Trees</b> Training and Visualizing DT, making prediction, estimating class, the CART training, computational complexity, GINI impurity, Entropy, regularization Hyper parameters, Regression, instability	
<b>Ensemble learning and Random Forest:</b> Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting, stacking	
<b>Text book 2: Chapter 6, Chapter 7</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<b>Bayes Theorem</b> – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– example-Bayesian Belief Network – EM Algorithm	
<b>Text book 1: Chapter 6</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand the concept of Machine Learning and Concept Learning.	
CO 2. Apply the concept of ML and various classification methods in a project.	
CO 3. Analyse various training models in ML and the SVM algorithm to be implemented.	
CO 4. Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest.	
CO 5. Apply Bayes techniques and explore more about the classification in ML.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Textbooks**

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

**Reference:**

1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2<sup>nd</sup> Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019
4. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

**Web links and Video Lectures (e-Resources):**

1. [https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaliy295pg6\\_SY5qznc77](https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaliy295pg6_SY5qznc77)
2. <https://nptel.ac.in/courses/106/106/106106139/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VI Semester

<b>BUSINESS INTELLIGENCE</b>			
Course Code	21AI641	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Explain the Decision Support systems and Business Intelligence framework.</p> <p>CLO 2. Illustrate the significance of computerized Decision Support, and understand the mathematical modeling behind decision support.</p> <p>CLO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.</p> <p>CLO 4. Explore knowledge management; explain its activities, approaches and its implementation.</p> <p>CLO 5. Describe the Expert systems , areas suitable for application of experts system</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Decision Support and Business Intelligence:</b> Opening Vignette, Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A framework for Business Intelligence (BI), A Work System View of Decision Support.</p>			
<b>Text Book 1: Chapter 1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-2</b>			
<p><b>Computerized Decision Support:</b> Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported.</p>			
<p><b>Modeling and Analysis:</b> Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal</p>			

Seeking.	
<b>Text Book 1: Chapter 2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<b>Data Warehousing:</b> Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes.	
<b>Text Book 1: Chapter 5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-4</b>	
<b>Knowledge Management:</b> Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation.	
<b>Text Book 1: Chapter 11</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-5</b>	
<b>Expert Systems:</b> Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems.	
<b>Text Book 1: Chapter 12</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
<p>CO 1. Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework.</p> <p>CO 2. Describe the significance of Computerized Decision Support, apply the basics of mathematics to Understand the mathematical modeling behind decision support.</p> <p>CO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.</p> <p>CO 4. Analyze the importance of knowledge management and explain its activities, approaches and Its implementation</p> <p>CO 5. Describe the Expert systems and analyze its development, discuss areas suitable for application of experts system.</p>	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal	



Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Book**

1. Business Intelligence, A managerial Perspective on Analytics. Sharda, R, Delen D, Turban E. Pearson. 2014

**Reference Books**

1. Data Mining Techniques. For Marketing, Sales and Customer Relationship Management Berry M.&Linoff G. Wiley Publishing Inc 2004
2. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media, Inc 2013

**Web links and Video Lectures (e-Resources):**

5. <https://www.youtube.com/watch?v=3DTFmMniGlg>
6. <https://www.youtube.com/watch?v=Hg8zBJ1DhLQ>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

<b>ADVANCED JAVA PROGRAMMING</b>			
Course Code	21CS642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understanding the fundamental concepts of Enumerations and Annotations</p> <p>CLO 2. Apply the concepts of Generic classes in Java programs</p> <p>CLO 3. Demonstrate the fundamental concepts of String operations</p> <p>CLO 4. Design and develop web applications using Java servlets and JSP</p> <p>CLO 5. Apply database interaction through Java database Connectivity</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same program</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Enumerations, Autoboxing and Annotations:</b>			
<p>Enumerations, Enumeration fundamentals, the values() and valueOf() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning</p> <p>Annotations, Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, Using default values, Marker Annotations, Single member annotations, Built in annotations</p>			
<b>Textbook 1: Chapter12</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Online demonstration, Problem based learning		
<b>Module-2</b>			
<b>Generics:</b> What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies, Erasure, Ambiguity errors, Some Generic Restrictions			
<b>Textbook 1: Chapter 14</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration		
<b>Module-3</b>			
<b>String Handling:</b> The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf(), Changing the case of characters within a String, String Buffer, String Builder			

<b>Textbook 1: Chapter 15</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Module-4</b>	
Background; The life cycle of a servlet; A simple servlet; the servlet API; The javax.servlet package Reading servlet parameter; the javax.servlet.http package; Handling HTTP Requests and Responses; using Cookies; Session Tracking, Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects	
<b>Textbook 1: Chapter 31</b>	
<b>Textbook 2: Chapter 11</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Module-5</b>	
The concept of JDBC; JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data Types; Exceptions.	
<b>Textbook 2: Chapter 6</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understanding the fundamental concepts of Enumerations and Annotations	
CO 2. Apply the concepts of Generic classes in Java programs	
CO 3. Demonstrate the concepts of String operations in Java	
CO 4. Develop web based applications using Java servlets and JSP	
CO 5. Illustrate database interaction and transaction processing in Java	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks	

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Herbert Schildt: JAVA the Complete Reference. 9<sup>th</sup> Edition, Tata McGraw-Hill
2. Jim Keogh, The Complete Reference J2EE, Tata McGraw-Hill

**Reference Books:**

1. Y. Daniel Liang: Introduction to JAVA Programming, 7<sup>th</sup> Edition, Pearson Education, 2007.

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. <https://nptel.ac.in/courses/106/105/106105225/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Programming exercises

## VI Semester

<b>NATURAL LANGUAGE PROCESSING</b>			
Course Code	21AI643	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Analyse the natural language text.</p> <p>CLO 2. Define the importance of natural language.</p> <p>CLO 3. Understand the concepts Text mining.</p> <p>CLO 4. Illustrate information retrieval techniques.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same program</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Overview and language modeling:</b> Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.</p>			
<p><b>Textbook 1: Ch. 1,2</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Online demonstration, Problem based learning		
<b>Module-2</b>			
<p><b>Word level and syntactic analysis:</b> Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.</p>			
<p><b>Textbook 1: Ch. 3,4</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration		
<b>Module-3</b>			
<p><b>Extracting Relations from Text: From Word Sequences to Dependency Paths:</b> Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.</p>			
<p><b>Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:</b> Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.</p>			

**A Case Study in Natural Language Based Web Search:** InFact System Overview, The GlobalSecurity.org Experience.

**Textbook 2: Ch. 3,4,5**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Module-4**

**Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models:** Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems,

**Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:** Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.

**Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling:** Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

**Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:** Related Work, A Semantically Guided Model for Effective Text Mining.

**Textbook 2: Ch. 6,7,8,9**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Module-5**

**INFORMATION RETRIEVAL AND LEXICAL RESOURCES:** Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

**Textbook 1: Ch. 9,12**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Course Outcomes**

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

- CO 1. Analyse the natural language text.
- CO 2. Define the importance of natural language.
- CO 3. Understand the concepts Text mining.
- CO 4. Illustrate information retrieval techniques.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

**Reference Books:**

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

**Weblinks and Video Lectures (e-Resources):**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VI Semester

<b>COMPUTER GRAPHICS AND FUNDAMENTALS OF IMAGE PROCESSING</b>			
Course Code	<b>21AI644</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Objectives:</b></p> <p>CLO 1. Overview of Computer Graphics along with its applications.</p> <p>CLO 2. Exploring 2D and 3D graphics mathematics along with OpenGL API's.</p> <p>CLO 3. Use of Computer graphics principles for animation and design of GUI's .</p> <p>CLO 4. Introduction to Image processing and Open CV.</p> <p>CLO 5. Image segmentation using Open CV.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Overview:</b> Computer Graphics hardware and software and OpenGL: Computer Graphics: Video Display Devices, Raster-Scan Systems Basics of computer graphics, Application of Computer Graphics. OpenGL: Introduction to OpenGL, coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms (DDA, Bresenham's).</p> <p><b>Textbook 1: Chapter -1,2,3, 5(1 and 2 only)</b></p> <p><b>Self-study topics :</b> Input devices, hard copy devices, coordinate representation, graphics functions, fill area primitives, polygon fill areas, pixel arrays, Parallel Line algorithms</p>			
<b>Teaching-Learning Process</b>	Chalk&board, Active Learning Virtual Lab		
<b>Module-2</b>			
<p><b>2D and 3D graphics with OpenGL:</b> 2D Geometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates, 2D Composite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function,</p> <p><b>3D Geometric Transformations:</b> Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions</p>			



**Textbook 1: Chapter -6, 8**

**Self-study topics:** Transformation between 2D coordinate system, OpenGL geometric-transformation, Transformation between 3D coordinate system.

<b>Teaching-Learning Process</b>	Chalk & board, Active Learning, Problem based learning Virtual Lab:
----------------------------------	--

**Module-3**

**Interactive Input Methods and Graphical User Interfaces:** Graphical Input Data ,Logical Classification of Input Devices, Input Functions for Graphical Data , Interactive Picture-Construction Techniques, Virtual-Reality Environments, OpenGL Interactive Input-Device Functions, OpenGL Menu Functions , Designing a Graphical User Interface.

**Computer Animation :**Design of Animation Sequences, Traditional Animation Techniques, General Computer-Animation Functions, Computer-Animation Languages, Character Animation, Periodic Motions, OpenGL Animation Procedures.

**Textbook 1: Chapter -11, 18**

**Self-study topics:** Raster methods for computer animation, Key frame systems, Motion specification.

<b>Teaching-Learning Process</b>	Chalk & board, MOOC, Active Learning
----------------------------------	--------------------------------------

**Module-4**

**Introduction to Image processing:** overview, Nature of IP, IP and its related fields, Digital Image representation, types of images.

**Digital Image Processing Operations:** Basic relationships and distance metrics, Classification of Image processing Operations.

**Text book 2: Chapter 3**

*( Below topics is for experiential learning only , No questions in SEE)*

**Computer vision and OpenCV:** What is computer vision, Evolution of computer vision, Application of Computer vision, Feature of OpenCV, OpenCV library modules, OpenCV environment, Reading, writing and storing images using OpenCV. OpenCV drawing Functions. OpenCV Geometric Transformations.

**(Note : Computer vision and OpenCV for experimental learning or Activity Based Learning using web sources, Preferred for assignments. No questions in SEE )**

**Web Source:** <https://www.tutorialspoint.com/opencv/>

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning Lab practice for OpenCV for basic geometric objects and basic image operation
----------------------------------	---

**Module-5**

**Image Segmentation:** Introduction, classification, detection of discontinuities, Edge detection (up to canny edge detection(included)).

**Text Book 2: Chapter 9: 9.1 to 9.4.4.4**

*( Below topics is for experiential learning only , No questions in SEE)*

**Image processing with Open CV:** Resizing , Rotation/ Flipping, Blending, Creating region of Interest (ROI), Image Thresholding, Image Blurring and smoothing, Edge Detection, Image contours and Face Detection on images using OpenCV.

**(Note :Image Processing withOpenCV for experimental learning or Activity Based**

**Learning using web sources, Preferred for assignments. No questions in SEE)**

Web source: <https://medium.com/analytics-vidhya/introduction-to-computer-vision-opencv-in-python-fb722e805e8b>

<b>Teaching-Learning Process</b>	Chalk & board, MOOC Lab practice on image processing. Virtual Lab:
----------------------------------	--

**Course Outcomes:**

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

- CO 1. Construct geometric objects using Computer Graphics principles and OpenGL APIs.
- CO 2. Use OpenGL APIs and related mathematics for 2D and 3D geometric Operations on the objects.
- CO 3. Design GUI with necessary techniques required to animate the created objects
- CO 4. Apply OpenCV for developing Image processing applications.
- CO 5. Apply Image segmentation techniques along with programming, using OpenCV, for developing simple applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- 1. The question paper will have ten questions. Each question is set for 20 marks.
- 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books**

- 1. Donald D Hearn, M Pauline Baker and Warren Carithers: Computer Graphics with OpenGL 4th

Edition, Pearson, 2014

2. S. Sridhar, Digital Image Processing, second edition, Oxford University press 2016.

**Reference Books**

1. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/106/106106090/>
2. <https://nptel.ac.in/courses/106/102/106102063/>
3. <https://nptel.ac.in/courses/106/103/106103224/>
4. <https://nptel.ac.in/courses/106/102/106102065/>
5. <https://www.tutorialspoint.com/opency/> (Tutorial, Types of Images, Drawing Functions )

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Mini project on computer graphics using Open GL/Python/Open CV.

## VI Semester

<b>INTRODUCTION TO DATA STRUCTURES</b>			
Course Code	21CS651	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Introduce elementary data structures.</p> <p>CLO 2. Analyze Linear Data Structures: Stack, Queues, Lists</p> <p>CLO 3. Analyze Non Linear Data Structures: Trees</p> <p>CLO 4. Assess appropriate data structure during program development/Problem Solving.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> </ol> <p>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</p>			
<b>Module-1</b>			
<b>Introduction:</b>			
Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays.			
Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications.			
Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, size of structures.			
<b>Textbook 1: Ch 8.3 to 8.15,Ch 12.3 to 12.19</b>			
<b>Textbook 2:Ch 2.1 to2.13,2.51 ,2.80 to 2.98</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Linear Data Structures-Stacks and queues:</b>			
Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.			
<b>Textbook 2: Ch 6.1 to 6.14 ,Ch 8.1,8.2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem Based Learning		
<b>Module-3</b>			
<b>Linear Data Structures-Linked List:</b>			
Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.			

<b>Textbook 1: Ch 15.1 ,15.3,15.4,15.8</b>	
<b>Textbook 2: Ch 9.2.9.5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Module-4</b>	
<b>Non Linear Data Structures – Trees</b>	
Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, Binary Search tree, Expression Trees.	
<b>Textbook1: Ch 16.1,16.2</b>	
<b>Textbook2:Ch 10.1,10.2,10.4,10.6.3</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Active Learning, Problem based learning
<b>Module-5</b>	
<b>Sorting and Searching</b>	
Sorting: Introduction, Bubble sort, Selection sort, Insertion sort	
Searching: Introduction, Linear search, Binary search.	
<b>Textbook1: Ch 17.1,17.2.2, 17.2.4, 17.3.1,17.3.2</b>	
<b>Textbook2: Ch 11.1.,11.2,11.3,11.7,11.10.1,11.10.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Express the fundamentals of static and dynamic data structure.	
CO 2. Summarize the various types of data structure with their operations.	
CO 3. Interpret various searching and sorting techniques.	
CO 4. Choose appropriate data structure in problem solving.	
CO 5. Develop all data structures in a high level language for problem solving.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question	

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. C Programming and data structures, E Balaguruswamy 4<sup>th</sup> Edition, 2007, McGraw Hill
2. Systematic approach to Data structures using C, A M Padma Reddy, 7<sup>th</sup> Edition 2007, Sri Nandi Publications.

**References**

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2<sup>nd</sup> Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1<sup>st</sup> Ed, McGraw Hill, 2014.

**Weblinks and Video Lectures (e-Resources):**

1. [https://www.youtube.com/watch?v=DFpWCl\\_49i0](https://www.youtube.com/watch?v=DFpWCl_49i0)
2. <https://www.youtube.com/watch?v=x7t-UlLoAZM>
3. <https://www.youtube.com/watch?v=I37kGX-nZEI>
4. <https://www.youtube.com/watch?v=XuCbpw6Bj1U>
5. <https://www.youtube.com/watch?v=R9PTBwOzceo>
6. <https://www.youtube.com/watch?v=qH6yxkw0u78>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration of projects developed using Linear/Non-linear data structures

## VI Semester

<b>INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS</b>			
Course Code	21CS652	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. Understand the basic concepts and the applications of database systems. CLO 2. Understand the relational database design principles. CLO 3. Master the basics of SQL and construct queries using SQL. CLO 4. Familiar with the basic issues of transaction processing and concurrency control.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain the functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Databases:</b> Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.			
<b>Overview of Database Languages and Architectures:</b> Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.			
<b>Conceptual Data Modelling using Entities and Relationships:</b> Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples			
<b>Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Relational Model:</b> Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.			
<b>Relational Algebra:</b> Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Examples of Queries in relational algebra.			
<b>Mapping Conceptual Design into a Logical Design:</b> Relational Database Design using ER-to-Relational mapping.			
<b>Textbook 1; ch5.1 to 5.3, 8.1 to 8.5, 9.1;</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<p><b>SQL:</b>SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.</p> <p><b>Advances Queries:</b> More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.Database</p> <p><b>Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<p><b>Normalization: Database Design Theory</b> – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.</p> <p><b>Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6</b></p>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<p><b>Transaction management and Concurrency</b> –Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.</p> <p><b>Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<p><b>Course Outcomes</b> At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS</li> <li>CO 2. Use Structured Query Language (SQL) for database manipulation.</li> <li>CO 3. Design and build simple database systems</li> <li>CO 4. Develop application to interact with databases.</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b> Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> <p>Two assignments each of <b>10 Marks</b></p> <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p> <ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	



The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Database Systems, RamezElmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=HI4NZB1XR9c>
7. [https://www.youtube.com/watch?v=EGEwkad\\_lIA](https://www.youtube.com/watch?v=EGEwkad_lIA)
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Developing and demonstration of models / projects based on DBMS application

## VI Semester

<b>INTRODUCTION TO CYBER SECURITY</b>			
Course Code	21CS653	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
CLO 1. To familiarize cybercrime terminologies and ACTs			
CLO 2. Understanding cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention			
CLO 3. Understand the motive and causes for cybercrime, cybercriminals, and investigators			
CLO 4. Understanding criminal case and evidence, detection standing criminal case and evidence.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Cybercrime:</b>			
<b>Cybercrime:</b> Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes,			
<b>Cybercrime:</b> The Legal Perspectives,			
<b>Cybercrimes:</b> An Indian Perspective, Cybercrime and the Indian ITA 2000.			
<b>Textbook1:Ch1 (1.1 to 1.8).</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Cyber offenses:</b>			
<b>How Criminals Plan Them:</b> Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes.			
<b>Botnets:</b> The Fuel for Cybercrime, Attack Vector			
<b>Textbook1: Ch2 (2.1 to 2.7).</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
<b>Tools and Methods Used in Cybercrime:</b> Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks.			

<b>Textbook1: Ch4 (4.1 to 4.9, 4.12).</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Case studies
<b>Module-4</b>	
<b>Understanding the people on the scene:</b> Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators.	
<b>The Computer Investigation process:</b> investigating computer crime.	
<b>Understanding Cybercrime Prevention:</b> Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security	
<b>Textbook 2:Ch3,Ch 4, Ch 7.</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Case studies
<b>Module-5</b>	
<b>Cybercrime Detection Techniques:</b> Security Auditing and Log Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems, Understanding E-Mail Headers Tracing a Domain Name or IP Address.	
<b>Collecting and preserving digital Evidence:</b> Introduction, understanding the role of evidence in a criminal case, collecting digital evidence, preserving digital evidence, recovering digital evidence, documenting evidence.	
<b>TextBook 2:Ch 9, Ch 10.</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Case studies
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Describe the cyber crime terminologies	
CO 2. Analyze cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention	
CO 3. Analyze the motive and causes for cybercrime, cybercriminals, and investigators	
CO 4. Apply the methods for understanding criminal case and evidence, detection standing criminal case and evidence.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2013
2. Debra Little John Shinder and Michael Cross, "Scene of the cybercrime", 2nd edition, Syngress publishing Inc, Elsevier Inc, 2008

**Reference Books:**

1. Robert M Slade, "Software Forensics", Tata McGraw Hill, New Delhi, 2005.
2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.
3. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
4. Kevin Mandia, Chris Prosize, Matt Pepe, "Incident Response and Computer Forensics", Tata McGraw -Hill, New Delhi, 2006.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=czDzUP1HclQ>
2. <https://www.youtube.com/watch?v=qS4ViqnjcC8>
3. [https://www.trendmicro.com/en\\_nz/ciso/21/h/cybercrime-today-and-the-future.html](https://www.trendmicro.com/en_nz/ciso/21/h/cybercrime-today-and-the-future.html)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to Cyber security.

## VI Semester

<b>PROGRAMMING IN JAVA</b>			
Course Code	21CS654	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. Learn fundamental features of object oriented language and JAVA. CLO 2. To create, debug and run simple Java programs. CLO 3. Learn object oriented concepts using programming examples. CLO 4. Study the concepts of importing of packages and exception handling mechanism. CLO 5. Discuss the String Handling examples with Object Oriented concepts.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>An Overview of Java:</b> Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries.			
<b>Data Types, Variables, and Arrays:</b> Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings			
<b>Textbook 1:Ch 2,Ch 3.</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning.		
<b>Module-2</b>			
<b>Operators:</b> Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses,			
<b>Control Statements:</b> Java's Selection Statements, Iteration Statements, Jump Statements.			
<b>Textbook 1:Ch 4,Ch 5.</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Introducing Classes:</b> Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize() Method, A Stack Class.			
<b>A Closer Look at Methods and Classes:</b> Overloading Methods, Using Objects as Parameters, A Closer			

Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited. **Inheritance:** Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding.

**Textbook 1: Ch 6, Ch 7.1-7.9, Ch 8.1-8.5**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Module-4**

**Packages and Interfaces:** Packages, Access Protection, Importing Packages, Interfaces.

**Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions

**Textbook 1: Ch 9, Ch 10.**

<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning, Demonstration
----------------------------------	--

**Module-5**

**Enumerations :** Enumerations, Type Wrappers.

**String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer, StringBuilder.

**Textbook 1: Ch 12.1, 12.2, Ch 15.**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Course Outcomes**

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

- CO 1. Develop JAVA programs using OOP principles and proper program structuring.
- CO 2. Develop JAVA program using packages, inheritance and interface.
- CO 3. Develop JAVA programs to implement error handling techniques using exception handling
- CO 4. Demonstrate string handling concepts using JAVA.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,15)

**Reference Books:**

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806.
2. Rajkumar Buyya,SThamarasiselvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.
3. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.
4. Anita Seth and B L Juneja, JAVA One step Ahead, Oxford University Press, 2017.

**Weblinks and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using JAVA

## VI Semester

<b>MACHINE LEARNING LABORATORY</b>			
Course Code	21AIL66	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 2. To learn and understand the Importance Machine learning Algorithms			
CLO 3. Compare and contrast the learning techniques like ANN approach, Bayesian learning and reinforcement learning.			
CLO 4. Able to solve and analyse the problems on ANN, Instance based learning and Reinforcement learning techniques.			
CLO 5. To impart the knowledge of clustering and classification Algorithms for predictions and evaluating Hypothesis.			
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>• Students should be familiarized about Python installation and setting Python environment</li> <li>• Usage and installation of Anaconda should be introduced <a href="https://www.anaconda.com/products/individual">https://www.anaconda.com/products/individual</a></li> <li>• Should have the knowledge about Probability theory, Statistics theory and linear Algebra.</li> <li>• Should have the knowledge of numpy, pandas, scikit-learn and scipy library packages.</li> </ul>			
<b>Sl. No.</b>	<b>PART A – List of problems for which student should develop program and execute in the Laboratory</b>		
1	<p>Aim: Illustrate and Demonstrate the working model and principle of Find-S algorithm.</p> <p>Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.</p> <p><b>Text Book 1: Ch2</b></p>		
2	<p>Aim: Demonstrate the working model and principle of candidate elimination algorithm.</p> <p>Program: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.</p> <p><b>Text Book 1: Ch2</b></p> <p>Reference: <a href="https://www.youtube.com/watch?v=tfpAm4kxGQI">https://www.youtube.com/watch?v=tfpAm4kxGQI</a></p>		
3	<p>Aim: To construct the Decision tree using the training data sets under supervised learning concept.</p> <p>Program: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.</p> <p><b>Text Book 1: Ch 3</b></p>		
4	<p>Aim: To understand the working principle of Artificial Neural network with feed forward and feed backward principle.</p> <p>Program: Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.</p> <p><b>Text Book 1: Ch 4</b></p>		



5	<p>Aim: Demonstrate the text classifier using Naïve bayes classifier algorithm.</p> <p>Program: Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.</p> <p><b>Text Book 1: Ch6</b></p>
6	<p>Aim: Demonstrate and Analyse the results sets obtained from Bayesian belief network Principle.</p> <p>Program:- Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API.</p> <p><b>Text Book 1: Ch 6</b></p>
7	<p>Aim: Implement and demonstrate the working model of K-means clustering algorithm with Expectation Maximization Concept.</p> <p>Program: Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.</p> <p><b>Text Book 1: Ch 8</b></p>
8	<p>Aim: Demonstrate and analyse the results of classification based on KNN Algorithm.</p> <p>Program: Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.</p> <p><b>Text Book 1: Ch 8</b></p>
9	<p>Aim: Understand and analyse the concept of Regression algorithm techniques.</p> <p>Program: Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.</p> <p><b>Text Book 1: Ch8</b></p>
10	<p>Aim: Implement and demonstrate classification algorithm using Support vector machine Algorithm.</p> <p>Program: Implement and demonstrate the working of SVM algorithm for classification.</p> <p><b>Text Book 2: Ch6</b></p>
<b>Pedagogy</b>	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk & Talk
<b>PART B</b>	
	A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the Program for the given problem with appropriate outputs.
<p><b>Course Outcomes:</b> At the end of the course the student will be able to:</p> <p>CO 1. Understand the Importance of different classification and clustering algorithms.</p> <p>CO 2. Demonstrate the working of various algorithms with respect to training and test data sets.</p> <p>CO 3. Illustrate and analyze the principles of Instance based and Reinforcement learning techniques.</p> <p>CO 4. Elicit the importance and Applications of Supervised and unsupervised machine learning.</p> <p>CO 5. Compare and contrast the Bayes theorem principles and Q learning approach.</p>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student</p>	

shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

### **Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

### **Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should*

*develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*

- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- *Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).*
- *The duration of SEE is 03 hours*
- *Rubrics suggested in Annexure-II of Regulation book*

**Text Books:**

1. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2017.
2. Nello Cristianini, John Shawe-Taylor, An Introduction to Support Vector Machines and Other Kernel-based Learning Methods, Cambridge University Press, 2013
3. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>)

**Suggested Web Links / E Resource**

1. <https://www.kaggle.com/general/95287>
2. <https://web.stanford.edu/~hastie/Papers/ESLII.pdf>

## VII Semester

<b>ADVANCED AI AND ML</b>			
Course Code	21AI71	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
CLO 1. Demonstrate the fundamentals of Intelligent Agents CLO 2. Illustrate the reasoning on Uncertain Knowledge CLO 3. Explore the explanation-based learning in solving AI problems CLO 4. Illustrate the use of KNN CLO 5. Explore the Text feature Engineering concepts with Applications			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Intelligent Agents:</b> Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents			
<b>Problem Solving :</b> Game Paying			
<b>Text book 1: Chapter 2, Chapter 5 (2.1 to 2.4, 5.1 to 5.6)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Uncertain knowledge and Reasoning:</b> Quantifying Uncertainty, Acting under Uncertainty , Basic Probability Notation, Inference Using Full Joint Distributions, Independence , Bayes' Rule and Its Use The WumpusWorld Revisited,			
<b>Text book 1: Chapter 13</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution			

and Learning.

**Text book 2: chapter 4.1-4.6 & 9.1-9.5**

**Neural networks and genetic algorithms:**

Brief history and Evolution of Neural network, Biological neuron, Basics of ANN, Activation function, MP model.

**Text book 3: chapter 6**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

#### Module-4

**Recommender System:**

Datasets, Association rules, Collaborative filtering, User-based similarity, item-based similarity, using surprise library, Matrix factorization

**Text Analytics:**

Overview, Sentiment Classification, Naïve Bayes model for sentiment classification, using TF-IDF vectorizer, Challenges of text analytics

**Text book 4: Chapter 9 and 10**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
----------------------------------	--------------------------------------

#### Module-5

**Clustering**

**Introduction,** Types of clustering, Partitioning methods of clustering (k-means, k-medoids), hierarchical methods

**Text book 3: Chapter 13**

Instance Based Learning: Introduction, k-nearest neighbour learning(review), locally weighted regression, radial basis function, cased-based reasoning,

**Text book 2: Chapter 8.1-8.5**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes**

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

- CO 1. Demonstrate the fundamentals of Intelligent Agents
- CO 2. Illustrate the reasoning on Uncertain Knowledge
- CO 3. Explore the explanation-based learning in solving AI problems
- CO 4. Apply effectively ML algorithms to solve real world problems.
- CO 5. Apply Instant based techniques and derive effectively learning rules to real world problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE

(Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Artificial Intelligence, A Modern Approach, Stuart J. Russell and Peter Norvig, Third Edition, Pearson, 2010
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
3. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley 2019
4. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley 2019

**Reference:**

1. An Introduction to Multi Agent Systems, Michael Wooldridge, Second Edition, John Wiley & Sons

**Web links and Video Lectures (e-Resources):**

1. [https://www.youtube.com/playlist?list=PLwdnzlV3ogoXaceHrrFVZCJkmb\\_laSHcH](https://www.youtube.com/playlist?list=PLwdnzlV3ogoXaceHrrFVZCJkmb_laSHcH)
2. <https://nptel.ac.in/courses/106/102/106102220/>
3. [https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6\\_SY5qznc77](https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77)
4. <https://nptel.ac.in/courses/106/106/106106139/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>CLOUD COMPUTING</b>			
Course Code	21CS72	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	02	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers</p> <p>CLO 2. Introduce various models of cloud computing</p> <p>CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.</p> <p>CLO 4. Realize the importance of Cloud Virtualization, Abstraction`s and Enabling Technologies and cloud security</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b>			
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka			
<b>Textbook 1: Chapter 1: 1.1,1.2 and 1.3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Virtualization:</b> Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples			
<b>Textbook 1 : Chapter 3: 3.1 to 3.6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
<b>Cloud Computing Architecture:</b> Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges			

<b>Textbook 1: Chapter 4: 4.1 to 4.5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration
<b>Module-4</b>	
<b>Cloud Security:</b> Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.	
<b>Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9</b>	
<b>Teaching-Learning Process</b>	Chalk and board
<b>Module-5</b>	
<b>Cloud Platforms in Industry</b> Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.	
<b>Textbook 1: Chapter 9: 9.1 to 9.2</b>	
<b>Cloud Applications:</b> Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.	
<b>Textbook 1: Chapter 10: 10.1 to 10.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board
<b>Course outcome (Course Skill Set)</b> At the end of the course the student will be able to: CO 1. Understand and analyze various cloud computing platforms and service provider. CO 2. Illustrate various virtualization concepts. CO 3. Identify the architecture, infrastructure and delivery models of cloud computing. CO 4. Understand the Security aspects of CLOUD. CO 5. Define platforms for development of cloud applications	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>  Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>  1. First test at the end of 5 <sup>th</sup> week of the semester 2. Second test at the end of the 10 <sup>th</sup> week of the semester 3. Third test at the end of the 15 <sup>th</sup> week of the semester  Two assignments each of <b>10 Marks</b>  4. First assignment at the end of 4 <sup>th</sup> week of the semester 5. Second assignment at the end of 9 <sup>th</sup> week of the semester  Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20</b>	



**Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013

**Reference Books**

1. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

**Weblinks and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=1N3oqYhzHv4>
- <https://www.youtube.com/watch?v=RWgW-CgdIk0>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>SOCIAL NETWORK ANALYSIS</b>			
Course Code	21AI731	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand Semantic Web for social network analysis.</p> <p>CLO 2. Learn the Representation, Modelling and Aggregating social network data.</p> <p>CLO 3. Learn the basic algorithms and techniques for detection and decentralization of social network.</p> <p>CLO 4. Study Human behaviour in social networks and its management.</p> <p>CLO 5. Visual representation of social network data in different applications.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction to Semantic Web:</b> Limitations of current Web - Development of Semantic Web - Emergence of the Social Web.</p> <p><b>Social Network analysis:</b> Development of Social Network Analysis - Key concepts and measures in network analysis.</p> <p><b>Electronic sources for network analysis:</b> Electronic discussion networks, Blogs and online communities - Web-based networks.</p> <p><b>Text book 1: Chapter1 – 1.1, 1.3, 1.4, Chapter2 – 2.2 , 2.3, Chapter3 – 3.1 to 3.3</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning,		
<b>Module-2</b>			
<p><b>Knowledge Representation on the Semantic Web:</b> Ontology and their role in the Semantic Web – Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework and schema - Web Ontology Language.</p> <p><b>Modelling and aggregating social network data:</b> State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships -</p>			

Aggregating and reasoning with social network data.	
<b>Text book 1: Chapter4 - 4.1(4.1.1), 4.2(4.2.1,4.2.2), Chapter5 - 5.1 to 5.4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<b>Detecting communities in social networks</b> - Definition of community - Evaluating communities - Methods for community detection - Tools for detecting communities	
<b>Decentralized online social networks</b> - Introduction - Challenges for DOSN - The Case for Decentralizing OSNs - General Purpose DOSNs - Specialized Application Centric DOSNs - Social Distributed Systems - Delay-Tolerant DOSN.	
<b>Text book 2: Chapter 12 - 12.2 to 12.5, Chapter 17</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>Understanding and predicting human behaviour for social communities:</b> User data management - Inference and Distribution - Enabling new human experiences - The Technologies.	
<b>Managing Trust in Online Social Networks:</b> Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons.	
<b>Text book 2: Chapter20 - 20.2, 20.3(20.3.1), Chapter22 - 22.3, 22.5, 22.6, 22.7, 22.9, 22.10</b>	
<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning, MOOC
<b>Module-5</b>	
<b>Visualization of Social Networks:</b> Social Network Analysis - Visualization - Visualizing online social networks,	
<b>Novel Visualizations and Interactions for Social Networks Exploration:</b> Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations.	
<b>Applications of Social Network Analysis:</b> Applications of Social Network Analysis - Covert networks - Community welfare - Collaboration networks - Co-Citation networks.	
<b>Text Book 2: Chapter 27 - 27.2, 27.3, 27.4, Chapter 28 - 28.5, Chapter 29 - 29.3.3, 29.3.5 to 29.3.7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand the Semantic Web and Electronic sources for social network analysis.	
CO 2. Understand the <b>Representation</b> , Modelling and Aggregating social network data.	
CO 3. Analyse the human behaviour in social network.	
CO 4. Apply techniques for detection and decentralization of social network.	
CO 5. Illustrate the visual representation of social network data.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The	

minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester
6. At the end of the 13<sup>th</sup> week of the semester -Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, 1<sup>st</sup> Edition, Springer, 2010.

**Reference:**

1. Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition Springer, 2011.
2. Dion Goh and Schubert Foo, “Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling”, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009

**Web links and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=liUDKDxScxI>
2. <http://www.nitttrc.edu.in/nptel/courses/video/106106146/L21.html>
3. <https://www.youtube.com/watch?v=DTxE9KV3YrE>
4. <https://www.youtube.com/watch?v=MQsTxRMMy3Xg>
5. <https://www.youtube.com/watch?v=BQWoMRS5CGA>
6. [https://onlinecourses.nptel.ac.in/noc20\\_cs78/preview](https://onlinecourses.nptel.ac.in/noc20_cs78/preview)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>DIGITAL IMAGE PROCESSING</b>			
Course Code	21CS732	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand the fundamentals of digital image processing</p> <p>CLO 2. Explain the image transform techniques used in digital image processing</p> <p>CLO 3. Apply different image enhancement techniques on digital images</p> <p>CLO 4. Evaluate image restoration techniques and methods used in digital imageprocessing</p> <p>CLO 5. Understand the Morphological Operations and Segmentation used in digital imageprocessing</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Digital Image Fundamentals:</b> What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.</p>			
<p><b>Textbook 1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<p><b>Spatial Domain:</b> Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters</p>			
<p><b>Frequency Domain:</b> Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.</p>			
<p><b>Textbook 1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10</b></p>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk and board, Active Learning, Demonstration</li> <li>2. Laboratory Demonstration</li> </ol>		
<b>Module-3</b>			
<p><b>Restoration:</b> Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and</p>			

Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, InverseFiltering, Minimum Mean Square Error (Wiener) Filtering, ConstrainedLeast Squares Filtering.

**Textbook 1: Chapter 5: Sections 5.2, to 5.9**

<b>Teaching-Learning Process</b>	1. Chalk and board
----------------------------------	--------------------

**Module-4**

**Color Image Processing:** Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multiresolution Expansions.

**Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

**Text: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2, Chapter 9: Sections 9.1 to 9.5**

<b>Teaching-Learning Process</b>	1.Chalk& board 2.Demonstartion of Case study /Application for wavelet transfer method
----------------------------------	--

**Module-5**

**Segmentation:** Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, Principles of Thresholding.

**Representation and Description:** Representation, Boundary descriptors.

**Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2**

<b>Teaching-Learning Process</b>	1.Chalk and board, MOOC. 2. Poster making activity for various image segmentation algorithms
----------------------------------	---

**Course Outcomes**

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

- CO 1. Understand the fundamentals of Digital Image Processing.
- CO 2. Apply different Image transformation techniques
- CO 3. Analyze various image restoration techniques
- CO 4. Understand colour image and morphological processing
- CO 5. Design image analysis and segmentation techniques

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

**Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2<sup>nd</sup> Edition, 2016

**Reference:**

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004

**Weblinks and Video Lectures (e-Resources):**

1. [https://https://nptel.ac.in/courses/106/105/106105032/](https://nptel.ac.in/courses/106/105/106105032/)
2. <https://github.com/PrajwalPrabhuiisc/Image-processing-assignments>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration of finding the histogram from grayscale image, to check the low pass filter properties, filtering the images using Gaussian low pass filter, etc... using Python programming

Practical Based Assignment like following or any topic which is in-line with the course requirement. Students shall present and demonstrate their work at the end of semester.

- Program to show rotation, scaling, and translation of an image.
- Read an image and extract and display low-level features such as edges, textures using filtering techniques
- Demonstrate enhancing and segmenting low contrast 2D images.
- To Read an image, first apply erosion to the image and then subtract the result from the original.

## VII Semester

<b>FULLSTACK DEVELOPMENT</b>			
Course Code	21AI733	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 T	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Learning Objectives:</b></p> <p>CLO 1.Explain the use of learning full stack web development.</p> <p>CLO 2.Make use of rapid application development in the design of responsive web pages.</p> <p>CLO 3.Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.</p> <p>CLO 4.Demonstrate the use of state management and admin interfaces automation in Django.</p> <p>CLO 5.Design and implement Django apps containing dynamic pages with SQL databases.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1: MVC based Web Designing</b>			
<p>Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.</p> <p><b>Textbook 1: Chapter 1 and Chapter 3</b></p>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration using Visual Studio Code</li> <li>PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>Live coding of all concepts with simple examples</li> </ol>		
<b>Module-2: Django Templates and Models</b>			
<p>Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.</p> <p>Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution</p> <p><b>Textbook 1: Chapter 4 and Chapter 5</b></p>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration using Visual Studio Code</li> <li>PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>Live coding of all concepts with simple examples</li> </ol>		



	4. Case Study: Apply concepts learnt for an Online Ticket Booking System
<b>Module-3: Django Admin Interfaces and Model Forms</b>	
Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.	
Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.	
<b>Textbook 1: Chapters 6, 7 and 8</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration using Visual Studio Code</li> <li>2. PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>3. Live coding of all concepts with simple examples</li> </ol>
<b>Module-4: Generic Views and Django State Persistence</b>	
Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.	
MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.	
<b>Textbook 1: Chapters 9, 11 and 12</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration using Visual Studio Code</li> <li>2. PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>3. Live coding of all concepts with simple examples</li> <li>4. Project Work: Implement all concepts learnt for Student Admission Management.</li> </ol>
<b>Module-5: jQuery and AJAX Integration in Django</b>	
Ajax Solution, Java Script, XMLHttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django	
<b>Textbook 2: Chapters 1, 2 and 7.</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration using Visual Studio Code</li> <li>2. PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>3. Live coding of all concepts with simple examples</li> <li>4. Case Study: Apply the use of AJAX and jQuery for development of EMI calculator.</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Understand the working of MVT based full stack web development with Django.	
CO 2. Designing of Models and Forms for rapid development of web pages.	
CO 3. Analyze the role of Template Inheritance and Generic views for developing full stack web applications.	
CO 4. Apply the Django framework libraries to render nonHTML contents like CSV and PDF.	
CO 5. Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is	

50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011

**Reference Books**

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3<sup>rd</sup> Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2<sup>nd</sup> Edition, Pack Publishers, 2020.
5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1<sup>st</sup> Edition, Oreily Publications,

2014

**Weblinks and Video Lectures (e-Resources):**

1. MVT architecture with Django: <https://freevideolectures.com/course/3700/django-tutorials>
2. Using Python in Django: <https://www.youtube.com/watch?v=2BqoLiMT3Ao>
3. Model Forms with Django: <https://www.youtube.com/watch?v=gMM1rtTwKxE>
4. Real time Interactions in Django: <https://www.youtube.com/watch?v=3gHmfoeZ45k>
5. AJAX with Django for beginners: <https://www.youtube.com/watch?v=3VaKNyjlxAU>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the Django framework concepts and its integration with AJAX to develop any shopping website with admin and user dashboards.

## VII Semester

<b>BLOCKCHAIN TECHNOLOGY</b>			
Course Code	21CS734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Explain the fundamentals of distributed computing and blockchain</p> <p>CLO 2. Discuss the concepts in bitcoin</p> <p>CLO 3. Demonstrate Ethereum platform</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Blockchain 101:</b> Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.			
<b>Decentralization and Cryptography:</b> Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.			
<b>Textbook 1: Chapter 1, 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning – Oral presentations.		
<b>Module-2</b>			
<b>Introduction to Cryptography &amp; Cryptocurrencies:</b> Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency,			
<b>How Bitcoin Achieves Decentralization:</b> Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Putting it all together,			
<b>Textbook 2: Chapter 1, 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration		
<b>Module-3</b>			
<b>Mechanics of Bitcoin:</b> Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements			
<b>How to Store and Use Bitcoins:</b> Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys,			

Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets

**Textbook2: Chapter 3,4**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration, MOOC
----------------------------------	--

**Module-4**

**Bitcoin Mining:** The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies,

**Bitcoin and Anonymity:** Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash,

**Textbook2: Chapter 5,6**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning, MOOC
----------------------------------	--

**Module-5**

**Smart Contracts and Ethereum 101:**

Smart Contracts: Definition, Ricardian contracts.

**Ethereum 101:** Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

**Textbook 1: Chapter 10**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC, Practical Demonstration
----------------------------------	--

**Course Outcomes**

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

- CO 1. Describe the concepts of Distributed computing and its role in Blockchain
- CO 2. Describe the concepts of Cryptography and its role in Blockchain
- CO 3. List the benefits, drawbacks and applications of Blockchain
- CO 4. Appreciate the technologies involved in Bitcoin
- CO 5. Appreciate and demonstrate the Ethereum platform to develop blockchain application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy**

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward W. Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

**Reference:**

1. Mastering Bitcoins: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos. O'Reilly Media, Inc, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. [http://bitcoinbook.cs.princeton.edu/?\\_ga=2.8302578.1344744326.1642688462-86383721.1642688462](http://bitcoinbook.cs.princeton.edu/?_ga=2.8302578.1344744326.1642688462-86383721.1642688462)
2. <https://nptel.ac.in/courses/106/105/106105184/>
3. <https://ethereum.org/en/developers/>
4. <https://developer.ibm.com/components/hyperledger-fabric/tutorials/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>INTERNET OF THINGS</b>			
Course Code	21CS735	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.</p> <p>CLO 2. Understand the recent application domains of IoT in everyday life.</p> <p>CLO 3. Understand the protocols and standards designed for IoT and the current research on it.</p> <p>CLO 4. Understand the other associated technologies like cloud and fog computing in the domain of IoT.</p> <p>CLO 5. Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.</p> <p>CLO 6. Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Emergence of IoT:</b> Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.			
<b>Textbook 1: Chapter 4 - 4.1 to 4.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>IoT Sensing and Actuation:</b> Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.			
<b>Textbook 1: Chapter 5 - 5.1 to 5.9</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>IoT Processing Topologies and Types:</b> Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.			

<b>Textbook 1: Chapter 6 – 6.1 to 6.5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>IoT Connectivity Technologies:</b> Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth	
<b>Textbook 1: Chapter 7 – 7.1 to 7.16</b>	
<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning
<b>Module-5</b>	
<b>IoT Communication Technologies:</b> Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols	
<b>IoT Interoperability:</b> Introduction, Taxonomy of interoperability, Standards, Frameworks	
<b>Textbook 1: Chapter 8 – 8.1, 6.2, 8.3, 8.4, 8.5, 8.6, .7</b>	
<b>Textbook 1: Chapter 9 – 9.1, 9.2, 9.3</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand the evolution of IoT, IoT networking components, and addressing strategies in IoT.	
CO 2. Analyze various sensing devices and actuator types.	
CO 3. Demonstrate the processing in IoT.	
CO 4. Apply different connectivity technologies.	
CO 5. Understand the communication technologies , protocols and interoperability in IoT.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
6. At the end of the 13 <sup>th</sup> week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks.	



2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.

**Reference:**

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>AUGMENTED REALITY</b>			
Course Code	21AI741	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
CLO 1. Understand the importance of Augmented reality			
CLO 2. Understand and analyse the importance of Tracking system.			
CLO 3. Compare and contrast the computer vision for Augmented reality and its applications			
CLO 4. Analyse and understand Registration and camera simulation of visual coherence.			
CLO 5. Acquire knowledge of Situated Visualization			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain the functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Augmented Reality</b>			
What Is Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Displays-Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model			
<b>Text book 1: Chapter 1,2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Tracking:</b> Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion			
<b>Text book 1: Chapter 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Computer Vision for Augmented Reality</b> -Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking			

Calibration and Registration-Camera Calibration, Display Calibration, Registration	
<b>Text book 1: Chapter 4,5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>Visual Coherence:</b> Registration, Photometric Registration, Common Illumination, Diminished Reality, Camera Simulation, Stylized Augmented Reality	
<b>Text book 1: Chapter 6</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<b>Situated Visualization:</b> Challenges, Visualization Registration, Annotations and Labeling, X-Ray Visualization, Spatial Manipulation, Information Filtering Interaction-Output Modalities, Input Modalities, Tangible Interfaces	
<b>Text Book 1: Chapter 7,8</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b> At the end of the course the student will be able to: CO1: Understand the importance of Augmented reality CO2: Comprehend and analyse the Tracking system. CO3: Compare and Contrast the computer vision for Augmented reality CO4: Analyse and understand Registration and camera simulation of visual coherence. CO5: Acquire knowledge of Situated Visualization	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>  Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>  <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> Two assignments each of <b>10 Marks</b>  <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol> Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>  <ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol> The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and	

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question papers are designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Augmented Reality: Principles and Practice by Dieter SCHMALSTIEG,Tobias HOLLERER

**Reference:**

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
2. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija - Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
3. Allan Fowler-AR Game Development||, 1st Edition, A press Publications, 2018, ISBN 978-1484236178

**Web links and Video Lectures (e-Resources):**

e-Books:

1. <https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf>
2. <https://docs.microsoft.com/en-us/windows/mixed-reality/>
3. <https://docs.microsoft.com/enus/archive/msdnmagazine/2016/november/hololensintroduction-to-the-hololens>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>MULTIAGENT SYSTEMS</b>			
Course Code	21CS742	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To introduce the concept of a multi agent systems and Distributed Constraints</p> <p>CLO 2. Explore the main issues surrounding the computer and extended form games.</p> <p>CLO 3. Develop cooperative learning, stochastic games</p> <p>CLO 4. Exhibit the awareness about protocols about multi agent resource allocation and auctions</p> <p>CLO 5. Construct voting mechanism design.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1: Multiagent Problem Formulation</b>			
Utility, Markov Decision Processes, Planning			
<b>Distributed Constraints:</b> Distributed Constraint Satisfaction, Distributed Constraint Optimization			
<b>Textbook 1: Chapters 1 &amp;2, Textbook 2: Chapter 1</b>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Decision Processes, Planning</li> <li>2. Demonstration of constraints and their optimization</li> </ol>		
<b>Module-2: Standard and Extended Form Games</b>			
Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation			
<b>Textbook 1: Chapters 3 &amp; 4, Textbook 2: Chapter 3</b>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Games in different forms</li> <li>2. Demonstration of coalition formation</li> </ol>		
<b>Module-3: Learning in Multiagent Systems</b>			
The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence			
<b>Textbook 1: Chapters 5</b>			

<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Cooperative learning, Collective intelligence</li> <li>2. Demonstration of stochastic games</li> </ol>
<b>Module-4: Negotiation</b>	
<p>The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hoc Negotiation Strategies, The Task Allocation Problem.</p> <p><b>Protocols for Multiagent Resource Allocation: Auctions:</b> Simple Auctions, Combinatorial Auctions</p> <p><b>Textbook 1: Chapters 6&amp;7,</b> <b>Textbook 2: Chapter 11</b></p>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Bargaining problems</li> <li>2. Demonstration of different auctions for resource allocation</li> </ol>
<b>Module-5: Voting and Mechanism Design</b>	
<p>The Voting Problem, Mechanism Design. <b>Nature-Inspired Approaches:</b> Ants and Termites, Immune System</p> <p><b>Textbook 1: Chapters 8&amp;10,</b> <b>Textbook 2: Chapter 10</b></p>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Voting Problem</li> <li>2. Demonstration of nature inspired Approaches</li> </ol>
<p><b>Course Outcomes</b></p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. Demonstrate the decision process with different constraints</li> <li>CO 2. Analyze games in different forms</li> <li>CO 3. Apply the cooperative learning in developing games</li> <li>CO 4. Analyze different negotiation strategies of Multi-Agent System</li> <li>CO 5. Design and develop solutions for voting problems</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b></p> <p>Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> <p>Two assignments each of <b>10 Marks</b></p> <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p> <ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol> <p>The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b></p> <p>(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).</p> <p><b>CIE methods /question papers are designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b></p> <p><b>Semester End Examination:</b></p>	

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Multiagent Systems by Jos'e M. Vidal, 2006, available online  
<http://jmvidal.cse.sc.edu/papers/mas.pdf>.
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations,  
By YoavShoham, Kevin Leyton-Brown, Cambridge University Press, 2008, 2<sup>nd</sup>ed  
<http://www.masfoundations.org/mas.pdf>

**Reference:**

1. Multiagent Systems : A Modern Approach to Distributed Artificial Intelligence Gerhard Weiss The MIT Press 2000

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/105/106105077/>
2. <https://www.youtube.com/watch?v=O2su1u2AXG0>.
3. <https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi-agent-systems-kAKyC>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>PREDICTIVE ANALYTICS</b>			
Course Code	21AI743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Comprehend the fundamental principles of analytics for business</p> <p>CLO 2. Explore various techniques for predictive modelling</p> <p>CLO 3. Analyse the data transformation of different predictors</p> <p>CLO 4. Examine how predictive analytics can be used in decision making</p> <p>CLO 5. Apply predictive models to generate predictions for new data</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Predictive analytics</b> – Business analytics: types, applications, Analytical Techniques, Tools			
<b>Predictive Modelling:</b> Propensity Models, Cluster Models, Applications.			
<b>Text book 1: Chapter 1, 2.</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Modelling Techniques:</b> Statistical Modelling, Machine Learning, Empirical Bayes Method, Point Estimation.			
<b>Text book 1: Chapter 3,4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
<b>Data Pre-processing:</b> Data Transformations for Individual Predictors, Data Transformation for Multiple Predictors, Dealing with Missing Values, Removing Predictors, Adding Predictors, Binning Predictors. Over-Fitting and Model Tuning.			



<b>Text book 2: 3, 4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning
<b>Module-4</b>	
<b>Regression Models:</b> Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures.	
<b>Text book 2: Chapter 5,6,7,8</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Active Learning, MOOC
<b>Module-5</b>	
<b>Classification Models:</b> Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models – Model Evaluation Techniques.	
<b>Text Book 2: Chapter 11,12,13,14</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
<p>CO 1. Understand the importance of predictive analytics, able to prepare and process data for the models</p> <p>CO 2. Apply the statistical techniques for predictive models</p> <p>CO 3. Comprehend the transformation of data in the predictors.</p> <p>CO 4. Apply regression and classification models for decision making and evaluate the performance</p> <p>CO 5. Apply and build the time series forecasting models in a variety of business contexts</p>	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
<ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books**

1. Jeffrey S. Strickland, Predictive Analytics using R, 2014
2. Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**Reference:**

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, 1<sup>st</sup> Edition Wiley, 2014.

**Web links and Video Lectures (e-Resources):**

1. <https://www.coursera.org/lecture/fundamentals-of-data-analysis/introduction-to-predictive-analytics-u4H61>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT</b>			
Course Code	21CS744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
<b>Course Learning Objectives</b>			
<p>CLO 1. To understand basic concepts of RPA            CLO 2. To Describe RPA, where it can be applied and how its implemented            CLO 3. To Describe the different types of variables, Control Flow and data manipulation techniques            CLO 4. To Understand Image, Text and Data Tables Automation            CLO 5. To Describe various types of Exceptions and strategies to handle</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>RPA Foundations-</b> What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps-Flowcharts.</p>			
<b>Textbook 1: Ch 1, Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<p><b>RPA Platforms-</b> Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.</p>			
<b>Textbook 2: Ch 1, Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<p><b>Sequence, Flowchart, and Control Flow-</b>Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step</p>			

example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

**Textbook 2: Ch 3, Ch 4**

**Teaching-Learning Process**

Chalk and board, Problem based learning, Demonstration

**Module-4**

**Taking Control of the Controls-** Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

**Textbook 2: Ch 5**

**Teaching-Learning Process**

Chalk& board, Problem based learning

**Module-5**

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

**Textbook 2: Ch 8**

**Textbook 1: Ch 13**

**Teaching-Learning Process**

Chalk and board, MOOC

**Course Outcomes**

- CO 1. To Understand the basic concepts of RPA
- CO 2. To Describe various components and platforms of RPA
- CO 3. To Describe the different types of variables, control flow and data manipulation techniques
- CO 4. To Understand various control techniques and OCR in RPA
- CO 5. To Describe various types and strategies to handle exceptions

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Tom Taulli , The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : Apress
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

**Reference:**

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3. Srikanth Merianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation

**Weblinks and Video Lectures (e-Resources):**

- <https://www.uipath.com/rpa/robotic-process-automation>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>NOSQL DATABASE</b>			
Course Code:	21CS745	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Recognize and Describe the four types of NoSQL Databases, the Document-oriented, Key-Value            CLO 2. Pairs, Column-oriented and Graph databases useful for diverse applications.            CLO 3. Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL            Databases.            CLO 4. Differentiate the detailed architecture of column oriented NoSQL database, Document database            and Graph Database and relate usage of processor, memory, storage and file system commands.            CLO 5. Evaluate several applications for location based service and recommendation services. Devise an            application using the components of NoSQL.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course            outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer methods (L) need not to be only traditional lecture methods, but alternative effective              teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical              thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design              thinking skills such as the ability to design, evaluate, generalize, and analyze information rather              than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with              their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps              improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p>Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A            (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the            Clusters, The Emergence of NoSQL,</p> <p>Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate            Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-            Oriented Databases.</p> <p>More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views,            Modeling for Data Access,  <b>Textbook1: Chapter 1,2,3</b></p>			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-2</b>			
<p>Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication,            Combining Sharding and Replication.</p>			

Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums.	
Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes	
<b>Textbook1: Chapter 4,5,6</b>	
<b>Teaching-Learning Process</b>	Active Learning and Demonstrations
<b>Module-3</b>	
Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce	
Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets	
<b>Textbook1: Chapter 7,8</b>	
<b>Teaching-Learning Process</b>	Active Learning, Problem solving based
<b>Module-4</b>	
Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure	
<b>Textbook1: Chapter 9</b>	
<b>Teaching-Learning Process</b>	Active learning
<b>Module-5</b>	
Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.	
<b>Textbook1: Chapter 11</b>	
<b>Teaching-Learning Process</b>	Active learning
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO1. Demonstrate an understanding of the detailed architecture of Column Oriented NoSQL databases, Document databases, Graph databases.	
CO2. Use the concepts pertaining to all the types of databases.	
CO3. Analyze the structural Models of NoSQL.	
CO4. Develop various applications using NoSQL databases.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addison Wesley, 2012

**Reference Books**

1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN- 13: 978-9332557338)
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694)

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.geeksforgeeks.org/introduction-to-nosql/> ( and related links in the page)
2. <https://www.youtube.com/watch?v=0buKQHokLK8> (How do NoSQL databases work? Simply explained)
3. <https://www.techtarget.com/searchdatamanagement/definition/NoSQL-Not-Only-SQL> (What is NoSQL and How do NoSQL databases work)
4. <https://www.mongodb.com/nosql-explained> (What is NoSQL)
5. <https://onlinecourses.nptel.ac.in/noc20-cs92/preview> (preview of Bigdata course contains NoSQL)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.



## VII Semester

<b>PROGRAMMING IN PYTHON</b>			
Course Code	21CS751	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To understand why Python is a useful scripting language for developers</p> <p>CLO 2. To read and write simple Python programs</p> <p>CLO 3. To learn how to identify Python object types.</p> <p>CLO 4. To learn how to write functions and pass arguments in Python.</p> <p>CLO 5. To use Python data structures -- lists, tuples, dictionaries.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>INTRODUCTION DATA, EXPRESSIONS, STATEMENTS:08 Hours</b>			
Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.			
<b>Textbook 1: Chapter 1.1,1.2,1.3,1.6, Chapter 2.1-2.6</b>			
<b>Textbook 2: Chapter 1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>CONTROL FLOW, LOOPS:</b>			
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, break, continue, pass statement.			
<b>Textbook 1: Chapter 3.1-3.6, chapter 5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>FUNCTIONS AND STRINGS:</b>			
Functions: Function calls, adding new functions, definition and uses, local and global scope, return values. Strings: strings, length of string, string slices, immutability, multiline comments, string functions and methods;			

<b>Textbook 1: Chapter 6</b>	
<b>Textbook 2: Chapter 3</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-4</b>	
<b>LISTS, TUPLES, DICTIONARIES:08 Hours</b>	
<b>Lists:</b> List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, list comprehension;	
<b>Tuples:</b> tuple assignment, tuple as return value, tuple comprehension;	
<b>Dictionaries:</b> operations and methods, comprehension;	
<b>Textbook 2: Chapter 10,11,12</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Active Learning
<b>Module-5</b>	
<b>REGULAR EXPRESSIONS,FILES AND EXCEPTION:</b>	
<b>Regular expressions:</b> Character matching in regular expressions, extracting data using regular expressions, Escape character	
<b>Files and exception:</b> Text files, reading and writing files, command line arguments, errors and exceptions, handling exceptions, modules.	
<b>Textbook 1: Chapter 11.1,11.2,11.4</b>	
<b>Textbook 2: Chapter 14</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Suggested Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.	
CO 2. Demonstrate proficiency in handling Strings and File Systems.	
CO 3. Represent compound data using Python lists, tuples, Strings, dictionaries.	
CO 4. Read and write data from/to files in Python Programs	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016.  
[http://do1.dr-chuck.com/pythonlearn/EN\\_us/pythonlearn.pdf](http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf)
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Chapters 15, 16, 17)  
<http://greenteapress.com/thinkpython2/thinkpython2.pdf>

**REFERENCE BOOKS:**

1. R. Nageswara Rao, "Core Python Programming", dreamtech
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming, Reema theraja, OXFORD publication

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.w3resource.com/python/python-tutorial.php>
2. <https://data-flair.training/blogs/python-tutorials-home/>
3. <https://www.youtube.com/watch?v=c235EsGFcZs>
4. <https://www.youtube.com/watch?v=v4e6oMRS2QA>
5. <https://www.youtube.com/watch?v=Uh2ebFW8OYM>
6. <https://www.youtube.com/watch?v=oSPMmeaiQ68>
7. <https://www.youtube.com/watch?v=uQrj0TkZlc>
8. <https://www.youtube.com/watch?v=K8L6KVGg-7o>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using python language

## VII Semester

<b>INTRODUCTION TO AI AND ML</b>			
Course Code	21CS752	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CL01. Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving CL02. Explore the basics of Machine Learning & Machine Learning process, understanding data CL03. Understand the Working of Artificial Neural Networks			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b> What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence, Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.			
<b>Textbook 1: Chapter: 1 and 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Problem solving by searching:</b> Problem solving agents, Example problems, Searching for solutions, Uniformed search strategies, Informed search strategies, Heuristic functions			
<b>Textbook 1: Chapter: 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Introduction to machine learning:</b> Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.			
<b>Understanding Data:</b> What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization			
<b>Textbook 2: Chapter: 1 and 2.1 to 2.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-4</b>			

**Understanding Data**

Bivariate and Multivariate data, Multivariate statistics , Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques,

**Basics of Learning Theory:** Introduction to learning and its types, Introduction computation learning theory, Design of learning system, Introduction concept learning.

**Similarity-based learning:** Introduction to Similarity or instance based learning, Nearest-neighbour learning, weighted k- Nearest - Neighbour algorithm.

**Textbook 2: Chapter: 2.6 to 2.10, 3.1 to 3.4, 4.1 to 4.3**

**Teaching-Learning Process**

Chalk& board, Problem based learning

**Module-5**

**Artificial Neural Network:** Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network, learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map,

**Textbook 2: Chapter: 10**

**Teaching-Learning Process**

Chalk and board, MOOC

**Course Outcomes**

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

- CO 1. Design intelligent agents for solving simple gaming problems.
- CO 2. Have a good understanding of machine leaning in relation to other fields and fundamental issues and Challenges of machine learning
- CO 3. Understand data and applying machine learning algorithms to predict the outputs.
- CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 3<sup>rd</sup> Edition, Pearson Education, 2015.
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford ,2021

**REFERENCE BOOKS:**

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980, ISBN: 978-3-540-11340-9.

**Weblinks and Video Lectures (e-Resources):**

<http://stpk.cs.rtu.lv/sites/all/files/stpk/materiali/MI/Artificial%20Intelligence%20A%20Modern%20Approach.pdf>

1. [http://www.getfreebooks.com/16-sites-with-free-artificial-intelligence-e-books/https://www.tutorialspoint.com/artificial\\_intelligence/artificial\\_intelligence\\_overview.htm](http://www.getfreebooks.com/16-sites-with-free-artificial-intelligence-e-books/https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_overview.htm)
2. [Problem solving agent:https://www.youtube.com/watch?v=KTPmo-KsOis.](https://www.youtube.com/watch?v=KTPmo-KsOis)
3. [https://www.youtube.com/watch?v=X\\_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCjKbm\\_laSHcH](https://www.youtube.com/watch?v=X_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCjKbm_laSHcH)
4. <https://www.javatpoint.com/history-of-artificial-intelligence>
5. <https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence>
6. <https://techvidvan.com/tutorials/ai-heuristic-search/>
7. <https://www.analyticsvidhya.com/machine-learning/>
8. <https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/>
9. <https://www.javatpoint.com/unsupervised-artificial-neural-networks>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to AI and ML.

## VII Semester

<b>INTRODUCTION TO BIG DATA</b>			
Course Code	21CS753	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand Hadoop Distributed File system and examine MapReduce Programming</p> <p>CLO 2. Explore Hadoop tools and manage Hadoop with Sqoop</p> <p>CLO 3. Appraise the role of data mining and its applications across industries</p> <p>CLO 4. Identify various Text Mining techniques</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Hadoop Distributed file system:</b> HDFS Design, Features, HDFS Components, HDFS user commands			
Hadoop MapReduce Framework: The MapReduce Model, Map-reduce Parallel Data Flow,Map Reduce Programming			
<b>Textbook 1: Chapter 3,5,6,8hr</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Essential Hadoop Tools:</b> Using apache Pig, Using Apache Hive, Using Apache Sqoop, Using Apache Apache Flume, Apache H Base			
<b>Textbook 1: Chapter 7,8hr</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Data Warehousing:</b> Introduction, Design Consideration, DW Development Approaches, DW Architectures			
<b>Data Mining:</b> Introduction, Gathering, and Selection, data cleaning and preparation, outputs of Data Mining, Data Mining Techniques			
<b>Textbook 2: Chapter 4,5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-4</b>			

**Decision Trees:** Introduction, Decision Tree Problem, Decision Tree Constructions, Lessons from Construction Trees. Decision Tree Algorithm

**Regressions:** Introduction, Correlations and Relationships, Non-Linear Regression, Logistic Regression, Advantages and disadvantages.

**Textbook 2: Chapter 6,7**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
----------------------------------	--------------------------------------

**Module-5**

**Text Mining:** Introduction, Text Mining Applications, Text Mining Process, Term Document Matrix, Mining the TDM, Comparison, Best Practices

**Web Mining:** Introduction, Web Content Mining, Web Structured Mining, Web Usage Mining, Web Mining Algorithms.

**Textbook 2: Chapter 11,14**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Suggested Course Outcomes**

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

- CO 1. Master the concepts of HDFS and MapReduce framework.
- CO 2. Investigate Hadoop related tools for Big Data Analytics and perform basic
- CO 3. Infer the importance of core data mining techniques for data analytics
- CO 4. Use Machine Learning algorithms for real world big data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- 1. The question paper will have ten questions. Each question is set for 20 marks.
- 2. There will be 2 questions from each module. Each of the two questions under a module (with a



maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1<sup>st</sup> Edition, Pearson Education, 2016.
2. Anil Maheshwari, "Data Analytics", 1<sup>st</sup> Edition, McGraw Hill Education, 2017

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/104/106104189/>
2. <https://www.youtube.com/watch?v=mNP44rZYiAU>
3. [https://www.youtube.com/watch?v=qr\\_awo5vz0g](https://www.youtube.com/watch?v=qr_awo5vz0g)
4. <https://www.youtube.com/watch?v=rr17cbPGWGA>
5. <https://www.youtube.com/watch?v=G4NYQox4n2g>
6. <https://www.youtube.com/watch?v=owI7zxCqNY0>
7. <https://www.youtube.com/watch?v=FuJVLsZYkuE>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of Big Data related projects

Exploring the applications which involves big data.

## VII Semester

<b>INTRODUCTION TO DATA SCIENCE</b>			
Course Code	21CS754	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To provide a foundation in data Science terminologies</p> <p>CLO 2. To familiarize data science process and steps</p> <p>CLO 3. To Demonstrate the data visualization tools</p> <p>CLO 4. To analyze the data science applicability in real time applications.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>PREPARING AND GATHERING DATA AND KNOWLEDGE</b>			
<p>Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.</p>			
<b>Textbook 1: Ch 1.1 to 1.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation		
<b>Module-2</b>			
<b>THE DATA SCIENCE PROCESS</b> -Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.			
<b>Textbook 1;Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation		
<b>Module-3</b>			
<b>MACHINE LEARNING:</b> Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.			
<b>Textbook 1: Ch 3.1 to 3.3</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, Video
<b>Module-4</b>	
<b>VISUALIZATION</b> –Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.	
<b>Textbook 1: Ch 9</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, MOOC
<b>Module-5</b>	
<b>CASE STUDIES</b> Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money.	
<b>Textbook 1: Ch 5.1, 5.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, Video
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Describe the data science terminologies	
CO 2. Apply the Data Science process on real time scenario.	
CO 3. Analyze data visualization tools	
CO 4. Apply Data storage and processing with frameworks	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks.	
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), <b>should have a mix of topics</b> under that module.	
The students have to answer 5 full questions, selecting one full question from each module	

**Textbooks**

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016.

**Reference Books**

1. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
4. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science>
2. <https://www.youtube.com/watch?v=N6BghzuFLIg>
3. <https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science-tPgFU>
4. <https://www.youtube.com/watch?v=ua-CiDNNj30>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using Data science techniques and demonstration of data visualization methods with the help of suitable project.