VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

3rd to 8th Semester BE –

Artificial Intelligence and Machine Learning (AI)

Scheme of Teaching and Examinations
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Artificial Intelligence and Machine Learning (AI)

Scheme of Teaching and Examinations

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(Effective from the academic year 2018 – 19)

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Transform Calculus, Fourier Series And Numerical Techniques	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18CS32	Data Structures and Applications	CS / IS / AI	3	2	--	03	40	60	100	4
3	PCC	18CS33	Analog and Digital Electronics	CS / IS / AI	3	0	--	03	40	60	100	3
4	PCC	18CS34	Computer Organization	CS / IS / AI	3	0	--	03	40	60	100	3
5	PCC	18CS35	Software Engineering	CS / IS / AI	3	0	--	03	40	60	100	3
6	PCC	18CS36	Discrete Mathematical Structures	CS / IS / AI	3	0	--	03	40	60	100	3
7	PCC	18CSL37	Analog and Digital Electronics Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
8	PCC	18CSL38	Data Structures Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
9	HSMC	18KVK39	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39	Aadalitha Kannada (Kannada for Administration)									
		OR	**OR**									
		18CPH39	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**17**	**10**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					18	**08**		**27**	**360**	**540**		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course

18KVK39 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and **18KAK39**Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

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

10	NCMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. 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 F grade. In such a case, the student have to fulfil the requirements during subsequent semester/s to appear for SEE.

(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the eighth semester grade card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Artificial Intelligence and Machine Learning (AI)

Scheme of Teaching and Examinations

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2018 – 19)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT41	Complex Analysis, Probability And Statistical Methods	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18CS42	Design and Analysis of Algorithms	CS / IS / AI	3	2	--	03	40	60	100	4
3	PCC	18CS43	Operating Systems	CS / IS / AI	3	0	--	03	40	60	100	3
4	PCC	18CS44	Microcontroller and Embedded Systems	CS / IS / AI	3	0	--	03	40	60	100	3
5	PCC	18CS45	Object Oriented Concepts	CS / IS / AI	3	0	--	03	40	60	100	3
6	PCC	18CS46	Data Communication	CS / IS / AI	3	0	--	03	40	60	100	3
7	PCC	18CSL47	Design and Analysis of Algorithm Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
8	PCC	18CSL48	Microcontroller and Embedded Systems Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
9	HSMC	18KVK49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK49	Aadalitha Kannada (Kannada for Administration)									
		OR	**OR**									
		18CPH49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**17 OR 18**	**10 OR 08**	**04**	**24 OR 27**	**420 OR 360**	**480 OR 540**	**900**	**24**

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course

18KVK49 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and **18KAK49**Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

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

10	NCMC	18MATDIP41	Additional Mathematics - II	Mathematics	02	01	--	03	40	60	100	0

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. 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 F grade. In such a case, the student has to fulfil the requirements during subsequent semester/s to appear for SEE.

(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE activity Points: In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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V SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSMC	18CS51	Management and Entrepreneurshipfor IT Industry	HSMC	2	2	--	03	40	60	100	3
2	PCC	18AI52	Python Programming	CS / IS / AI	3	2	--	03	40	60	100	4
3	PCC	18CS53	Database Management System	CS / IS / AI	3	2	--	03	40	60	100	4
4	PCC	18CS54	Automata Theory and Computability	CS / IS / AI	3	--	--	03	40	60	100	3
5	PCC	18AI55	Principles of Artificial Intelligence	CS / IS / AI	3	--	--	03	40	60	100	3
6	PCC	18AI56	Mathematics for Machine Learning	CS / IS / AI	3	--	--	03	40	60	100	3
7	PCC	18AIL57	Artificial Intelligence Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
8	PCC	18CSL58	DBMS Laboratory with mini project	CS / IS / AI	--	2	2	03	40	60	100	2
9	HSMC	18CIV59	Environmental Studies	Civil/ Environmental [Paper setting: Civil Engineering Board]	1	--	--	02	40	60	100	1
				TOTAL	**18**	**10**	**4**	**26**	**360**	**540**	**900**	**25**

Note: PCC: Professional Core, HSMC: Humanity and Social Science.

AICTE activity Points: In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18AI61	Machine Learning	CS / IS / AI	3	2	--	03	40	60	100	4
2	PCC	18AI62	Digital Image Processing	CS / IS / AI	3	2	--	03	40	60	100	4
3	PCC	18AI63	Java for Mobile Applications	CS / IS / AI	3	2	--	03	40	60	100	4
4	PEC	18AI64X	Professional Elective -1	CS / IS / AI	3	--	--	03	40	60	100	3
5	OEC	18AI65X	Open Elective –A	CS / IS / AI	3	--	--	03	40	60	100	3
6	PCC	18AIL66	Machine Learning Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
7	PCC	18AIL67	Digital Image Processing Laboratory with mini project	CS / IS / Ai	--	2	2	03	40	60	100	2
8	MP	18AIL68	Mobile Application Development Laboratory	CS / IS / AI	--	2	2	03	40	60	100	2
9	INT	--	Internship	(To be carried out during the intervening vacations of VI and VII semesters)				--	--	--	--	--
				TOTAL	**15**	**12**	**6**	**24**	**320**	**480**	**800**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OE: Open Elective, MP: Mini-project, INT: Internship.

Professional Elective -1

Course code under18XX64X	Course Title
18AI641	Natural Language Processing
18AI642	Software Project and Management
18AI643	Web Programming
18AI644	Foundation forData Science

Open Elective –A (18CS65x are not to be opted by CSE / ISE /AIML Programs)

18CS651	Mobile Application Development
18CS652	Introduction to Data Structures and Algorithms
18CS653	Programming in JAVA
18CS654	Introduction to Operating System

Students can select any one of the open electives offered by any Department (Please refer to the list of open electives under 18CS65X).
Selection of an open elective is not allowed provided,

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

Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor.

Mini-project work: 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 senior faculty members of the Department, one of whom shall be 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 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 college. 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.

SEE for Mini project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not takeup/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18AI71	Advanced Artificial Intelligence	CS / IS / AI	4	--	--	03	40	60	100	4
2	PCC	18AI72	Advanced Machine Learning	CS / IS / AI	4	--	--	03	40	60	100	4
3	PEC	18AI73X	Professional Elective – 2	CS / IS / AI	3	--	--	03	40	60	100	3
4	PEC	18AI74X	Professional Elective – 3	CS / IS / AI	3	--	--	03	40	60	100	3
5	OEC	18AI75X	Open Elective –B	CS / IS / AI	3	--	--	03	40	60	100	3
6	PCC	18AIL76	AI and ML Application Development Laboratory	CS / IS / AI	--	--	2	03	40	60	100	1
7	Project	18AIP77	Project Work Phase – 1	CS / IS / AI	--	--	2	--	100	--	100	2
8	INT	--	Internship	(If not completed during the vacation of VI and VII semesters, it has to be carried out during the intervening vacations of VII and VIII semesters								
				TOTAL	**17**	--	**4**	**18**	**340**	**360**	**700**	**20**

Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective, INT: Internship.

Professional Elective – 2

Course code under 18CS73X	Course Title		
18AI731	Internet of Things	18AI733	Blockchain Technology
18AI732	Multiagent Systems	18AI734	Cloud Computing and Virtualization

Professional Electives – 3

Course code under 18CS74X	Course Title		
18AI741	Fuzzy Logic& its Applications	18AI743	Semantic Web and Social Network
18AI742	Computer Vision	18AI744	Business Intelligence

Open Elective –B (18CS75x are not to be opted by CSE / ISE / AIML Programs)

18CS751	Introduction to Big Data Analytics
18CS752	Python Application Programming
18CS753	Introduction to Artificial Intelligence
18CS754	Introduction to Dot Net framework for Application Development

Students can select any one of the open electives offered by any Department (Please refer to the list of open electives under 18CS75X).
Selection of an open elective is not allowed provided,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.
- Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor.

Project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

CIE procedure for Project Work Phase - 1:

(i) 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 phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), 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.

(ii) 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 phase -1, shall be based on the evaluation of project work phase -1 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.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not takeup/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

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VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18AI81	Neural Networks and Deep Learning	AM	3	--	--	03	40	60	100	3
2	PEC	18AI82X	Professional Elective – 4	AM	3	--	--	03	40	60	100	3
3	Project	18AIP83	Project Work Phase – 2	AM	--	--	2	03	40	60	100	8
4	Seminar	18AIS84	Technical Seminar	AM	--	--	2	03	100	--	100	1
5	INT	18AII85	Internship	(Completed during the intervening vacations of VI and VII semesters and /or VII and VIII semesters.)				03	40	60	100	3
				TOTAL	**06**	--	**4**	**15**	**260**	**240**	**500**	**18**

Note: PCC: Professional Core, PEC: Professional Elective, OEC: Open Elective, INT: Internship.

Professional Electives – 4

Course code under 18CS82X	Course Title
18AI821	System Modelling and Simulation
18AI822	Soft and Evolutionary Computing
18AI823	Robotic Process Automation Design and Development
18AI824	Modern Information Retrieval

Project Work CIE procedure for Project Work Phase - 2:

(i) 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 phase -2, shall be based on the evaluation of project work phase -2 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.

(ii) 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 phase -2, shall be based on the evaluation of project work phase -2 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 for Project Work Phase - 2:

(i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Internship: Those, who have not pursued /completed the internship shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements

AICTE activity Points: In case students fail to earn the prescribed activity Points, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card. Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

[1]TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES (Effective from the academic year 2018 -2019) SEMESTER – III			
Subject Code	18MAT31	**CIE Marks**	40
Number of Contact Hours/Week	2:2:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Module 1	**Contact Hours**
Laplace Transform: Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions (statement only) and unit-step function – problems. **Inverse Laplace Transform**: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Solution of linear differential equations using Laplace transforms. **RBT: L2, L3**	08
Module 2	
Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis. **RBT: L1, L2**	08
Module 3	
Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems. **Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transformand applications to solve difference equations. **RBT: L1, L2**	08
Module 4	
Numerical Solutions of Ordinary Differential Equations(ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge - Kutta method of fourth order, Milne's and Adam-Bashforthpredictor and corrector method (No derivations of formulae)-Problems. **RBT: L1, L2**	08
Module 5	
Numerical Solution of Second Order ODE's: Runge -Kutta method and Milne's predictor and corrector method. (No derivations of formulae). **Calculus of Variations:** Variation of function and functional, variational problems, Euler's	08

equation, Geodesics, hanging chain, problems. **RBT: L1, L2, L3**	

Course Outcomes: The student will be able to :

- Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017
3. Srimanta Pal et al , Engineering Mathematics, Oxford University Press, 3rd Edition, 2016

Reference Books:

1. C.Ray Wylie, Louis C.Barrett , Advanced Engineering Mathematics, McGraw-Hill Book Co, 6th Edition, 1995
2. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition 2010
3. B.V.Ramana, Higher Engineering Mathematics, McGraw-Hill, 11th Edition,2010
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME – 20

ADDITIONAL MATHEMATICS – I
(Mandatory Learning Course: Common to All Branches)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech programmes)
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	18MATDIP31	**CIE Marks**	40
Number of Contact Hours/Week	2:1:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 00

Course Learning Objectives: This course will enable students to:

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

Module 1	**Contact Hours**
Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). **Vector Algebra:** Scalar and vectors. Addition and subtraction and multiplication of vectors-Dot and Cross products, problems. **RBT: L2, L2**	08
Module 2	
Differential Calculus: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems. **RBT: L1, L2**	08
Module 3	
Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems. **RBT: L1, L2**	08
Module 4	
Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof) and evaluation of these with standard limits-Examples. Double and triple integrals-Simple examples. **RBT: L1, L2**	08
Module 5	
Ordinary differential equations (ODE's. Introduction-solutions of first order and first degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation. **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
- Learn techniques of integration including the evaluation of double and triple integrals.

- Identify and solve first order ordinary differential equations.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015

Reference Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016
2. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014
3. RohitKhurana , Engineering Mathematics Vol.I, Cengage Learning, 1st Edition, 2015.

DATA STRUCTURES AND APPLICATIONS (Effective from the academic year 2018 -2019) SEMESTER – III			
Subject Code	18CS32	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Explain fundamentals of data structures and their applications essential for programming/problem solving.
- Illustrate linear representation of data structures: Stack, Queues, Lists, Trees and Graphs.
- Demonstrate sorting and searching algorithms.
- Find suitable data structure during application development/Problem Solving.

Module 1	**Contact Hours**
Introduction: Data Structures, Classifications (Primitive &Non Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays. **Array Operations**: Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices. **Strings:** Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples. **Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14Reference 3: Chapter 1: 1.4** **RBT: L1, L2, L3**	10
Module 2	
Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression. **Recursion** - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function. **Queues:** Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples. **Textbook 1: Chapter 3: 3.1 -3.7Textbook 2: Chapter 6: 6.1 -6.3, 6.5, 6.7-6.10, 6.12, 6.13** **RBT: L1, L2, L3**	10
Module 3	
Linked Lists: Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples **Textbook 1: Chapter 4: 4.1 – 4.6, 4.8, Textbook 2: Chapter 5: 5.1 – 5.10,** **RBT: L1, L2, L3**	10
Module 4	
Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples **Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9** **RBT: L1, L2, L3**	10
Module 5	
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First	10

Search. **Sorting and Searching**: Insertion Sort, Radix sort, Address Calculation Sort. **Hashing:** Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. **Files and Their Organization:**Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing **Textbook 1: Chapter 6 : 6.1 –6.2, Chapter 7:7.2, Chapter 8 : 8.1-8.3** **Textbook 2: Chapter 8 : 8.1 – 8.7, Chapter 9 : 9.1-9.3, 9.7, 9.9** **Reference 2: Chapter 16 : 16.1 - 16.7** **RBT: L1, L2, L3**	

Course Outcomes: The student will be able to :

- Use different types of data structures, operations and algorithms
- Apply searching and sorting operations on files
- Use stack, Queue, Lists, Trees and Graphs in problem solving
- Implement all data structures in a high-level language for problem solving.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Ellis Horowitz and SartajSahni, 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.

Reference Books:

1. Gilberg&Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
2. ReemaThareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
3. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
4. A M Tenenbaum, Data Structures using C, PHI, 1989
5. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

ANALOG AND DIGITAL ELECTRONICS
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	18CS33	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Explain the use of photoelectronics devices, 555 timer IC, Regulator ICs and uA741 opamap IC
- Make use of simplifying techniques in the design of combinational circuits.
- Illustrate combinational and sequential digital circuits
- Demonstrate the use of flipflops and apply for registers
- Design and test counters, Analog-to-Digital and Digital-to-Analog conversion techqniues.

Module 1	**ContactHours**
Photodiodes, Light Emitting Diodes and Optocouplers ,BJT Biasing :Fixed bias ,Collector to base Bias , voltage divider bias, Operational Amplifier Application Circuits: Multivibrators using IC-555, 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. **Text Book 1 :Part A:Chapter 2(Section 2.9,2.10,2.11), Chapter 4(Section 4.2 ,4.3,4.4),Chapter 7 (section (7.2,7.3.1,7.4,7.6 to 7.11), Chapter 8 (section (8.1,8.5), Chapter 9** **RBT: L1, L2**	08
Module 2	
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 **Text book 1:Part B: Chapter 5 (Sections 5.1 to 5.4) Chapter 6(Sections 6.1 to 6.5)** **RBT: L1, L2**	08
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, Programmable Logic Arrays, Programmable Array Logic. **Text book 1:Part B: Chapter 8,Chapter 9 (Sections 9.1 to 9.6)** **RBT: L1, L2**	08
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, Flip Flop with additional inputs, Asynchronous Sequential Circuits	08

Text book 1:Part B: Chapter 10(Sections 10.1 to 10.3),Chapter 11 (Sections 11.1 to 11.9) **RBT: L1, L2**	
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, sequential parity checker, state tables and graphs **Text book 1:Part B: Chapter 12(Sections 12.1 to 12.5),Chapter 13(Sections 13.1,13.3** **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp.
- Explain the basic principles of A/D and D/A conversion circuits and develop the same.
- Simplify digital circuits using Karnaugh Map , and Quine-McClusky Methods
- Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types.
- Develop simple HDL programs

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Charles H Roth and Larry L Kinney, Raghunandan G H, 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&GoutamSaha, 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

COMPUTER ORGANIZATION (Effective from the academic year 2018 -2019) SEMESTER – III			
Subject Code	18CS34	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Explain the basic sub systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.
- Describe memory hierarchy and concept of virtual memory.
- Describe arithmetic and logical operations with integer and floating-point operands.
- Illustrate organization of a simple processor, pipelined processor and other computing systems.

Module 1	**ContactHours**
Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions **Text book 1: Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.10** **RBT: L1, L2, L3**	08
Module 2	
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB. **Text book 1: Chapter4 – 4.1, 4.2, 4.4, 4.5, 4.6, 4.7** **RBT: L1, L2, L3**	08
Module 3	
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations. **Text book 1: Chapter5 – 5.1 to 5.4, 5.5(5.5.1, 5.5.2), 5.6** **RBT: L1, L2, L3**	08
Module 4	
Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division. **Text book 1: Chapter2-2.1, Chapter6 – 6.1 to 6.6** **RBT: L1, L2, L3**	08
Module 5	
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. **Pipelining:** Basic concepts of pipelining**,** **Text book 1: Chapter7, Chapter8 – 8.1** **RBT: L1, L2, L3**	08

Course Outcomes: The student will be able to :

- Explain the basic organization of a computer system.
- Demonstrate functioning of different sub systems, such as processor, Input/output,and memory.
- Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems.
- Design and analyse simple arithmetic and logical units.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 6, 7, 8, 9 and12)

Reference Books:

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

SOFTWARE ENGINEERING
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	18CS35	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- 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.
- Explain the fundamentals of object oriented concepts
- Describe the process of requirements gathering, requirements classification, requirements specification and requirements validation. Differentiate system models, use UML diagrams and apply design patterns.
- Discuss the distinctions between validation testing and defect testing.
- Recognize the importance of software maintenance and describe the intricacies involved in software evolution.Apply estimation techniques, schedule project activities and compute pricing.
- Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Module 1	**Contact Hours**
Introduction: Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies. **Software Processes**: Models: Waterfall Model **(Sec 2.1.1)**, Incremental Model **(Sec 2.1.2)** and Spiral Model **(Sec 2.1.3)**. Process activities. **Requirements Engineering**: Requirements Engineering Processes **(Chap 4)**. Requirements Elicitation and Analysis **(Sec 4.5).** Functional and non-functional requirements **(Sec 4.1)**. The software Requirements Document **(Sec 4.2)**. Requirements Specification **(Sec 4.3)**. Requirements validation **(Sec 4.6)**. Requirements Management **(Sec 4.7)**. **RBT: L1, L2, L3**	08
Module 2	
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. **Introduction, Modelling Concepts and Class Modelling:** 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; **Textbook 2: Ch 1,2,3.** **RBT: L1, L2 L3**	08
Module 3	
System Models: Context models **(Sec 5.1)**. Interaction models **(Sec 5.2)**. Structural models **(Sec 5.3)**. Behavioral models **(Sec 5.4)**. Model-driven engineering **(Sec 5.5)**. **Design and Implementation**: Introduction to RUP **(Sec 2.4)**, Design Principles **(Chap 17)**. Object-oriented design using the UML **(Sec 7.1)**. Design patterns **(Sec 7.2)**. Implementation issues **(Sec 7.3)**. Open source development **(Sec 7.4)**. **RBT: L1, L2, L3**	08
Module 4	
Software Testing: Development testing **(Sec 8.1)**, Test-driven development **(Sec 8.2)**,	08

Release testing **(Sec 8.3)**, User testing **(Sec 8.4)**. Test Automation **(Page no 42, 70,212, 231,444,695)**. **Software Evolution**: Evolution processes **(Sec 9.1)**. Program evolution dynamics **(Sec 9.2)**. Software maintenance **(Sec 9.3)**. Legacy system management **(Sec 9.4)**. **RBT: L1, L2, L3**	
Module 5	
Project Planning: Software pricing **(Sec 23.1)**. Plan-driven development **(Sec 23.2)**. Project scheduling **(Sec 23.3)**: Estimation techniques **(Sec 23.5)**. **Quality management**: Software quality **(Sec 24.1)**. Reviews and inspections **(Sec 24.3)**. Software measurement and metrics **(Sec 24.4)**. Software standards **(Sec 24.2)** **RBT: L1, L2, L3**	08

Course Outcomes: The student will be able to :

- Design a software system, component, or process to meet desired needs within realistic constraints.
- Assess professional and ethical responsibility
- Function on multi-disciplinary teams
- Use the techniques, skills, and modern engineering tools necessary for engineering practice
- Analyze, design, implement, verify, validate, implement, apply, and maintain software systems or parts of software systems

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012. (Listed topics only from Chapters 1,2,3,4, 5, 7, 8, 9, 23, and 24)
2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005.

Reference Books:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India

DISCRETE MATHEMATICAL STRUCTURES (Effective from the academic year 2018 -2019) SEMESTER – III			
Subject Code	18CS36	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Provide theoretical foundations of computer science to perceive other courses in the programme.
- Illustrate applications of discrete structures: logic, relations, functions, set theory and counting.
- Describe different mathematical proof techniques,
- Illustrate the importance of graph theory in computer science

Module 1	**ContactHours**
Fundamentals of Logic: Basic Connectives and Truth Tables, Logic 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. **Text book 1: Chapter2** **RBT: L1, L2, L3**	08
Module 2	
Properties of the Integers: The Well Ordering Principle – Mathematical Induction, **Fundamental Principles of Counting:** The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition. **Text book 1: Chapter4 – 4.1, Chapter1** **RBT: L1, L2, L3**	08
Module 3	
Relations and Functions: Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions. **Relations:** Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders –Hasse Diagrams, Equivalence Relations and Partitions. **Text book 1: Chapter5 , Chapter7 – 7.1 to 7.4** **RBT: L1, L2, L3**	08
Module 4	
The Principle of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials. **Recurrence Relations:** First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. **Text book 1: Chapter8 – 8.1 to 8.4, Chapter10 – 10.1, 10.2** **RBT: L1, L2, L3**	08
Module 5	
Introduction to Graph Theory: Definitions and Examples, Sub graphs, Complements, and Graph Isomorphism, **Trees**: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Weighted Trees and Prefix Codes	08

Text book 1: Chapter11 – 11.1 to 11.2 Chapter12 – 12.1 to 12.4 **RBT: L1, L2, L3**	

Course Outcomes: The student will be able to :

- Use propositional and predicate logic in knowledge representation and truth verification.
- Demonstrate the application of discrete structures in different fields of computer science.
- Solve problems using recurrence relations and generating functions.
- Application of different mathematical proofs techniques in proving theorems in the courses.
- Compare graphs, trees and their applications.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004.

Reference Books:

1. Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016
2. Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.
3. Jayant Ganguly: A Treatise on Discrete Mathematical Structures, Sanguine-Pearson, 2010.
4. D.S. Malik and M.K. Sen: Discrete Mathematical Structures: Theory and Applications, Thomson, 2004.
5. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 2005, Reprint 2008.

ANALOG AND DIGITAL ELECTRONICS LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	18CSL37	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours	36	**Exam Hours**	3 Hrs

CREDITS – 2

Course Learning Objectives: This course will enable students to:

This laboratory course enable students to get practical experience in design, assembly and evaluation/testing of

- Analog components and circuits including Operational Amplifier, Timer, etc.
- Combinational logic circuits.
- Flip - Flops and their operations
- Counters and registers using flip-flops.
- Synchronous and Asynchronous sequential circuits.
- A/D and D/A converters

Descriptions (if any):

- Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant.
- For Part A (Analog Electronic Circuits) students must trace the wave form on Tracing sheet / Graph sheet and label trace.
- Continuous evaluation by the faculty must be carried by including performance of a student in both hardware implementation and simulation (if any) for the given circuit.
- A batch not exceeding 4 must be formed for conducting the experiment. For simulation individual student must execute the program.

Laboratory Programs:

	PART A (Analog Electronic Circuits)
1.	Design an astablemultivibratorciruit for three cases of duty cycle (50%, <50% and >50%) using NE 555 timer IC. Simulate the same for any one duty cycle.
2.	Using ua 741 Opamp, design a 1 kHz Relaxation Oscillator with 50% duty cycle. And simulate the same.
3.	Using ua 741 opamap, design a window comparate for any given UTP and LTP. And simulate the same.
	PART B (Digital Electronic Circuits)
4.	Design and implement Half adder, Full Adder, Half Subtractor, Full Subtractor using basic gates. And implement the same in HDL.
5.	Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC. And implement the same in HDL.
6.	Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table. And implement the same in HDL.
7.	Design and implement code converter I)Binary to Gray (II) Gray to Binary Code using basic gates.
8.	Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.
9.	Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (n<=9) and demonstrate on 7-segment display (using IC-7447)

Laboratory Outcomes: The student should be able to:

- Use appropriate design equations / methods to design the given circuit.
- Examine and verify the design of both analog and digital circuits using simulators.
- Make us of electronic components, ICs, instruments and tools for design and testing of circuits for the given the appropriate inputs.
- Compile a laboratory journal which includes; aim, tool/instruments/software/components used, design equations used and designs, schematics, program listing, procedure followed, relevant theory, results as graphs and tables, interpreting and concluding the findings.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  a) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  b) For laboratories having PART A and PART B
     i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
     ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

DATA STRUCTURES LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	18CSL38	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours	36	**Exam Hours**	3 Hrs

CREDITS – 2

Course Learning Objectives: This course will enable students to:

This laboratory course enable students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Asymptotic performance of algorithms.
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs
- Sorting and searching algorithms

Descriptions (if any):

- Implement all the programs in 'C / C++'Programming Language and Linux / Windows as OS.

Programs List:

1.	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. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position(POS) e. Exit. Support the program with functions for each of the above operations.
2.	Design, Develop and Implement a Program in C for the following operationson Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
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) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4.	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.
5.	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks
6.	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE

	c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Branch, Sem, PhNo* a. Create a SLL of N Students Data by using *front insertion*. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo* a. Create a DLL of N Employees Data by using *end insertion*. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Design, Develop and Implement a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	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 digraph using DFS/BFS method
12.	Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K $\rightarrow$L as H(K)=K mod 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.
Laboratory Outcomes: The student should be able to:	
• Analyze and Compare various linear and non-linear data structures • Code, debug and demonstrate the working nature of different types of data structures and their applications • Implement, analyze and evaluate the searching and sorting algorithms • Choose the appropriate data structure for solving real world problems	
Conduct of Practical Examination:	
• Experiment distribution	

- For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
- For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.

- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  d) For laboratories having PART A and PART B
     i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
     ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS
(Effective from the academic year 2018 -2019)
SEMESTER – IV

Subject Code	18MAT41	**CIE Marks**	40
Number of Contact Hours/Week	2:2:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

Module 1	**Contact Hours**
Calculus of complex functions: Review offunction of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in cartesian and polar forms and consequences. Construction of analytic functions : Milne-Thomson method- Problems. **RBT: L1, L2**	08
Module 2	
Conformal transformations: Introduction. Discussion of transformations: $w=z^2$, $w=e^z$, $w=z+\frac{1}{z},(z\neq 0)$. Bilinear transformations- Problems. **Complex integration**: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems. **RBT: L1, L2**	08
Module 3	
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples. **RBT: L1, L2, L3**	08
Module 4	
Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y=ax+b, y=ax^b$ & $y=ax^2+bx+c.$ **Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **RBT: L1, L2, L3**	08
Module 5	
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.	08

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. **RBT:L2, L3, L4**	

Course Outcomes: The student will be able to :

- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017
3. Srimanta Pal et al , Engineering Mathematics, Oxford University Press, 3rd Edition, 2016

Reference Books:

1. C.Ray Wylie, Louis C.Barrett , Advanced Engineering Mathematics, McGraw-Hill Book Co, 6th Edition, 1995
2. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition 2010
3. B.V.Ramana, Higher Engineering Mathematics, McGraw-Hill, 11th Edition,2010
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME – 20

ADDITIONAL MATHEMATICS – II
(Mandatory Learning Course: Common to All Branches)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech programmes)
(Effective from the academic year 2018 -2019)
SEMESTER – IV

Subject Code	18MATDIP41	**CIE Marks**	40
Number of Contact Hours/Week	2:1:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 0

Course Learning Objectives: This course will enable students to:

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

Module 1	**Contact Hours**
Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Problems. **RBT: L2, L2**	08
Module 2	
Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems. **RBT: L1, L2, L3**	08
Module 3	
Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.*[Particular Integral restricted to R(x)=* $e^{ax}, \sin ax / \cos ax$ *for* $f(D)y = R(x)$.] **RBT: L1, L2**	08
Module 4	
Partial Differential Equations(PDE's):- Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. **RBT: L1, L2**	08
Module 5	
Probability: Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems. **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Solve systems of linear equations using matrix algebra.
- Apply the knowledge of numerical methods in modelling and solving engineering problems.
- Make use of analytical methods to solve higher order differential equations.
- Classify partial differential equations and solve them by exact methods.
- Apply elementary probability theory and solve related problems.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015

Reference Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2016
2. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014
3. RohitKhurana , Engineering Mathematics Vol.I, Cengage Learning, 1st Edition, 2015.

DESIGN AND ANALYSIS OF ALGORITHMS (Effective from the academic year 2018 -2019) SEMESTER – IV			
Subject Code	18CS42	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Explain various computational problem solving techniques.
- Apply appropriate method to solve a given problem.
- Describe various methods of algorithm analysis.

Module 1	**Contact Hours**
Introduction: What is an Algorithm? **(T2:1.1),** Algorithm Specification **(T2:1.2),** Analysis Framework **(T1:2.1),Performance Analysis**: Space complexity, Time complexity **(T2:1.3)**. **Asymptotic Notations:** Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples **(T1:2.2, 2.3, 2.4).Important Problem Types:**Sorting, Searching, String processing, Graph Problems, Combinatorial Problems. **Fundamental Data Structures:**Stacks, Queues, Graphs, Trees, Sets and Dictionaries. **(T1:1.3,1.4).** **RBT: L1, L2, L3**	8
Module 2	
Divide and Conquer: General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum **(T2:3.1, 3.3, 3.4)**, Merge sort, Quick sort **(T1:4.1, 4.2)**, Strassen's matrix multiplication **(T2:3.8)**, Advantages and Disadvantages of divide and conquer. **Decrease and Conquer Approach:** Topological Sort. **(T1:5.3).** **RBT: L1, L2, L3**	8
Module 3	
Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines **(T2:4.1, 4.3, 4.5).Minimum cost spanning trees:** Prim's Algorithm, Kruskal's Algorithm **(T1:9.1, 9.2)**. **Single source shortest paths:** Dijkstra's Algorithm **(T1:9.3)**. **Optimal Tree problem:**Huffman Trees and Codes **(T1:9.4)**. **Transform and Conquer Approach:** Heaps and Heap Sort **(T1:6.4)**. **RBT: L1, L2, L3**	8
Module 4	
Dynamic Programming: General method with Examples, Multistage Graphs **(T2:5.1, 5.2)**. **Transitive Closure:**Warshall's Algorithm, **All Pairs Shortest Paths:**Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem **((T1:8.2, 8.3, 8.4)**, Bellman-Ford Algorithm **(T2:5.4)**, Travelling Sales Person problem **(T2:5.9)**, Reliability design **(T2:5.8)**. **RBT: L1, L2, L3**	8
Module 5	
Backtracking: General method **(T2:7.1)**, N-Queens problem **(T1:12.1)**, Sum of subsets problem **(T1:12.1)**, Graph coloring**(T2:7.4)**, Hamiltonian cycles **(T2:7.5)**. **Branch and Bound:** Assignment Problem, Travelling Sales Person problem **(T1:12.2)**, **0/1 Knapsack problem (T2:8.2, T1:12.2):** LC Branch and Bound solution **(T2:8.2)**, FIFO Branch and Bound solution **(T2:8.2)**. **NP-Complete and NP-Hard problems:** Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes **(T2:11.1)**. **RBT: L1, L2, L3**	8

Course Outcomes: The student will be able to :

- Describe computational solution to well known problems like searching, sorting etc.
- Estimate the computational complexity of different algorithms.

- Devise an algorithm using appropriate design strategies for problem solving.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Introduction to the Design and Analysis of Algorithms, AnanyLevitin:, 2rd 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).

OPERATING SYSTEMS (Effective from the academic year 2018 -2019) SEMESTER – IV			
Subject Code	18CS43	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Introduce concepts and terminology used in OS
- Explain threading and multithreaded systems
- Illustrate process synchronization and concept of Deadlock
- Introduce Memory and Virtual memory management, File system and storage techniques

Module 1	**Contact Hours**
Introduction to operating systems, System structures: 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. **Operating System Services;** 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. **Process Management** Process concept; Process scheduling; Operations on processes; Inter process communication **Text book 1: Chapter 1, 2.1, 2.3, 2.4, 2.5, 2.6, 2.8, 2.9, 2.10, 3.1, 3.2, 3.3, 3.4** **RBT: L1, L2, L3**	08
Module 2	
Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling. **Process Synchronization:** Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors. **Text book 1: Chapter 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 5.4, 5.5, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7** **RBT: L1, L2, L3**	08
Module 3	
Deadlocks : Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Memory Management:** Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. **Text book 1: Chapter 7, 8.1 to 8.6** **RBT: L1, L2, L3**	08
Module 4	
Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. **File System, Implementation of File System:** 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. **Text book 1: Chapter 91. To 9.6, 10.1 to 10.5**	08

RBT: L1, L2, L3	
Module 5	
Secondary Storage Structures, Protection: 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. **Case Study: The Linux Operating System:** Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication. **Text book 1: Chapter 12.1 to 12.6, 21.1 to 21.9** **RBT: L1, L2, L3**	08

Course Outcomes: The student will be able to :

- Demonstrate need for OS and different types of OS
- Apply suitable techniques for management of different resources
- Use processor, memory, storage and file system commands
- Realize the different concepts of OS in platform of usage through case studies

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

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 Dhamdhere, 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.

MICROCONTROLLER AND EMBEDDED SYSTEMS (Effective from the academic year 2018 -2019) SEMESTER – IV			
Subject Code	18CS44	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Understand the fundamentals of ARM based systems, basic hardware components, selection methods and attributes of an embedded system.
- Program ARM controller using the various instructions
- Identify the applicability of the embedded system
- Comprehend the real time operating system used for the embedded system

Module 1	**Contact Hours**
Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions **Text book 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5** **RBT: L1, L2**	08
Module 2	
Introduction to the ARM Instruction Set : Data Processing Instructions , Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants **ARM programming using Assembly language:** Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs **Text book 1: Chapter 3:Sections 3.1 to 3.6 (Excluding 3.5.2), Chapter 6(Sections 6.1 to 6.6)** **RBT: L1, L2**	08
Module 3	
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. **Text book 2:Chapter 1(Sections 1.2 to 1.6),Chapter 2(Sections 2.1 to 2.6)** **RBT: L1, L2**	08
Module 4	
Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes ,non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development **Text book 2: Chapter-3, Chapter-4, Chapter-7 (Sections 7.1, 7.2 only), Chapter-9**	08

(Sections 9.1, 9.2, 9.3.1, 9.3.2 only) **RBT: L1, L2**	
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. **Text book 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)** **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Describe the architectural features and instructions of ARM microcontroller
- Apply the knowledge gained for Programming ARM for different applications.
- Interface external devices and I/O with ARM microcontroller.
- Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware /software co-design and firmware design approaches.
- Demonstrate the need of real time operating system for embedded system applications

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

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, 2nd 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.

OBJECT ORIENTED CONCEPTS (Effective from the academic year 2018 -2019) SEMESTER – IV			
Subject Code	18CS45	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Learn fundamental features of object oriented language and JAVA
- Set up Java JDK environment to create, debug and run simple Java programs.
- Create multi-threaded programs and event handling mechanisms.
- Introduce event driven Graphical User Interface (GUI) programming using applets and swings.

Module 1	**Contact Hours**
Introduction to Object Oriented Concepts: A Review of structures, Procedure–Oriented Programming system, Object Oriented Programming System, Comparison of Object Oriented Language with C, Console I/O, variables and reference variables, Function Prototyping, Function Overloading. **Class and Objects:** Introduction, member functions and data, objects and functions. **Text book 1: Ch 1: 1.1 to 1.9 Ch 2: 2.1 to 2.3** **RBT: L1, L2**	08
Module 2	
Class and Objects (contd): Objects and arrays, Namespaces, Nested classes, Constructors, Destructors. **Introduction to Java**: Java's magic: the Byte code; Java Development Kit (JDK); the Java Buzzwords, Object-oriented programming; Simple Java programs. Data types, variables and arrays, Operators, Control Statements. **Text book 1:Ch 2: 2.4 to 2.6Ch 4: 4.1 to 4.2** **Text book 2: Ch:1 Ch: 2 Ch:3 Ch:4 Ch:5** **RBT: L1, L2**	08
Module 3	
Classes, Inheritance,Exception Handling: Classes: Classes fundamentals; Declaring objects; Constructors, this keyword, garbage collection. **Inheritance:** inheritance basics, using super, creating multi level hierarchy, method overriding. **Exception handling:** Exception handling in Java. **Text book 2: Ch:6 Ch: 8 Ch:10** **RBT: L1, L2, L3**	08
Module 4	
Packages and Interfaces: Packages, Access Protection,ImportingPackages.Interfaces. **Multi ThreadedProgramming:**Multi Threaded Programming: What are threads? How to make the classes threadable ; Extending threads; Implementing runnable; Synchronization; Changing state of the thread; Bounded buffer problems, producer consumer problems. **Text book 2: CH: 9 Ch 11:** **RBT: L1, L2, L3**	08
Module 5	
Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes. **Swings:** Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField;The Swing Buttons; JTabbedpane; JScrollPane; JList;	08

JComboBox; JTable. **Text book 2: Ch 22: Ch: 29 Ch: 30** **RBT: L1, L2, L3**	

Course Outcomes: The student will be able to :

- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.
- Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Sourav Sahay, Object Oriented Programming with C++ , 2nd Ed, Oxford University Press,2006
2. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.

Reference Books:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806
2. Herbert Schildt, The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2003.
3. Stanley B.Lippmann, JoseeLajore, C++ Primer, 4th Edition, Pearson Education, 2005.
4. RajkumarBuyya,SThamarasiselvi, xingchenchu, Object oriented Programming with java, Tata McGraw Hill education private limited.
5. Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
6. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

Mandatory Note: Every institute shall organize bridge course on C++, either in the vacation or in the beginning of even semester for a minimum period of ten days (2hrs/day). Maintain a copy of the report for verification during LIC visit.

Faculty can utilize open source tools to make teaching and learning more interactive.

DATA COMMUNICATION (Effective from the academic year 2018 -2019) SEMESTER – IV			
Subject Code	18CS46	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Comprehend the transmission technique of digital data between two or more computers and a computer network that allows computers to exchange data.
- Explain with the basics of data communication and various types of computer networks;
- Demonstrate Medium Access Control protocols for reliable and noisy channels.
- Expose wireless and wired LANs.

Module 1	**Contact Hours**
Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, **Networks Models**: Protocol Layering, TCP/IP Protocol suite, The OSI model, **Introduction to Physical Layer-1:** Data and Signals**,** Digital Signals, Transmission Impairment, Data Rate limits, Performance. **Textbook1: Ch 1.1 to 1.5, 2.1 to 2.3, 3.1, 3.3 to 3.6** **RBT: L1, L2**	08
Module 2	
Digital Transmission: Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding). **Physical Layer-2:** Analog to digital conversion (only PCM), Transmission Modes, **Analog Transmission**: Digital to analog conversion. **Textbook1: Ch 4.1 to 4.3, 5.1** **RBT: L1, L2**	08
Module 3	
Bandwidth Utilization: Multiplexing and Spread Spectrum, **Switching**: Introduction, Circuit Switched Networks and Packet switching. **Error Detection and Correction**: Introduction, Block coding, Cyclic codes, Checksum, **Textbook1: Ch 6.1, 6.2, 8.1 to 8.3, 10.1 to 10.4** **RBT: L1, L2**	08
Module 4	
Data link control: DLC services, Data link layer protocols, Point to Point protocol (Framing, Transition phases only). **Media Access control**: Random Access, Controlled Access and Channelization, **Introduction to Data-Link Layer:** Introduction, Link-Layer Addressing, ARP **IPv4 Addressing and subnetting:** Classful and CIDR addressing, DHCP, NAT **Textbook1: Ch 9.1, 9.2, 11.1, 11.2 11.4, 12.1 to 12.3, 18.4** **RBT: L1, L2**	08
Module 5	
Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit Ethernet, **Wireless LANs:** Introduction, IEEE 802.11 Project and Bluetooth. **Other wireless Networks**: Cellular Telephony	08

Textbook1: Ch 13.1 to 13.5, 15.1 to 15.3, 16.2 **RBT: L1, L2**	

Course Outcomes: The student will be able to :

- Explain the various components of data communication.
- Explain the fundamentals of digital communication and switching.
- Compare and contrast data link layer protocols.
- Summarize IEEE 802.xx standards

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2013.

Reference Books:

1. Alberto Leon-Garcia and IndraWidjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.
2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
3. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.
4. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007.

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – IV

Subject Code	18CSL47	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours	36	**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Design and implement various algorithms in JAVA
- Employ various design strategies for problem solving.
- Measure and compare the performance of different algorithms.

Descriptions (if any):

- Design, develop, and implement the specified algorithms for the following problems using Java language under LINUX /Windows environment. Netbeans / Eclipse or IntellijIdea Community Edition IDE tool can be used for development and demonstration.
- **Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.**

Programs List:

1.	
a.	Create a Java class called ***Student***with the following details as variables within it. (i) USN (ii) Name (iii) Branch (iv) Phone Write a Java program to create *nStudent* objects and print the USN, Name, Branch, and Phoneof these objects with suitable headings.
b.	Write a Java program to implement the Stack using arrays. Write Push(), Pop(), and Display() methods to demonstrate its working.
2.	
a.	Design a superclass called ***Staff*** 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.
b.	Write a Java class called ***Customer*** to store their name and date_of_birth. The date_of_birth format should be dd/mm/yyyy. Write methods to read customer data as <name, dd/mm/yyyy> and display as <name, dd, mm, yyyy> using StringTokenizer class considering the delimiter character as "/".
3.	
a.	Write a Java program to read two integers *a*and*b*. Compute *a*/*b* and print, when *b* is not zero. Raise an exception when *b* is equal to zero.
b.	Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number andprints; third thread will print the value of cube of the number.
4.	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*> 5000 and record the time taken to sort. Plot a graph of the time taken versus ***n***on graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.

5.	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*> 5000, and record the time taken to sort. Plot a graph of the time taken versus ***n***on graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
6.	Implement in Java, the **0/1 Knapsack** problem using (a) Dynamic Programming method (b) Greedy method.
7.	From a given vertex in a weighted connected graph, find shortest paths to other vertices using **Dijkstra's algorithm**. Write the program in Java.
8.	Find Minimum Cost Spanning Tree of a given connected undirected graph using **Kruskal'salgorithm.** Use Union-Find algorithms in your program
9.	Find Minimum Cost Spanning Tree of a given connected undirected graph using **Prim's algorithm**.
10.	Write Java programs to (a) Implement All-Pairs Shortest Paths problem using **Floyd's algorithm**. (b) Implement **Travelling Sales Person problem** using Dynamic programming.
11.	Design and implement in Java to find a **subset** of a given set **S** = {Sl, S2,.....,Sn} 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.
12.	Design and implement in Java to find all **Hamiltonian Cycles** in a connected undirected Graph G of *n* vertices using backtracking principle.

Laboratory Outcomes: The student should be able to:

- Design algorithms using appropriate design techniques (brute-force, greedy, dynamic programming, etc.)
- Implement a variety of algorithms such assorting, graph related, combinatorial, etc., in a high level language.
- Analyze and compare the performance of algorithms using language features.
- Apply and implement learned algorithm design techniques and data structuresto solve real-world problems.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  e) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  f) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

MICROCONTROLLER AND EMBEDDED SYSTEMS LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – IV

Subject Code	18CSL48	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours	36	**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Develop and test Program using ARM7TDMI/LPC2148
- Conduct the experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

Descriptions (if any):

Programs List:

PART A Conduct the following experiments by writing program using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool.

1.	Write a program to multiply two 16 bit binary numbers.
2.	Write a program to find the sum of first 10 integer numbers.
3.	Write a program to find 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 look-up table.
6.	Write a program to find the largest/smallest number in an array of 32 numbers .
7.	Write a program to arrange a series of 32 bit numbers in ascending/descending order.
8.	Write a program to count the number of ones and zeros in two consecutive memory locations.

PART –B Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

9.	Display "Hello World" message using Internal UART.
10.	Interface and Control a DC Motor.
11.	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12.	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13.	Interface a DAC and generate Triangular and Square waveforms.
14.	Interface a 4x4 keyboard and display the key code on an LCD.
15.	Demonstrate the use of an external interrupt to toggle an LED On/Off.
16.	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between

Laboratory Outcomes: The student should be able to:

- Develop and test program using ARM7TDMI/LPC2148
- Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  g) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  h) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

MANAGEMENT AND ENTREPRENEURSHIP FOR IT INDUSTRY
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18CS51	**CIE Marks**	40
Number of Contact Hours/Week	2:2:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Explain the principles of management, organization and entrepreneur.
- Discuss on planning, staffing, ERP and their importance
- Infer the importance of intellectual property rights and relate the institutional support

Module – 1	**CH**
Introduction - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories,. Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection **RBT: L1, L2**	08
Module – 2	
Directing and controlling- meaning and nature of directing, leadership styles, motivationTheories, Communication- Meaning and importance, Coordination- meaning andimportance, Controlling- meaning, steps in controlling, methods of establishing control. **RBT: L1, L2**	08
Module – 3	
Entrepreneur – meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study. **RBT: L1, L2**	08
Module – 4	
Preparation of project and ERP - meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, **Enterprise Resource Planning: Meaning and Importance- ERP** and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation **RBT: L1, L2**	08
Module 5 **Micro and Small Enterprises:** Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises, case study (Microsoft), Case study(Captain G R Gopinath),case study (N R Narayana Murthy &Infosys), **Institutional support:** MSME-DI, NSIC, SIDBI, KIADB, KSSIDC, TECSOK, KSFC, DIC and District level single window agency, **Introduction to IPR.** **RBT: L1, L2**	

Course outcomes: The students should be able to:

- Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship
- Utilize the resources available effectively through ERP
- Make use of IPRs and institutional support in entrepreneurship

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 4th / 6th Edition, 2010.
2. Dynamics of Entrepreneurial Development & Management -Vasant Desai Himalaya Publishing House.
3. Entrepreneurship Development -Small Business Enterprises -Poornima M Charantimath Pearson Education – 2006.
4. Management and Entrepreneurship - KanishkaBedi- Oxford University Press-2017

Reference Books:

1. Management Fundamentals -Concepts, Application, Skill Development Robert Lusier – Thomson.
2. Entrepreneurship Development -S S Khanka -S Chand & Co.
3. Management -Stephen Robbins -Pearson Education /PHI -17th Edition, 2003

PYTHON PROGRAMMING
[(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18AI52	**IA Marks**	40
Number of Lecture Hours/Week	3:2:0	**Exam Marks**	60
Total Number of Lecture Hours	50	**Exam Hours**	03

CREDITS – 04

Course Learning Objectives: This course will enable students to:

- Learn the syntax and semantics of Python programming language.
- Illustrate the process of structuring the data using lists, tuples and dictionaries.
- Demonstrate the use of built-in functions to navigate the file system.
- Implement the Object Oriented Programming concepts in Python.
- Appraise the need for working with various documents like Excel, PDF, Word and Others.

Module – 1	**Contact Hours**
Python Basics, Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program,**Flow control,** Boolean Values, Comparison Operators, Boolean Operators,Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules,Ending a Program Early with sys.exit(), **Functions,**def Statements with Parameters, Return Values and return Statements,The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number **Textbook 1: Chapters 1 – 3** **RBT: L1, L2**	10
Module – 2	
Lists, The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples,References, **Dictionaries and Structuring Data,** The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things, **Manipulating Strings,** Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup **Textbook 1: Chapters 4 – 6** **RBT: L1, L2, L3**	10
Module – 3	
Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions,More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re .IGNORECASE, re .DOTALL, and re .VERBOSE, Project: Phone Number and Email Address Extractor, **Reading and Writing Files,** Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module,Saving Variables with the pprint.pformat() Function, Project: Generating Random Quiz Files, Project: Multiclipboard. **Textbook 1: Chapters 7 – 10** **RBT: L1, L2, L3**	10

Module – 4	
Classes and objects, Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, **Classes and functions,** Time, Pure functions, Modifiers, Prototyping versus planning, **Classes and methods,** Object-oriented features, Printing objects, Another example, A more complicated example,Theinit method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation,**Inheritance,** Card objects, Class attributes, Comparing cards, Decks, Printing the deck, Add, remove, shuffle and sort, Inheritance, Class diagrams, Data encapsulation **Textbook 2: Chapters 15 – 18** **RBT: L1, L2, L3**	10
Module – 5	
Web Scraping, Project: MAPIT.PY with the webbrowser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML, Parsing HTML with the BeautifulSoup Module, Project: "I'm Feeling Lucky" Google Search,Project: Downloading All XKCD Comics, Controlling the Browser with the selenium Module, **Working with Excel Spreadsheets,** Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns, Charts, **Working with PDF and Word Documents,** PDF Documents, Project: Combining Select Pages from Many PDFs, Word Documents, **Working with CSV files and JSON data,** The csv Module, Project: Removing the Header from CSV Files, JSON and APIs, The json Module, Project: Fetching Current Weather Data **Textbook 1: Chapters 11 – 14** **RBT: L1, L2, L3**	10

Course Outcomes: After studying this course, students will be able to

- Demonstrate proficiency in handling of loops and creation of functions.
- Identify the methods to create and manipulate lists, tuples and dictionaries.
- Discover the commonly used operations involving regular expressions and file system.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Determine the need for scraping websites and working with CSV, JSON and other file formats.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

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/)
   (Chapters 1 to 18)
2. 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)
   (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above links)

Reference Books:

1. Jake VanderPlas, **"Python Data Science Handbook: Essential Tools for Working with Data",** 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
2. Charles Dierbach, **"Introduction to Computer Science Using Python",** 1st Edition, Wiley India Pvt Ltd, 2015. ISBN-13: 978-8126556014
3. Wesley J Chun, **"Core Python Applications Programming",** 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365

DATABASE MANAGEMENT SYSTEM (Effective from the academic year 2018 -2019) SEMESTER – V			
Subject Code	18CS53	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in database
- Design and build database applications for real world problems.

Module 1	**Contact Hours**
Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples, Specialization and Generalization. **Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10** **RBT: L1, L2, L3**	10
Module 2	
Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping. **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. **Textbook 1: Ch4.1 to 4.5, 5.1 to 5.3, 6.1 to 6.5, 8.1; Textbook 2: 3.5** **RBT: L1, L2, L3**	10
Module 3	
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. **Internet Applications:** The three-Tier application architecture, The presentation layer, The Middle Tier **Textbook 1: Ch7.1 to 7.4; Textbook 2: 6.1 to 6.6, 7.5 to 7.7.** **RBT: L1, L2, L3**	10
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. **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: Ch14.1 to 14.7, 15.1 to 15.6**	10

RBT: L1, L2, L3	
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. **Introduction to Database Recovery Protocols:** Recovery Concepts, NO-UNDO/REDO recovery based on Deferred update, Recovery techniques based on immediate update, Shadow paging, Database backup and recovery from catastrophic failures **Textbook 1: 20.1 to 20.6, 21.1 to 21.7, 22.1 to 22.4, 22.7.** **RBT: L1, L2, L3**	10

Course Outcomes: The student will be able to :

- Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
- Use Structured Query Language (SQL) for database manipulation.
- Design and build simple database systems
- Develop application to interact with databases.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

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

Reference Books:

1. SilberschatzKorth and Sudharshan, Database System Concepts, 6th Edition, Mc-GrawHill, 2013.
2. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, Cengage Learning 2012.

AUTOMATA THEORY AND COMPUTABILITY (Effective from the academic year 2018 -2019) SEMESTER – V			
Subject Code	18CS54	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Introduce core concepts in Automata and Theory of Computation
- Identify different Formal language Classes and their Relationships
- Design Grammars and Recognizers for different formal languages
- Prove or disprove theorems in automata theory using their properties
- Determine the decidability and intractability of Computational problems

Module 1	**Contact Hours**
Why study the Theory of Computation, Languages and Strings: Strings, Languages. A Language Hierarchy, Computation, **Finite State Machines (FSM)**: Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, From FSMs to Operational Systems, Simulators for FSMs, Minimizing FSMs, Canonical form of Regular languages, Finite State Transducers, Bidirectional Transducers. **Textbook 1: Ch 1,2, 3,4, 5.1 to 5.10** **RBT: L1, L2**	08
Module 2	
Regular Expressions (RE): what is a RE?, Kleene's theorem, Applications of REs, Manipulating and Simplifying REs. Regular Grammars: Definition, Regular Grammars and Regular languages. Regular Languages (RL) and Non-regular Languages: How many RLs, To show that a language is regular, Closure properties of RLs, to show some languages are not RLs. **Textbook 1: Ch 6, 7, 8: 6.1 to 6.4, 7.1, 7.2, 8.1 to 8.4** **RBT: L1, L2, L3**	08
Module 3	
Context-Free Grammars(CFG): Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, proving that a Grammar is correct, Derivation and Parse trees, Ambiguity, Normal Forms. Pushdown Automata (PDA): Definition of non-deterministic PDA, Deterministic and Non-deterministic PDAs, Non-determinism and Halting, alternative equivalent definitions of a PDA, alternatives that are not equivalent to PDA. **Textbook 1: Ch 11, 12: 11.1 to 11.8, 12.1, 12.2, 12,4, 12.5, 12.6** **RBT: L1, L2, L3**	08
Module 4	
Algorithms and Decision Procedures for CFLs: Decidable questions, Un-decidable questions. **Turing Machine**: Turing machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction. Variants of Turing Machines (TM), The model of Linear Bounded automata. **Textbook 1: Ch 14: 14.1, 14.2, Textbook 2: Ch 9.1 to 9.8** **RBT: L1, L2, L3**	08
Module 5	
Decidability: Definition of an algorithm, decidability, decidable languages, Undecidable languages, halting problem of TM, Post correspondence problem. Complexity: Growth rate of functions, the classes of P and NP, Quantum Computation: quantum computers, Church-Turing thesis. **Applications:** G.1 Defining syntax of programming language, Appendix J: Security **Textbook 2: 10.1 to 10.7, 12.1, 12.2, 12.8, 12.8.1, 12.8.2** **Textbook 1: Appendix: G.1(only), J.1 & J.2**	08

RBT: L1, L2, L3

Course Outcomes: The student will be able to :

- Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation
- Learn how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).
- Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.
- Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness.
- Classify a problem with respect to different models of Computation.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson education,2012/2013
2. K L P Mishra, N Chandrasekaran , 3rd Edition, Theory of Computer Science, PhI, 2012.

Reference Books:

1. John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, Introduction to AutomataTheory, Languages, and Computation, 3rd Edition, Pearson Education, 2013
2. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013
3. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013
4. Peter Linz, "An Introduction to Formal Languages and Automata", 3rd Edition, NarosaPublishers, 1998
5. Basavaraj S. Anami, Karibasappa K G, Formal Languages and Automata theory, Wiley India, 2012
6. C K Nagpal, Formal Languages and Automata Theory, Oxford University press, 2012.

Faculty can utilize open source tools (like JFLAP) to make teaching and learning more interactive.

PRINCIPLES OF ARTIFICIAL INTELLIGENCE
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18AI55	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

1.Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward problem solving
3.Get to know approaches of inference, perception, knowledge representation, and learning.

Module – 1	**CH**
Introduction to AI: history, Intelligent systems, foundation and sub area of AI , applications, current trend and development of AI. **Problem solving**: state space search and control strategies. **Chapter 1 and 2** **RBT: L1, L2**	08
Module – 2	
Problem reduction and Game playing : Problem reduction, game playing, Bounded look-ahead strategy, alpha-beta pruning, Two player perfect information games **Chapter 3** **RBT: L1, L2**	08
Module – 3	
Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic, Logic programming. **Chapter 4** **RBT: L1, L2**	08
Module – 4	
Advanced problem solving paradigm: Planning: types of planning sytem, block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis, Non linear planning strategies, learning plans **Chapter 6.** **RBT: L1, L2**	08
Module – 5	
Knowledge Representation , Expert system Approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, Knowledge representation using Frames. Expert system: introduction phases, architecture ES verses Traditional system **Chapter 7 and 8 (8.1 to 8.4)** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Apply the knowledge of Artificial Intelligence to write simple algorithm for agents.
- Apply the AI knowledge to solve problem on search algorithm.
- Develop knowledge base sentences using propositional logic and first order logic.
- Apply first order logic to solve knowledge engineering process.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014

Reference Books:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. StaurtRussel, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3rd Edition, 2009
4. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

MATHEMATICS FOR MACHINE LEARNING
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18AI56	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Improve the skills and knowledge in linear algebra to get more out of machine learning.
- Understand the vector calculus required to build many common machine learning techniques.
- Learn the probability and distribution in statistics to build machine learning applications.
- Learn the basic theoretical properties of optimization problems, for applications in machine learning

Module – 1	**CH**
Linear Algebra-Part1: Introduction,Matrices , System of Linear Equations, Vector Spaces, Linear Dependence and Independence, Gaussian Elimination, Basis and basis set, Rank, Norms , Inner Products, Lengths and Distances, Angles **(Ch: 2-2.6, Ch:3-3.3)** **RBT: L1, L2**	08
Module – 2	
Linear Algebra-Part2: Orthogonality, Orthonormal Basis, Orthogonal Complement, Rotations, Determinant and Trace, Eigenvalues and Eigenvectors – its interpretations, Projections, Regression, Diagonalization, Singular Value Decomposition**(Ch:3.4-3.6, 3.9, Ch:4-4.5)** **RBT: L1, L2**	08
Module – 3	
Vector Calculus: Introduction, Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation **(Ch-5)** **RBT: L1, L2**	08
Module – 4	
Probability and Distribution: Probability concepts, Conditional probability, Bayes' Theorem, Discrete and Continuous Random Variables and Distributions, Expectation and its Interpretations, Standard discrete and continuous distribution functions, Central Limit theorem **(Ch-6)** **RBT: L1, L2**	08
Module – 5	
Optimization: Introduction, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization **(Ch-7)** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Improve the skills and knowledge in linear algebra to get more out of machine learning.
- Understand the vector calculus required to build many common machine learning techniques.
- Learn the probability and distribution in statistics to build machine learning applications.
- Learn the basic theoretical properties of optimization problems, for applications in machine learning

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. "Mathematics for Machine Learning" , Published by Cambridge University Press, Copyright 2020

Reference Books:

1. Sheldon Axler, “Linear Algebra Done Right” third edition, 2015, Springer
2. David C. Lay, “Linear Algebra and its Applications,” 3rd edition, Pearson Education (Asia) Pte. Ltd,2005.
3. Gilbert Strang, "Linear Algebra and its Applications”, 3rd edition, Thomson Learning Asia, 2003.
4. D. Chatterjee, “Analytical Geometry: Two and Three Dimensions”, Alpha Science International Limited, 2009
5. Charles M. Grinstead, J. Laurie Snell, “Introduction to Probability”.
6. DasGupta, Anirban, “Probability for Statistics and Machine Learning: Fundamentals and Advanced Topics” , Springer, 2011
7. David Morin, “Probability: For the Enthusiastic Beginner”, 2016
8. V. Jeyakumar, Alexander M. Rubinov, “ Continuous Optimization: Current Trends and Modern Applications(Applied Optimization) 2005th Edition
9. Kulkarni, Anand J., Satapathy, Suresh Chandra, “Optimization in Machine Learning and Applications”, Springer, 2020

ARTIFICIAL INTELLIGENCE LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18AIL57	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours		**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Implement and evaluate AI algorithms in Python programming language.

Descriptions (if any):

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

Programs List:

Practicing Problems in Python(Students can be encouraged to practice good number of practice problems , some practice problems are listed here)

1.	(a) Write a python program to print the multiplication table for the given number (b) Write a python program to check whether the given number is prime or not? (c) Write a python program to find factorial of the given number?
2.	(a) Write a python program to implement List operations (Nested List, Length,Concatenation, Membership, Iteration, Indexing and Slicing) (b) Write a python program to implement List methods (Add, Append, Extend & Delete).
3.	Write a python program to implement simple Chatbot with minimum 10 conversations
4.	Write a python program to Illustrate Different Set Operations
5.	(a)Write a python program to implement a function that counts the number of times a string(s1) occurs in another string(s2) (b)Write a program to illustrate Dictionary operations([],in,traversal)and methods: keys(),values(),items()

AI Problems to be implemented in Python

1	Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem
2	Implement and Demonstrate Best First Search Algorithm on any AI problem
3	Implement AO* Search algorithm.
4	Solve 8-Queens Problem with suitable assumptions
5	Implementation of TSP using heuristic approach
6	Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining
7	Implement resolution principle on FOPL related problems
8	Implement any Game and demonstrate the Game playing strategies

Laboratory Outcomes: The student should be able to:

- Implement and demonstrate AI algorithms.
- Evaluate different algorithms.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  i) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks

  j) For laboratories having PART A and PART B
     i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
     ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

DBMS LABORATORY WITH MINI PROJECT
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18CSL58	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours		**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Foundation knowledge in database concepts, technology and practice to groom students into well-informed database application developers.
- Strong practice in SQL programming through a variety of database problems.
- Develop database applications using front-end tools and back-end DBMS.

Descriptions (if any):

PART-A: SQL Programming ()

- 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.

PART-B: Mini Project ()

- Use Java, C#, PHP, Python, or any other similar front-end tool. All applications must be demonstrated on desktop/laptop as a stand-alone or web based application (Mobile apps on Android/IOS are not permitted.)

.

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

Programs List:

PART A

1.	Consider the following schema for a Library Database: BOOK(Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS(Book_id, Author_Name) PUBLISHER(Name, Address, Phone) BOOK_COPIES(Book_id, Branch_id, No-of_Copies) BOOK_LENDING(Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH(Branch_id, Branch_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. **5.** Create a view of all books and its number of copies that are currently available in the Library.
2.	Consider the following schema for Order Database: SALESMAN(Salesman_id, Name, City, Commission) CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesman who had more than one customer. 3. List all the salesman and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order

	of a day. 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
3.	Consider the schema for Movie Database: ACTOR(Act_id, Act_Name, Act_Gender) DIRECTOR(Dir_id, Dir_Name, Dir_Phone) MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST(Act_id, Mov_id, Role) RATING(Mov_id, Rev_Stars) Write SQL queries to 1. List the titles of all movies directed by 'Hitchcock'. 2. Find the movie names where one or more actors acted in two or more movies. 3. List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation). 4. 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. 5. Update rating of all movies directed by 'Steven Spielberg' to 5.
4.	Consider the schema for College Database: STUDENT(USN, SName, Address, Phone, Gender) SEMSEC(SSID, Sem, Sec) CLASS(USN, SSID) SUBJECT(Subcode, Title, Sem, Credits) IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to 1. List all the student details studying in fourth semester 'C' section. 2. Compute the total number of male and female students in each semester and in each section. 3. Create a view of Test1 marks of student USN '1BI15CS101' in all subjects. 4. Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students. 5. 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< 12 then CAT = 'Weak' Give these details only for 8th semester A, B, and C section students.
5.	Consider the schema for Company Database: EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate) DLOCATION(DNo,DLoc) PROJECT(PNo, PName, PLocation, DNo) WORKS_ON(SSN, PNo, Hours) Write SQL queries to 1. 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. 2. Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise. 3. 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 4. Retrieve the name of each employee who works on all the projects controlledby department number 5 (use NOT EXISTS operator). 5. 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.
PART B: Mini Project	

•	**For any problem selected make sure that the application should have five or more tables indicative areas include; health care , salary management, office automation, etc.**

Laboratory Outcomes: The student should be able to:

- Create, Update and query on the database.
- Demonstrate the working of different concepts of DBMS
- Implement, analyze and evaluate the project developed for an application.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accoradance with university regulations)*
  k) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  l) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

MACHINE LEARNING
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AI61	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs

CREDITS – 04

Course Learning Objectives: This course will enable students to:

- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Understand the basic concepts of learning and decision trees.
- Understand Bayesian techniques for problems appear in machine learning
- Perform statistical analysis of machine learning techniques.

Module – 1	**CH**
Introduction: Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML (T2:Chapter1) **Concept learning and Learning Problems** – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS-Inductive bias – **T2: Chapter 1** **T1:Chapter 1 and 2)**	10
Module – 2	
End to end Machine learning Project : 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 **Classification** : MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification **(T2: Chapter 2 and 3)**	10
Module – 3	
Training Models: Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression Support Vector Machine: linear, Nonlinear , SVM regression and under the hood (**T2**: **Chapter 4 and 5**) **RBT: L1, L2**	10
Module – 4	
Decision Trees Training and Visualizing DT, making prediction, estimating class, the CART training, computational complexity, GINI impurity, Entropy, regularization Hyper parameters, Regression, instability **Ensemble learning and Random Forest**: Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting, stacking **(T2: Chapter 6 and 7)** **RBT: L1, L2**	10
Module – 5	
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– example-Bayesian Belief Network – EM Algorithm **Text book (T1: Chapter 6)** **RBT: L1, L2**	10
Course outcomes: The students should be able to:	

- Choose the learning techniques with this basic knowledge.
- Apply effectively ML algorithms for appropriate applications.
- Apply bayesian techniques and derive effectively learning rules.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

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

Reference Books:

1. EthemAlpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd 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, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

DIGITAL IMAGE PROCESSING (Effective from the academic year 2018 -2019) SEMESTER – VI			
Subject Code	18AI62	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	03
CREDITS –4			

- **Course Learning Objectives:** This course will enable students to:
- Understand the fundamentals of digital image processing
- Understand the image transform used in digital image processing
- Understand the image enhancement techniques used in digital image processing
- Understand the image restoration techniques and methods used in digital imageprocessing
- Understand the Morphological Operations and Segmentation used in digital image processing

Module-1	**Contact Hours.**
Digital Image Fundamentals: What is Digital Image Processing?,Originsof Digital Image Processing, Examples of fields that use DIP, FundamentalSteps in Digital Image Processing, Components of an Image ProcessingSystem, Elements of Visual Perception, Image Sensing and Acquisition,Image Sampling and Quantization, Some Basic Relationships betweenPixels, Linear and Nonlinear Operations. [Text1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2]	10
RBT: L1,L2	
Module-2	
Spatial Domain: Some Basic Intensity Transformation Functions,Histogram Processing, Fundamentals of Spatial Filtering,-SmoothingSpatial Filters, Sharpening SpatialFilters**Frequency Domain**: Preliminary Concepts, The Discrete FourierTransform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering inthe Frequency Domain, Image Smoothing and Image Sharpening UsingFrequency Domain Filters, and Selective Filtering. [Text1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to4.10]	10
RBT: L1,L2, L3	
Module-3	
Restoration: Noise models, Restoration in the Presence of Noise Onlyusing Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, InverseFiltering, Minimum Mean Square Error (Wiener) Filtering, and ConstrainedLeast Squares Filtering. [Text1: Chapter 5: Sections 5.2, to 5.9]	10
RBT: L1,L2, L3	
Module-4	
Color Image Processing: Color Fundamentals, Color Models, and Pseudo-colorImage Processing. **Wavelets:** Background, Multiresolution Expansions. **Morphological Image Processing:** Preliminaries, Erosion and Dilation,Opening and Closing,	10

The Hit-or-Miss Transforms, and Some BasicMorphological Algorithms. [Text1: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2,Chapter 9: Sections 9.1 to 9.5]	
RBT: L1,L2, L3	
Module-5	
Segmentation: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, and Principles of Thresholding. **Representation and Description:** Representation, and Boundary descriptors. [Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2]	10
RBT: L1,L2, L3	

Course Outcomes: At the end of the course students should be able to:

- Understand, Ascertain and describe the basics of image processing concepts through mathematical interpretation.
- Apply image processing techniques in both the spatial and frequency (Fourier)domains.
- Demonstrate image restoration process and its respective filters required.
- Design image analysis techniques in the form of image segmentation and toevaluate the Methodologies for segmentation.
- Conduct independent study and analysis of Image Enhancement techniques.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will 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, 2nd Edition, 2016.

Reference Books:

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004.

JAVA FOR MOBILE APPLICATIONS
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AI63	**CIE Marks**	40
Number of Contact Hours/Week	3:2:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs

CREDITS –4

Course Learning Objectives: This course will enable students to:

- To have an insight into enumerations and collection frameworks for storing and processing data.
- To understand the architecture and components of android application.
- To design interactive user interface.
- To work with SQLite database

Module 1	**Contact Hours**
Enumerations, Autoboxing and Annotations(metadata): Enumerations, Enumeration fundamentals, the values () and valueOf() Methods, java enumerations are class types, enumerations Inherits Enum, example, type wrappers, Autoboxing, Autoboxing and Methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of Warning. 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. **RBT: L2, L3**	10
Module 2	
The collections and Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working with Maps, Comparators, The Collection Algorithms, Why Generic Collections? The legacy Classes and Interfaces, Parting Thoughts on Collections **RBT: L1, L2**	10
Module 3	
String Handling: The String Constructors, String Length, Special String Operations, String Literals, String Concatenation, String Concatenation with Other Data Types, String Conversion and toString( ) Character Extraction, charAt( ), getChars( ), getBytes( ) toCharArray(), String Comparison, equals( ) and equalsIgnoreCase( ), regionMatches( ) startsWith( ) and endsWith( ), equals( ) Versus ==, compareTo( ) Searching Strings, Modifying a String, substring( ), concat( ), replace( ), trim( ), Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer, StringBuffer Constructors, length( ) and capacity( ), ensureCapacity( ), setLength( ), charAt( ) and setCharAt( ), getChars( ),append( ), insert( ), reverse( ), delete( ) and deleteCharAt( ), replace( ), substring( ), Additional StringBuffer Methods, StringBuilder **Text Book 1: Ch 15**	10
Module 4	
Getting Started with Android Programming: What is Android? Features of Android, Android Architecture, obtaining the required tools, launching your first android application **Activities, Fragments and Intents:** Understanding activities, linking activities using intents, fragments.**Text Book 3: Ch 1, 3**	10

RBT: L1, L2, L3	
Module 5	
Getting to know the Android User Interface: Views and ViewGroups, FrameLayout, LinearLayout, TableLayout, RelativeLayout, ScrollView **Designing User Interface with Views:** TextView view – Button, ImageButton, EditText, Checkbox, ToggleButton, RadioButton and RadioGroupViews. **Creating and using Databases:** Creating the DBAdapter Helper class, using the database programmatically. **Text Book 3: Ch 4.1, 5.1, 7.3** **RBT: L1, L2, L3**	10

Course Outcomes: The student will be able to:

- Interpret the need for advanced Java concepts like enumerations and collections in developing modular and efficient programs
- Understand various application components in android.
- Design efficient user interface using different layouts.
- Develop application with persistent data storage using SQLite

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1.Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007.
2.Jim Keogh: J2EE-TheCompleteReference, McGraw Hill, 2007
3.J. F. DiMarzio, Beginning Android Programming with Android Studio, 4th Edition, 2017

Reference Books:

1. John Horton,Android Programming for Beginners, 1st Edition, 2015
2.Dawn Griffiths & David Griffiths, Head First Android Development, O'Reilly, 1st Edition, 2015

NATURAL LANGUAGE PROCESSING (Effective from the academic year 2018 -2019) SEMESTER – VI			
Subject Code	18AI641	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			

Course Learning Objectives: This course will enable students to:

- Analyze the natural language text.
- Define the importance of natural language.
- Understand the concepts Text mining.
- Illustrate information retrieval techniques.

Module – 1	**Contact Hours**
Overview and language modeling: 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. **Textbook 1: Ch. 1,2** **RBT: L1, L2, L3**	08
Module – 2	
Word level and syntactic analysis: 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. **Textbook 1: Ch. 3,4** **RBT: L1, L2, L3**	08
Module – 3	
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. **Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:** Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. **A Case Study in Natural Language Based Web Search:** InFact System Overview, The GlobalSecurity.org Experience. **Textbook 2: Ch. 3,4,5** **RBT: L1, L2, L3**	08
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** **RBT: L1, L2, L3**	08
Module – 5	
Information Retrieval And Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information	08

Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger-Research Corpora. **Textbook 1: Ch. 9,12** **RBT: L1, L2, L3**	

Course outcomes: The students should be able to:

- Analyze the natural language text.
- Define the importance of natural language.
- Understand the concepts Text mining.
- Illustrate information retrieval techniques.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

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 LanguageProcessing and Text Mining", Springer-Verlag London Limited 2007.

Reference Books:

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

SOFTWARE PROJECT MANAGEMENT
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AI642	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the basics of software project management concepts, principles and practices.
- Understand the different methods of estimation for software project.
- Understand the basic concepts, principles and practices of software project scheduling and riskmanagement.
- Analyse a software project based on various review metrics with review guidelines.
- Understand software project maintenance, reengineering and configuration management.

Module – 1	**Contact Hours**
Project Management Concepts: The Management Spectrum – The People, The Products, The Process, TheProject, People -The Stakeholders, Team Leaders, The Software Team, Agile Teams, Coordination AndCommunication Issues, The Product – Software Scope, Problem Decomposition, The Process – Melding TheProductsAnd The Process, Process Decomposition, The Project, The W5HH Principle, Critical Practices. **T1: Chapter 31** **RBT: L1, L2**	08
Module – 2	
Metrics in the Process and Project Domains -Process Metrics And Software Process Improvement, ProjectMetrics, Software Measurement – Size-Oriented Metrics, Function-Oriented Metrics, Reconciling LOC AndFP Metrics, Object-Oriented Metrics, Use Cases- Oriented Metrics, Webapp Project Metrics, Metrics ForSoftware Quality – Measuring Quality ,Defect Removal Efficiency, Integrating Metrics With The SoftwareProcess - Arguments For Software Metrics, Establishing A Baseline, Metrics Collection Computation AndEvaluation, Metrics For Small Organisation, Establishing A Software Metrics Program. **T1: Chapter 32** **RBT: L1, L2**	08
Module – 3	
Estimation for Software Project: Observations On Estimation, The Project Planning Process, SoftwareScope And Feasibility, Resources – Human Resources, Reusable Software Resources, EnvironmentalResources, Software Project Estimation, Decomposition Techniques – Software Sizing, Problem BasedEstimation, An Example Of LOC Based Estimation, An Example Of FP – Based Estimation, Process-BasedEstimation, An Example Of Process- Based Estimation, Estimation With Usecases, An Example Of EstimationUsing Use Case Points, Reconciling Estimates, Empirical Estimation Models – The Structure Of EstimationModels, The COCOMO II Model, The Software Equation. **T1: Chapter 33** **RBT: L1, L2**	08
Module – 4	

Project Scheduling: Basic concepts, Project Scheduling – Basic Principles - The Relationship BetweenPeople and Effort – Effort Distribution, defining a Task Set for The Software Project – a Task Set Example –Refinement of Major Tasks, defining a Task Network, Scheduling – Timeline Charts – Tracking the Schedule– Tracking Progress for an OO Project. **T1: Chapter 34** **RBT: L1, L2**	08
Module – 5	
Software Quality: What is Quality? Software Quality – Garvin's Quality Dimensions, McCall‟sQualityFactors, ISO 9126 Quality Factors, Targeted Quality Factors, The Transition to a Quantitative View, TheSoftware Quality Dilemma - "Good Enough" Software, The Cost Of Quality, Risks, Negligence and Liability,Quality and Security, The Impact Of Management Actions, Achieving Software Quality – SoftwareEngineering Methods, Project Management Techniques, Quality Control, Quality Assurance. **T1: Chapter 19** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Describe the basics of software project management concepts, principles and practices.
- Apply the different metrics and techniques to measure a software project.
- Apply software cost estimation models.
- Apply scheduling techniques to software project.
- Discuss the software quality concepts and good practices.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Software Engineering: APractitioner'sApproachRoger S. Pressman, BruceMaximMcGraw Hill 8th Edition,2015

Reference Books:

1. Software Project ManagementBobHughesMikeCotterellRajibMallMcGraw Hill 6th Edition 2018
2. Managing the Software ProcessWattsHumphreyPearson Education 2000
3. Software Project Management inpracticePankajJalote Pearson Education 2002

WEB PROGRAMMING (Effective from the academic year 2018 -2019) SEMESTER – VI			
Subject Code	18AI643	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Illustrate the Semantic Structure of HTML and CSS
- Compose forms and tables using HTML and CSS
- Design Client-Side programs using JavaScript and Server-Side programs using PHP
- Infer Object Oriented Programming capabilities of PHP
- Examine JavaScript frameworks such as jQuery and Backbone

Module 1	**Contact Hours**
Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling. **Textbook 1: Ch. 2, 3** **RBT: L1, L2, L3**	8
Module 2	
HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks. **Textbook 1: Ch. 4,5** **RBT: L1, L2, L3**	8
Module 3	
JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions **Textbook 1: Ch. 6, 8** **RBT: L1, L2, L3**	8
Module 4	
PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling **Textbook 1: Ch. 9, 10** **RBT: L1, L2, L3**	8
Module 5	
Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation, Backbone MVC Frameworks, XML Processing and Web Services, XML Processing, JSON, Overview of Web Services. **Textbook 1: Ch. 13, 15,17** **RBT: L1, L2, L3**	8

Course Outcomes: The student will be able to :

- Adapt HTML and CSS syntax and semantics to build web pages.
- Construct and visually format tables and forms using HTML and CSS
- Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.
- Appraise the principles of object oriented development using PHP
- Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Randy Connolly, Ricardo Hoar, **"Fundamentals of Web Development",** 1st Edition, Pearson Education India. (**ISBN:**978-9332575271)

Reference Books:

1. Robin Nixon, **"Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5",** 4th Edition, O'Reilly Publications, 2015. (**ISBN:**978-9352130153)
2. Luke Welling, Laura Thomson, **"PHP and MySQL Web Development",** 5th Edition, Pearson Education, 2016. (**ISBN:**978-9332582736)
3. Nicholas C Zakas, **"Professional JavaScript for Web Developers",** 3rd Edition, Wrox/Wiley India, 2012. (**ISBN:**978-8126535088)
4. David Sawyer Mcfarland, **"JavaScript & jQuery: The Missing Manual",** 1st Edition, O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 2014

Mandatory Note:

Distribution of CIE Marks is a follows (Total 40 Marks):

- 20 Marks through IA Tests
- 20 Marks through practical assessment

Maintain a copy of the report for verification during LIC visit.

FOUNDATION FOR DATA SCIENCE
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AI644	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the knowledge of mathematics to explain the concept of data science
- Design Decision tree to predict the class for a given data
- Analyze the given data set, and solve a problem by performing Classification using the basics of mathematics and data science
- Develop solutions to group entities in data set and apply it for the given real-world data using the basic knowledge of similarity, neighbors and clustering

Module – 1	CH
Introduction: Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data-Driven Decision Making, Data Processing and ―Big Data‖, Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking. **Business Problems and Data Science Solutions:** From Business Problems to Data Mining Tasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining **Text Book 1: Chapter 1, Chapter 2** **RBT: L1, L2**	08
Module – 2	
Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree- Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction. **Text Book 1: Chapter 3** **RBT: L1, L2**	08
Module – 3	
Fitting a Model to Data: Classification via Mathematical Functions: LinearDiscriminant Functions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic ―Regression‖. Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non-Linear Functions, Support vector machines and Neural Networks OverfittingandIts Avoidance: Fundamental Concepts,ExemplaryTechniques,Regularization,Genaralization, Overfitting,Overfitting Examined **Text Book 1: Chapter 4, Chapter 5** **RBT: L1, L2, L3**	08
Module – 4	
Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning, Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering **Text Book 1: Chapter 6** **RBT: L1, L2,L3**	08
Module – 5	
Decision Analytic Thinking I: What is a Good Model? Evaluating Classifiers Plain Accuracyand its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits. **Representing and Mining Text**: Why Text Is Important? Why Text Is Difficult? Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document Frequency, Combining Them: TFIDF, Example: Jazz Musicians	08

Other Data Science Tasks and Techniques: Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behavior, Link Prediction and Social Recommendation. **Text Book 1: Chapter 7, Chapter 10, Chapter 12** **RBT: L1, L2, L3**	

Course outcomes: The students should be able to:

- **Apply** the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business
- **Develop** a Decision tree based on supervised segmentation and predict the class for a given data set by selecting (through solving) the attribute for segmentation using the available techniques.
- **Analyze** the given data set, and solve a problem by performing Classification using the basics of mathematics and data science
- **Develop** solutions to group entities in data set and **apply** it for the given real-world data using the basic **knowledge** of similarity, neighbors and clustering
- **Analyze** the importance of mining text (social data) and formulate the association rules based on market basket analysis

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Foster Provost and Tom Fawcett, Data Science for Business, O'Reilly, 2013

Reference Books:

1. Cathy O'Neil and Rachel Schutt, **Doing Data Science**, O'Reilly, 2014.
2. Hector Cuesta, **Practical Data Analysis**, PACKT Publishing, 2013
3. Michael R. Berthold, Christian Borgelt, Frank Hijppner Frank Klawonn, **Guide to Intelligent Data Analysis**, Springer-Verlag London Limited, 2010
4. Data Analytics using Python, Bharti Motwani, Wiley, 2020

MOBILE APPLICATION DEVELOPMENT
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18CS651	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Learn to setup Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications

Module – 1	**CH**
Get started, Build your first app, Activities, Testing, debugging and using support libraries **Textbook 1: Lesson 1,2,3** **RBT: L1, L2**	08
Module – 2	
User Interaction, Delightful user experience, Testing your UI **Textbook 1: Lesson 4,5,6** **RBT: L1, L2**	08
Module – 3	
Background Tasks, Triggering, scheduling and optimizing background tasks **Textbook 1: Lesson 7,8** **RBT: L1, L2**	08
Module – 4	
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders **Textbook 1: Lesson 9,10,11,12** **RBT: L1, L2**	08
Module – 5	
Permissions, Performance and Security, Firebase and AdMob, Publish// **Textbook 1: Lesson 13,14,15** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Create, test and debug Android application by setting up Android development environment
- Implement adaptive, responsive user interfaces that work across a wide range of devices.
- Infer long running tasks and background work in Android applications
- Demonstrate methods in storing, sharing and retrieving data in Android applications
- Analyze performance of android applications and understand the role of permissions and security
- Describe the steps involved in publishing Android application to share with the world

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

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

Textbooks:

1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-

training/android-developer-fundamentals-course-concepts/details (Download pdf file from the above link)

Reference Books:

1. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
3. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
4. Anubhav Pradhan, Anil V Deshpande, " Composing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2

INTRODUCTION TO DATA SRUCTURES AND ALGORITHM
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18CS652	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Identify different data structures in C programming language
- Appraise the use of data structures in problem solving
- Implement data structures using C programming language.

Module 1	**Contact Hours**
Introduction to C, constants, variables, data types, input output operations, operators and expressions, control statements, arrays, strings, built-in functions, user defined functions, structures, unions and pointers **Text Book 1: Chapter 1 and 2** **RBT: L1, L2**	08
Module 2	
Algorithms, Asymptotic notations, Introduction to data structures, Types of data structures, Arrays. **Text Book 1: Chapter 3 and 4** **RBT: L1, L2**	08
Module 3	
Linked lists, Stacks **Text Book 1: Chapter 5 and 6** **RBT: L1, L2**	08
Module 4	
Queues, Trees **Text Book 1: Chapter 7 and 8** **RBT: L1, L2**	08
Module 5	
Graphs, Sorting ,(selection, insertion, bubble, quick)and searching(Linear, Binary, Hash) **Text Book 1: Chapter 9 and 10** **RBT: L1, L2**	08

Course Outcomes: The student will be able to :

- Identify different data structures in C programming language
- Appraise the use of data structures in problem solving
- Implement data structures using C programming language.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Data structures using C , E Balagurusamy, McGraw Hill education (India) Pvt. Ltd, 2013.

Reference Books:

1. Ellis Horowitz and SartajSahni, 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.

PROGRAMMING IN JAVA
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18CS653	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Learn fundamental features of object oriented language and JAVA
- Set up Java JDK environment to create, debug and run simple Java programs.
- Learn object oriented concepts using programming examples.
- Study the concepts of importing of packages and exception handling mechanism.
- Discuss the String Handling examples with Object Oriented concepts

Module – 1	**CH**
An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: 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 **Text book 1: Ch 2, Ch 3** **RBT: L1, L2**	08
Module – 2	
Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements. **Text book 1: Ch 4, Ch 5** **RBT: L1, L2**	08
Module – 3	
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, A Closer Look at Methods and Classes: 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, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. **Text book 1: Ch 6, Ch 7.1-7.9, Ch 8.** **RBT: L1, L2**	08
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. **Text book 1: Ch 9, Ch 10** **RBT: L1, L2**	08
Module – 5	
Enumerations, Type Wrappers, I/O, Applets, and Other Topics: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, Applet Fundamentals, The transient and volatile Modifiers, Using instanceof, strictfp, Native Methods, Using assert, Static Import, Invoking Overloaded Constructors Through this( ), 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.	08

Text book 1: Ch 12.1,12.2, Ch 13, Ch 15 **RBT: L1, L2**	

Course outcomes: The students should be able to:

- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.

Develop simple GUI interfaces for a computer program to interact with users

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)

Reference Books:

1. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016.
2. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning Press, 1st Edition, 2014.

INTRODUCTION TO OPERATING SYSTEM
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18CS654	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Explain the fundamentals of operating system
- Comprehend multithreaded programming, process management, memory management and storage management.
- Familier with various types of operating systems

Module – 1	**CH**
Introduction: What OS do, Computer system organization, architecture, structure, Operations, Process, memory and storage management, Protection and security, Distributed systems, Special purpose systems, computing environments. System Structure: OS Services, User OSI, System calls, Types of system calls, System programs, OS design and implementation, OS structure, Virtual machines, OS generation, system boot **Textbook1: Chapter 1, 2** **RBT: L1, L2**	08
Module – 2	
Process Concept: Overview, Process scheduling, Operations on process, IPC, Examples in IPC, Communication in client-server systems. Multithreaded Programming: Overview, Models, Libraries, Issues, OS Examples **Textbook1: Chapter 3,4** **RBT: L1, L2**	08
Module – 3	
Process Scheduling: Basic concept, Scheduling criteria, Algorithm, multiple processor scheduling, thread scheduling, OS Examples, Algorithm Evaluation. Synchronization: Background, the critical section problem, Petersons solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors, Synchronization examples, Atomic transactions **Textbook1: Chapter 5, 6** **RBT: L1, L2**	08
Module – 4	
Deadlocks: System model, Deadlock characterization, Method of handling deadlock, Deadlock prevention, Avoidance, Detection, Recovery from deadlock Memory management strategies: Background, swapping, contiguous memory allocation, paging, structure of page table, segmentation, **Textbook1: Chapter 7, 8** **RBT: L1, L2**	08
Module – 5	
Virtual Memory management: Background, Demand paging, Copy-on-write, Page replacement,	08

allocation of frames, Trashing, Memory mapped files, Allocating Kernel memory, Operating system examples File system: File concept, Access methods, Directory structure, File system mounting, File sharing, protection **Textbook1: Chapter 9, 10** **RBT: L1, L2**	

Course outcomes: The students should be able to:

- Explain the fundamentals of operating system
- Comprehend process management, memory management and storage management.
- Familiar with various types of operating systems

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. A. Silberschatz, P B Galvin, G Gagne, Operating systems, 7th edition, John Wiley and sons,.

Reference Books:

1. William Stalling,"Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016

MACHINE LEARNING LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AIL66	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours		**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Implement and evaluate ML algorithms in Python/Java programming language.

Descriptions (if any):
1. The programs can be implemented in either JAVA or Python.
2. Data sets can be taken from standard repository such as UCI

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

Programs List:

1.	Implement and demonstratethe**FIND-Salgorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file and show the output for test cases. Develop an interactive program by Compareing the result by implementing **LIST THEN ELIMINATE** algorithm.
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination**algorithm. Output a description of the set of all hypotheses consistent with the training examples.
3	Demonstrate Pre processing (Data Cleaning, Integration and Transformation) activity on suitable data: For example: Identify and Delete **Rows that Contain Duplicate Data** by considering an appropriate dataset. Identify and Delete **Columns That Contain a Single Value** by considering an appropriate dataset.
4	Demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge toclassify a new sample.
5	Demonstrate the working of the Random forest **algorithm**. Use an appropriate data set for building and apply this knowledge toclassify a new sample.
6	Implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7	Assuming a set of documents that need to be classified, use the **naive Bayesian Classifier** model to perform this task. Calculate the accuracy, precision, and recall for your data set.
8	Construct a**Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
9	Demonstrate the working of EM algorithm to cluster a set of data stored in a .CSV file.
10	Demonstrate the working of SVM classifier for a suitable data set

Laboratory Outcomes: The student should be able to:

- Implement and demonstration of ML algorithms.
- Evaluation of different algorithms.

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accordance with university regulations)*

m) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks

n) For laboratories having PART A and PART B

i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks

ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

DIGITAL IMAGE PROCESSING LABORATORY WITH MINI PROJECT
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Subject Code	18AIL67	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours		**Exam Hours**	03

CREDITS – 2

Course Learning Objectives: This course will enable students to:

- Demonstrate the basic skills of image process
- Demonstrate the application development skills
- Design and develop the applications of images

Descriptions (if any): --

- Programming tools preferred: SCILAB, Python, Java or any other relevant platform.
- For Part A: Students must exhibit the results and its print copy to be attached to Lab record.
- For Part B: Real Time Images can be used to demonstrate the work.
  During the practical exam: the students should demonstrate and answer Viva-Voce

Programs List:PART A

1	Write a Program to read a digital image. Split and display image into 4 quadrants, up, down, right and left
2	Write a program to showrotation, scaling, and translation of an image.
3	Read an image, first apply erosion to the image and then subtract the result from the original. Demonstrate the differencein the edge image if you use dilation instead of erosion.
4	Read an image and extract and display low-level features such as edges, textures usingfiltering techniques
5	Demonstrate enhancing and segmenting low contrast 2D images.

PART B :MINI PROJECT

Student should develop a mini project and it should be demonstratedin the laboratory examination, Some of the projects are listed and it is not limited to:

- Recognition of License Plate through Image Processing
- Recognition of Face Emotion in Real-Time
- Detection of Drowsy Driver in Real-Time
- Recognition of Handwriting by Image Processing
- Detection of Kidney Stone
- Verification of Signature
- Compression of Color Image
- Classification of Image Category
- Detection of Skin Cancer
- Marking System of Attendance using Image Processing
- Detection of Liver Tumor
- IRIS Segmentation
- Detection of Skin Disease and / or Plant Disease
- Biometric Sensing System
- Mobile Phone Camera-based Light Communications
- Modeling of Perspective Distortion within Face Images &Library for Object Tracking
- Controlling of Intelligent Traffic Light & Image Processing

- Controlling of Pests in Agriculture Field with Image Processing

(**During the practical exam: the students should demonstrate and answer Viva-Voce**)

Laboratory Outcomes: The student should be able toillustrate the following operations:

- Image Segmentation algorithm development
- Image filtering in spatial and frequency domain.
- Morphological operations in analyzing image structures

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A: Students are allowed to pick one experiment from PART A, with equal opportunity. The mini project from PART B to be run &exhibit the results also a report on the work is produced.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accordance with university regulations)*
  - o) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  - p) For laboratories having PART A and PART B
    - i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    - ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

MOBILE APPLICATION DEVELOPMENT LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – VI

Course Code	**18AIMP68**	**IA Marks**	40
Number of Contact Hours/Week	0:2:2	**Exam Marks**	60
Total Number of Contact Hours	3 Hours/Week	**Exam Hours**	03

CREDITS – 02

Course Learning Objectives: This course will enable students to:

- Learn and acquire the art of AndroidProgramming.
- Configure Android studio to run theapplications.
- Understand and implement Android's User interfacefunctions.
- Create, modify and query on SQlitedatabase.
- Inspect different methods of sharing data usingservices.

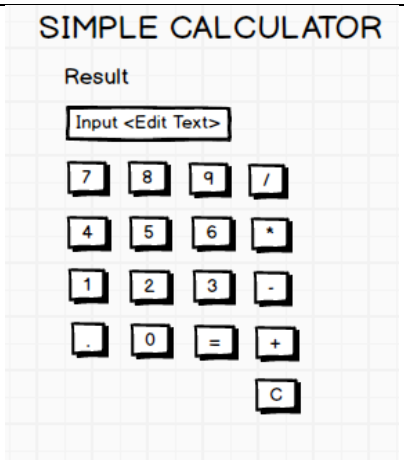
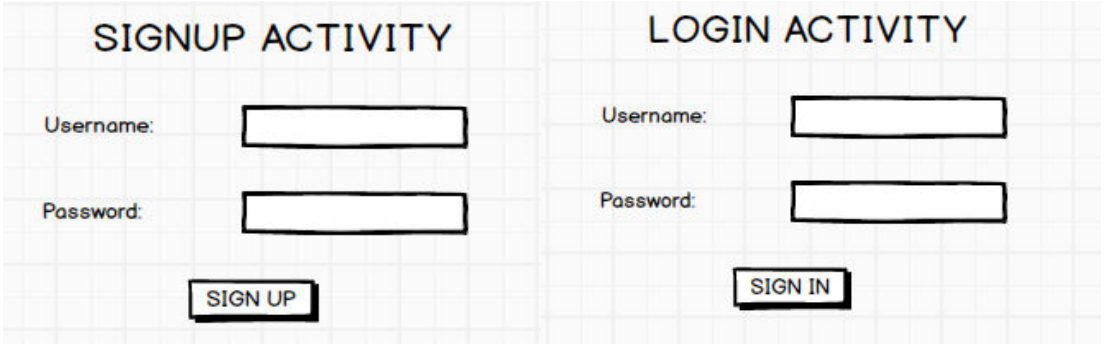
Descriptions (if any):

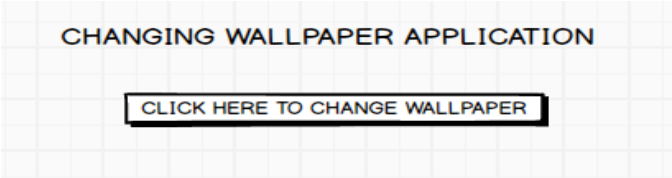
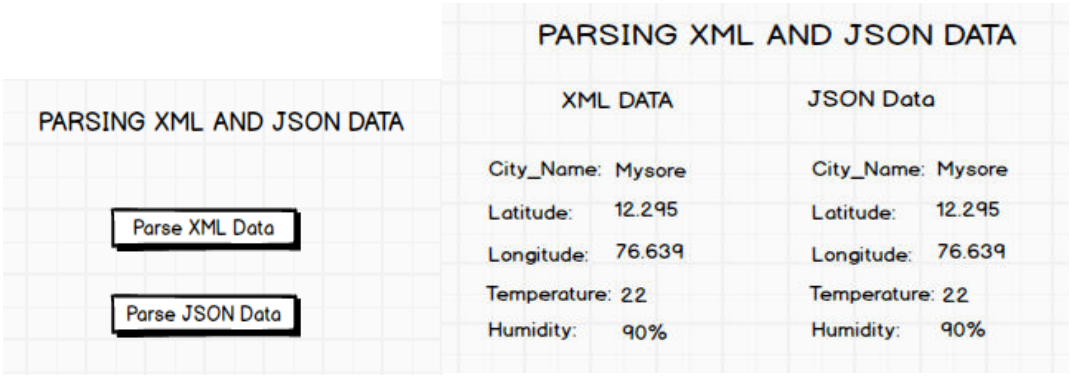
1. Installation procedure of the Android Studio/Java software must be demonstrated and carried out ingroups.
2. Students should use the latest version of Android Studio/Java/Kotlin to execute these programs. Diagrams given are for representational purpose only, students are expected to improvise on it.
3. Part B programs should be developed as an application and be demonstrated as a mini project in a group by adding extra features or the students can also develop their own application and demonstrate it as a mini project. (Projects/programs are not limited to the list given in Part B)

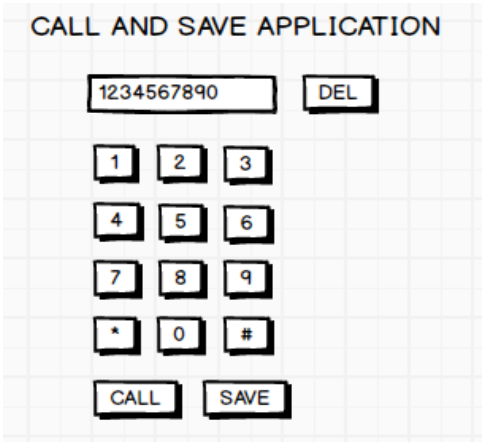
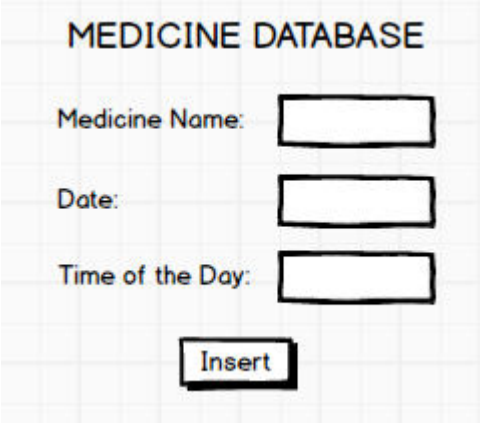
Programs List:

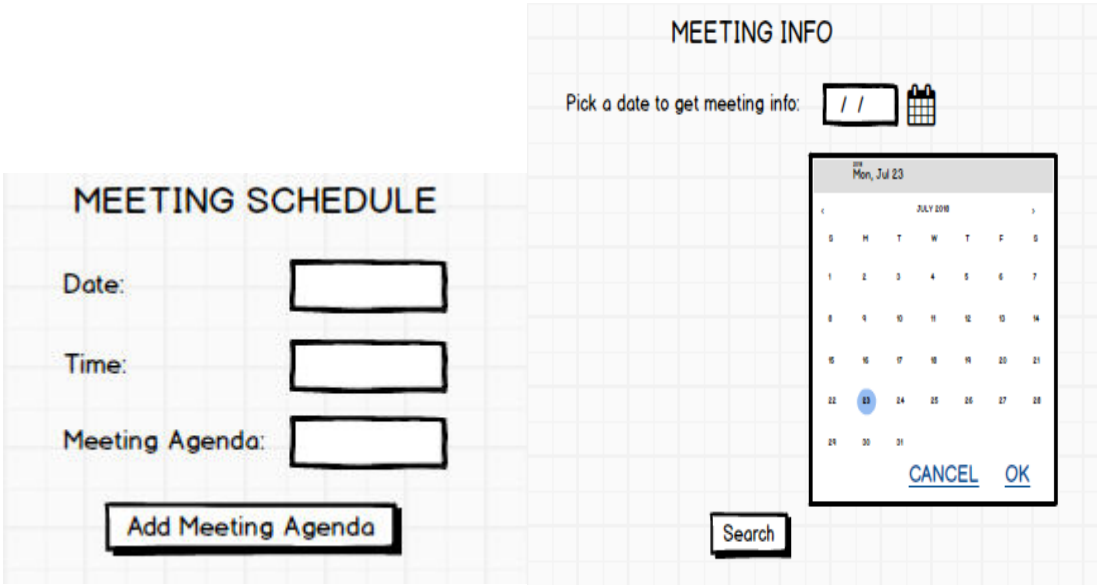
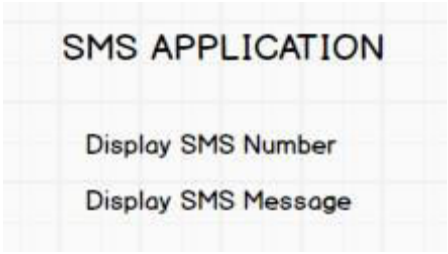
PART – A

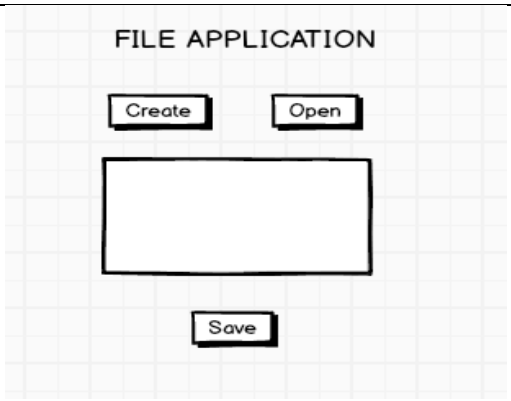
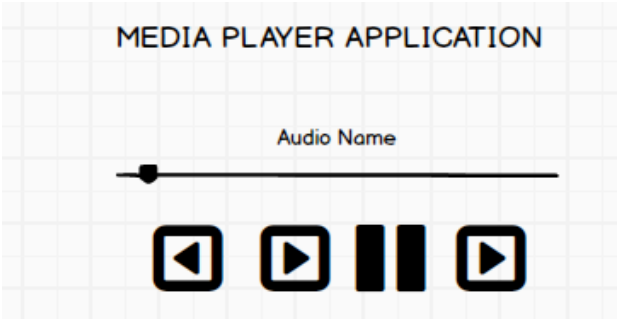
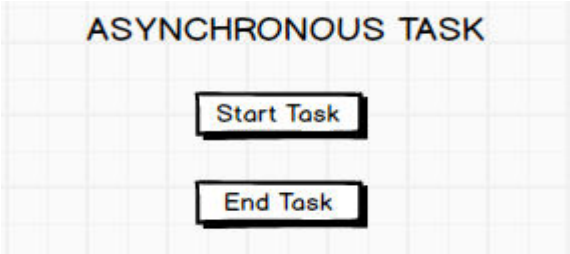
1	Create an application to design aVisiting Card. The Visiting card should haveacompanylogoatthe top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address isto be displayed. Insert a horizontal line between the job title and the phone number. 
2	Develop an Android application usingcontrols like Button, TextView, EditText for designing a calculatorhaving basic functionality like Addition, Subtraction, Multiplication,andDivision.

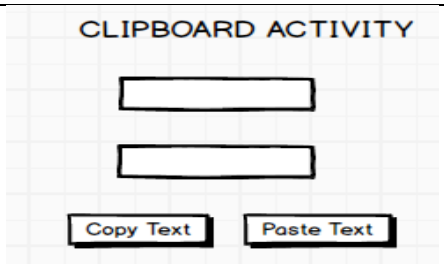
	
3	Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules: • Password should contain uppercase and lowercaseletters. • Password should contain letters andnumbers. • Password should contain specialcharacters. • Minimum length of the password (the default value is8). On successful **SIGN UP** proceed to the next Login activity. Here the user should **SIGN IN** using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity whichdisplays a message saying "Successful Login" or else display a toast message saying "Login Failed".The user is given only two attempts and after thatdisplay a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another. 

4	Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds. 
5	Write a program to create an activity with two buttons START and STOP. On pressin g of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a TextViewcontrol. 
6	Create two files of XML and JSON type with values for City_Name, Latitude, Longitude, Temperature, and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side. 

7	Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called “Convert Text to Speech” that converts the user input text into voice. 
8	Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phonecontacts. 
PART - B	
1	Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name. 

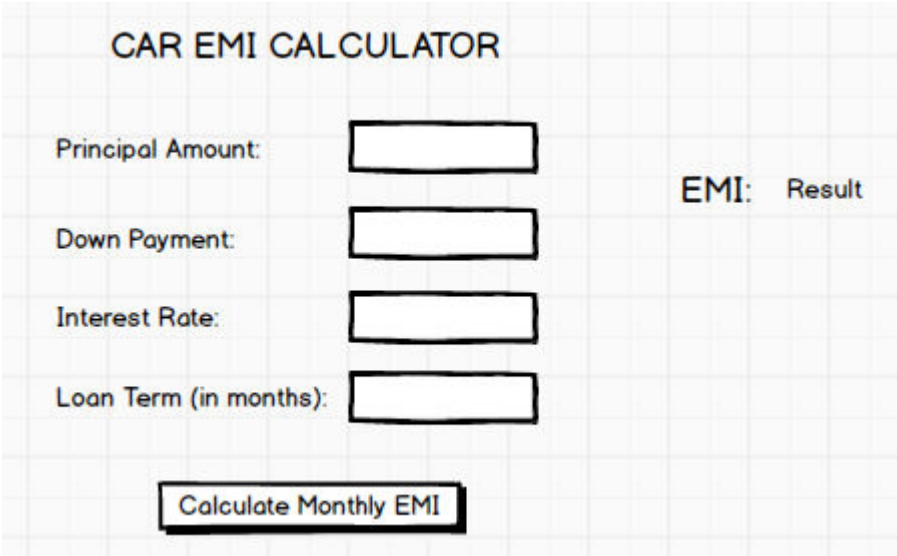
2	Develop a content provider application with an activity called “Meeting Schedule” which takes Date, Time and Meeting Agenda as input from the user and store this information into the SQLite database. Create another application with an activity called “Meeting Info” having DatePicker control, which on the selection of a date should display the Meeting Agenda information for that particular date, else it should display a toast message saying “No Meeting on this Date”. 
3	Create an application to receive an incoming SMS which is notified to the user. On clicking this SMS notification, the message content and the number should be displayed on the screen. Use appropriate emulator control to send the SMS message to your application. 
4	Write a program to create an activity having a Text box, and also Save, Open and Create buttons. The user has to write some text in the Text box. On pressing the Create button the text should be saved as a text file in MkSDcard. On subsequent changes to the text, the Save button should be pressed to store the latest content to the same file. On pressing the Open button, it should display the contents from the previously stored files in the Text box. If the user tries to save the contents in the Textbox to a file without creating it, then a toast message has to be displayed saying “First Create aFile”.

	
5	Create an application to demonstrate a basic media player that allows the user to Forward, Backward, Play and Pause an audio. Also, make use of the indicator in the seek bar to move the audio forward or backward as required. 
6	Develop an application to demonstrate the use of Asynchronous tasks in android. The asynchronous task should implement the functionality of a simple moving banner. On pressing the **Start Task** button, the banner message should scroll from right to left. On pressing the **Stop Task** button, the banner message should stop. Let the banner message be "Demonstration of Asynchronous Task". 
7	Develop an application that makes use of the clipboard framework for copying and pasting of the text. The activity consists of two Edit Text controls and two Buttons to trigger the copy and paste functionality.

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>8</td><td>Create an AIDL service that calculates Car Loan EMI. The formula to calculate EMI is

$E = P * (r(1+r)^n)/((1+r)^n-1)$
where
E = The EMI payable on the car loan amount
P = The Car loan Principal Amount
r = The interest rate value computed on a monthly basis
n = The loan tenure in the form of months

The down payment amount has to be deducted from the principal amount paid towards buying the Car. Develop an application that makes use of this AIDL service to calculate the EMI. This application should have four Edit Text to read the Principal Amount, Down Payment, Interest Rate, Loan Term (in months) and a button named as “Calculate Monthly EMI”. On click of this button, the result should be shown in a Text View. Also, calculate the EMI by varying the Loan Term and Interest Rate values.

 
</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Laboratory Outcomes: After studying these laboratory programs, students will be able to</td></tr>
<tr><td colspan="2">• Create, test and debug Android application by setting up Android developmentenvironment.
• Implement adaptive, responsive user interfaces that work across a wide range ofdevices.
• Infer long running tasks and background work in Androidapplications.
• Demonstrate methods in storing, sharing and retrieving data in Androidapplications.</td></tr>
</table>

- Infer the role of permissions and security for Androidapplications.

Procedure to Conduct Practical Examination

- **Experiment distribution**
  - **For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.**
  - **For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A with equal opportunity and in Part B demonstrate the Mini project.**
- **Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.**
- **Marks Distribution** ***(Subjected to change in accoradance with university regulations)***
  - **q) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks**
  - **r) For laboratories having PART A and PART B**
    - **i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks**
    - ii. **Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks**

Text Books:

1. Google Developer Training, **"Android Developer Fundamentals Course – Concept Reference",** Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details
(Download pdf file from the above link)

Reference Books:

1. Erik Hellman, **"Android Programming – Pushing the Limits",** 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197
2. Dawn Griffiths and David Griffiths, **"Head First Android Development",** 1st Edition, O'Reilly SPD Publishers, 2015. ISBN-13:978-9352131341
3. Bill Phillips, Chris Stewart and Kristin Marsicano, **"Android Programming: The Big Nerd Ranch Guide",** 3rd Edition, Big Nerd Ranch Guides, 2017. ISBN-13:978-0134706054

ADVANCED ARTIFICIAL INTLLIGENCE (Effective from the academic year 2018 -2019) SEMESTER – VII			
Subject Code	18AI71	**CIE Marks**	40
Number of Contact Hours/Week	4:0:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Demonstrate the fundamentals of Intelligent Agents
- Illustrate the reasoning on Uncertain Knowledge
- Explore the explanation based learning in solving AI problems
- Demonstrate the applications of Rough sets and Evolutionary Computing algorithms

Module 1	**Contact Hours**
IntelligentAgents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents **Problem Solving :**Game Paying **T1: Chapter 2, Chapter 5 (2.1 to 2.4, 5.1 to 5.6)**	10
Module 2	
Uncertain knowledge and Reasoning: Quantifying Uncertainty**,** Acting under Uncertainty , Basic Probability Notation, Inference Using Full Joint Distributions, Independence , Bayes'Rule and Its Use The WumpusWorld Revisited, **T1: Chapter 13**	10
Module 3	
Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks , Efficient Representation of Conditional Distributions Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks. **T1: Chapter 14**	10
Module 4	
Perception: Image Formation, Early Image-Processing Operation, Object Recognition by Appearance, Reconstructing the 3DWorld. Object Recognition from Structural Information, Using Vision **T1: Chapter 24**	10
Module 5	
Overview and language modeling: 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. **T2: Chapter 1, 2**	10

Course Outcomes: The student will be able to :

- Demonstrate the fundamentals of Intelligent Agents
- Illustrate the reasoning on Uncrtain Knowledge

- Explore the explanation based learning in solving AI problems
- Demonstrate the applications of Rough sets and Evolutionary Computing algorithms

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Artificial Intelligence, A Modern Approach, Stuart J. Russell and Peter Norvig, Third Edition, Pearson, 2010
2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Reference Books:

1. An Introduction to Multi Agent Systems, Michael Wooldridge, Second Edition, John Wiley & Sons

ADVANCED MACHINE LEARNING (Effective from the academic year 2018 -2019) SEMESTER – VII			
Subject Code	18AI72	**CIE Marks**	40
Number of Contact Hours/Week	4:0:0	**SEE Marks**	60
Total Number of Contact Hours	50	**Exam Hours**	3 Hrs
CREDITS –4			

Course Learning Objectives: This course will enable students to:

- Demonstrate the fundamentals of GDT
- Illustrate the use of KNN
- Explore the Text feature Engineering concepts with Applications
- Demonstrate the use of Ensemble Methods

Module 1	**Contact Hours**
Advanced Machine Learning: Overview, Gradient Descent algorithm, Scikit-learn library for ML, Advanced Regression models, Advanced ML algorithms, KNN, ensemble methods. **T2: Chapter 6 (upto 6.5.4)** **Forecasting:**Overview, components, moving average, decomposing time series, auto-regressive Models. **T2: Chapter: 8**	10
Module 2	
Hidden Markov Model: Introduction, Issues in HMM(Evalution, decoding, learning, classifier) **T3: Chapter 12** **CLUSTERING** **Introduction,** Types of clustering, Partitioning methods of clustering (k-means, k-medoids), hierarchical methods **T3: Chapter 13**	10
Module 3	
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 **T2: Chapter 9 and** 10	10
Module 4	
Neural networks and genetic algorithms: Brief history and Evolution of Neural network, Biological neuron, Basics of ANN,Activation function, MP model. **T3: Chapter 6** Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Genetic Algorithms – Hypothesis Space Search – Genetic	10

Programming – Models of Evolution and Learning. **T1: Chapter 4 & 9**	
Module 5	
Instant based learning and learning set of rules: Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbor learning(review), locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning **T1 :Sections: 5.1-5.6, 8.1-8.5, 13.1-13.3**	10

Course Outcomes: The student will be able to :

- Apply effectively ML algorithmsto solve real world problems.
- Apply Instant based techniques and derive effectively learning rules to real world problems.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

T1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013

T2. Machine Learning using Python ,Manaranjan Pradhan, U Dinesh Kumar, Wiley 2019

T3. Machine Learning, Anuradha Srinivasaraghavan, VincyJoeph, Wiley 2019

Reference Books:

1. EthemAlpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

INTERNET OF THINGS (Effective from the academic year 2018 -2019) SEMESTER – VII			
Subject Code	18AI731	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Assess the genesis and impact of IoT applications, architectures in real world.
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.

Module 1	**Contact Hours**
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. **Textbook 1: Ch.1, 2** **RBT: L1, L2, L3**	08
Module 2	
Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. **Textbook 1: Ch.3, 4** **RBT: L1, L2, L3**	08
Module 3	
IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. **Textbook 1: Ch.5, 6** **RBT: L1, L2, L3**	08
Module 4	
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment **Textbook 1: Ch.7, 8** **RBT: L1, L2, L3**	08
Module 5	
IoT Physical Devices and Endpoints – Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints –RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture,	08

Smart City Use-Case Examples. **Textbook 1: Ch.12** **Textbook 2: Ch.7.1 to 7.4, Ch.8.1 to 8.4, 8.6** **RBT: L1, L2, L3**	

Course Outcomes: The student will be able to :

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,**"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",** 1st Edition, Pearson Education (Cisco Press Indian Reprint). (**ISBN:** 978-9386873743)
2. Srinivasa K G, **"Internet of Things",**CENGAGE Leaning India, 2017

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands-on-Approach)",** 1st Edition, VPT, 2014. (**ISBN:** 978-8173719547)
2. Raj Kamal, **"Internet of Things: Architecture and Design Principles",** 1st Edition, McGraw Hill Education, 2017. (**ISBN:** 978-9352605224)

Mandatory Note:

Distribution of CIE Marks is a follows (Total 40 Marks):

- 20 Marks through IA Tests
- 20 Marks through practical assessment

Maintain a copy of the report for verification during LIC visit.

Posssible list of practicals:

1. Transmit a string using UART
2. Point-to-Point communication of two Motes over the radio frequency.
3. Multi-point to single point communication of Motes over the radio frequency.LAN (Sub-netting).
4. I2C protocol study
5. Reading Temperature and Relative Humidity value from the sensor

MULTIAGENT SYSTEMS (Effective from the academic year 2018 -2019) SEMESTER – VII			
Subject Code	18AI732	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			

Course Learning Objectives: This course will enable students to:

- To introduce the concept of amultiagent systems and Distributed Constraints
- To explore the main issues surrounding the 93omputer and extended form games.
- To understand learning in Multiagent Systems
- To introduce a contemporary platform for implementing agents and multiagent systems.

Module – 1	**Contact Hours**
Multiagent Problem Formulation: Utility, Markov Decision Processes, Planning **Distributed Constraints**:Distributed Constraint Satisfaction, Distributed Constraint Optimization **T1: Chapters 1 &2, T2: Chapter 1**	08
Module – 2	
Standard and Extended Form Games: Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation **T1: Chapters 3&4, T2: Chapter 3**	08
Module – 3	
Learning in Multiagent Systems: The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence **T1: Chapters 5**	08
Module – 4	
Negotiation: The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hoc Negotiation Strategies, The Task Allocation Problem. **Protocols for Multiagent Resource Allocation: Auctions:** Simple Auctions,Combinatorial Auctions **T1: Chapters 6&7,** **T2: Chapter 11**	08
Module – 5	
Voting and Mechanism Design: The Voting Problem, Mechanism Design. **Nature-Inspired Approaches:**Ants and Termites, Immune System **T1: Chapters 8&10,** **T2: Chapter 10**	08

Course outcomes: The students should be able to:

- Explain the concept of anmulti-agent systems and Distributed Constraints
- Explore the applications of 93omputer and extended form games.
- Understand learning in Multiagent Systems
- Introduce a contemporary platform for implementing agents and multi-agent systems.

Question Paper Pattern:

- The question paper will have ten questions.

- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

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, 2nd edhttp://www.masfoundations.org/mas.pdf

Reference Books:

1. Multiagent Systems : A Modern Approach to Distributed Artificial IntelligenceGerhard Weiss The MIT Press 2000

BLOCKCHAIN TECHNOLOGY
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AI733	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Define and Explain the fundamentals of Blockchain
- Illustrate the technologies of blockchain
- Decribe the models of blockchain
- Analyze and demonstrate the Ethereum

Module – 1	**Contact Hours**
Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain. **Text Book 1: Chapter 1**	08
Module-2	
Decentralization and Cryptography: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys **Text Book 1: Chapter 2,Chapter 4**	08
Module-3	
Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash **Text Book 1: Chapter 3, Chapter 6, Chapter 8**	08
Module-4	
Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts. **Text Book 1: Chapter 10**	08
Module-5	
Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance,	08

Media **Text Book 1: Chapter 17**	

Course outcomes: The students should be able to:

- Define and Explain the fundamentals of Blockchain
- Illustrate the technologies of blockchain
- Decribe the models of blockchain
- Analyze and demonstrate the Ethereum
- Analyze and demonstrate Hyperledger fabric

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbook:

1.**Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017**

Reference Books:

1. Blockchain Technology (Concepts and applications), Kumar saurabh, Ashutosh saxena, Wiley, 2020
2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten,2016
3. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017
4. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

CLOUD COMPUTING AND VIRTUALIZATION
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AI734	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Interpret the data in the context of cloud computing.
- Identify an appropriate method to analyze the data in cloud enviornmnet
- Understanding of virtalization concept

Module – 1	**Contact Hours**
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, Exercises and problems. **Textbook 1: Chapter 1 (1.3-1.6), Chapter 3 (3.1-3.5, 3.7,3.8)** RBT: L1, L2	08
Module – 2	
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The GreThe Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing. **Textbook 1: Chapter 4 (4.1-4.11)** RBT:L1,L2	08
Module – 3	
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems	08

Textbook 1: Chapter 5 (5.1-5.9, 5.11,5.12,5.16) RBT:L1,L2	
Module – 4	
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems. **Textbook1: Chapter 6 (6.1-6.14, 6.16)** RBT : L1, L2, L3	08
Module – 5	
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to useS3 in java **Textbook1: Chapter 9 (**9.1-9.9, 11.1-11.5) RBT: L1, L2, L3	08
Course outcomes: The students should be able to:	
• Understand the concepts of cloud computing, virtualization and classify services of cloud computing • Illustrate architecture and programming in cloud • Define the platforms for development of cloud applications and List the application of cloud.	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module.	

• The students will have to answer 5 full questions, selecting one full question from each module.
Text Books:
1. Cloud Computing Theory and Practice, Dan C. Marinescu, Morgan Kaufmann, Elsevier 2013.
Reference Books:
1. Mastering Cloud Computing Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi McGraw Hill Education

FUZZY LOGIC AND ITS APPLICATION (Effective from the academic year 2018 -2019) SEMESTER – VII			
Subject Code	18AI741	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			
Course Learning Objectives: This course will enable students to:			
• Define crisp set and fuzzy set theory. • Identify the requirements to make calculation of fuzzy set theory. • Describe fuzzy arithmetic principles. • Explain fuzzy rules based systems. • Apply fuzzy graphical techniques to draw inference over the computing problems.			
Module – 1			**Contact Hours**
Introduction: Historical perspective, utility of fuzzy systems, limitations of fuzzy systems, statistics andrandom processes, uncertainty in information, fuzzy sets and membership, chance versus fuzziness, sets aspoints in Hypercube.**Classical Sets and Fuzzy Sets:** classical sets, operations on them, mapping of classical sets to functions, fuzzysets, fuzzy set operations, properties of fuzzy sets, non-interactive fuzzy sets. **RBT: L1, L2**			08
Module – 2			
Classical Relations and Fuzzy Relations: Cartesian Product, Crisp Relations – Cardinality of Crisp Relations,Operations on Crisp Relations, and Properties of Crisp Relations, Composition. Fuzzy Relations –Cardinalityof Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Productand Composition, Non-interactive Fuzzy Sets. **RBT: L1, L2**			08
Module – 3			
Membership Functions: Features of the Membership Function, Standard Forms and Boundaries,Fuzzification, defuzzification to crisp sets, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations,DefuzzificationMethods.Development of membership Functions: Membership value assignments **RBT: L1, L2**			08
Module – 4			
Fuzzy Arithmetic and the Extension Principle : Crisp Functions, Mapping and Relations,			08

Functions of fuzzySets – Extension Principle, Fuzzy Transform (Mapping), Practical Considerations. Fuzzy Numbers IntervalAnalysis in Arithmetic, Approximate Methods of Extension – Vertex method, DSW Algorithm, RestrictedDSW Algorithm, Comparisons. Fuzzy Vectors. **RBT: L1, L2**	
Module – 5	
Fuzzy Rule Based Systems: Natural Language, Linguistic Hedges, Rule-Based Systems – Canonical RuleForms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules.Graphical Techniques of Inference. **RBT: L1, L2**	08
Course outcomes: The students should be able to:	
• Provide basic elements of fuzzy sets. • Differentiate between fuzzy set and classical set theory. • Apply fuzzy membership functions to solve value assignment problems. • Explain approximate methods of fuzzy arithmetic and extension principle. • Discuss the applications of fuzzy rule based systems.	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Textbooks:	
1. Fuzzy Logic with EngineeringApplicationsTimothy J. Ross Wiley IndiaInternational edition,2010 reprint	
Reference Books:	
1. Fuzzy Logic- Intelligence,Control, and informationJohnYenRezaLangariPearson Education 1st Edition, 2004 2. Fuzzy Sets and Fuzzy Logic-Theory and ApplicationsGeorge J. KlirBoYuanPrentice Hall of India 1st Edition, 2000 3. Fuzzy Mathematical approach to pattern Recognition, S K Pal, and D Dutta majumder , John wiley 1986 4. Neuro-fuzzy pattern recognition: methods in Soft computing, S K Pal and S Mitra 5. Fuzzy set theory and its applications by H J Zimmermann, Springer Publications	

COMPUTER VISION **(Effective from the academic year 2018 -2019)** **SEMESTER – VII**			
Subject Code	18AI742	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			
Course Learning Objectives: This course will enable students to:			
• Learn basic principles of image formation, image processing algorithms and different			

algorithms for recognition from single or multiple images (video).

- Understand the core vision tasks of scene understanding and recognition.
- Applications to 3D modelling, video analysis, video surveillance, object recognition

Module – 1	**Contact Hours**
Introduction and Image Formation: What is computer vision? A brief history, Geometric primitives and transformations, Photometric image formation, The digital camera. Pinhole Perspective, Weak Perspective, Cameras with Lenses, The Human Eye, Intrinsic Parameters and Extrinsic Parameters, Geometric Camera Calibration **T1: Chap 1-1.1 & 1.2, Chap 2-2.1 to 2.3. T2:Chap 1-1.1 to 1.3**	08
Module – 2	
Early Vision – One Image: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Local Image Features, Texture **T2:Chap 4-4.1 to 4.5, Chap5-5.1 to 5.5, Chap6-6.1 to 6.3, 6.5**	08
Module – 3	
Early Vision – Multiple Images: Stereopsis and Structure from Motion **T2:Chap7-7.1 to 7.7, Chap 8-8.1 to 8.3**	08
Module – 4	
Mid-level Vision: Segmentation by Clustering, Grouping and Model fitting, Tracking **T2:Chap9-9.1 to 9.4, Chap 10-10.1 to 10.7, Chap 11-11.1 to 11.3**	08
Module – 5	
High-level Vision: Registration, Smooth Surface and their Outlines, Range Data Detecting Objects in Images, Recognition **T2:Chap12-12.1 to 12.3, Chap 13-13.1 to 13.3, Chap 14-14.1 to 14.4, Chap 17-17.1 to 17.3. T1:Chap 6-6.1 to 6.6**	08

Course outcomes: The students should be able to:

- Implement fundamental image processing techniques required for computer vision
- Understand Image formation process
- Perform shape analysis
- Develop applications using computer vision techniques
- Understand video processing and motion computation

Question Paper Pattern:

- The question paper will have ten questions.

- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Computer Vision: Algorithms and Applications (CVAA), Richard Szeliski, Springer, 2nd edition, 2020, http://szeliski.org/Book/
2. Computer Vision – A modern approach, by D. Forsyth and J. Ponce, Prentice Hall, 2nd edition, 2012

Reference Books:

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University, Press, 2012
5. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
6. Building Computer Vision Applications Using Artificial Neural Networks - With Step-by-step Examples in OpencvAndTensorflow With Python, Shamshad Ansari,Apress, 2020

SEMANTIC WEB AND SOCIAL NETWORKS

(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AI743	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To know the applications in real time systems.

Module – 1	**Contact Hours**
Web Intelligence: Thinking and Intelligent Web Applications, The Information Age ,The World Wide. Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map,Logic on the semantic Web. **T1: Chapter 1,3,4**	08

RBT: L1, L2	
Module – 2	
Knowledge Representation for the Semantic Web: Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema. **T1: Chapter 2,5** **RBT: L1, L2**	08
Module – 3	
Ontology Engineering: Ontology Engineering, Constructing Ontology, Ontology Development Tools,Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic,Rule and Inference Engines. **T1: Chapter 7,8** **RBT: L1, L2**	08
Module – 4	
Semantic Web Applications, Services and Technology: Semantic Web applications and services,Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services,Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods **T1: Chapter 10,11,12** **RBT: L1, L2**	08
Module – 5	
Social Network Analysis and semantic web. What is social Networks analysis, development of the social networks analysis, Electronic Sources forNetwork Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features. **T2: Chapter 2,3** **RBT: L1, L2**	08
Course outcomes: The students should be able to:	
• Work on the internal components of the social network. • Model and visualize the social network. • Analyse the behaviour of the users in the social network. • Predict the possible next outcome of the social network. • Apply social network in real time applications.	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks	

- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

Reference Books:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
3. Information Sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen,Springer Publications.
4. Programming the Semantic Web, T. Segaran, C.Evans, J. Taylor, O'Reilly, SPD.

BUSINESS INTELLIGENCE
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AI744	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Explain the Decision Support systems and Business Intelligence framework.
- Illustrate the significance of computerized Decision Support, and understand the mathematicalmodelling behind decision support.
- Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.Explore knowledge management, explain its activities, approaches and its implementation.
- Describe the Expert systems , areas suitable for application of experts system

Module – 1	**Contact Hours**
Decision Support and Business Intelligence: Opening Vignette, Changing Business Environments andComputerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, AnEarly Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), Aframework for Business Intelligence (BI), A Work System View of Decision Support. **Text Book 1: Chapter 1** **RBT: L1, L2**	08
Module – 2	
Computerised Decision Support: Decision Making, Models, Phases of the Decision-Making Process, TheIntelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions AreSupported.**Modelling and Analysis:**Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, andRisk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, andGoal Seeking **Text Book 1: Chapter 2** **RBT: L1, L2**	08
Module – 3	
Data Warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, DataWarehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes. **Text Book 1: Chapter 5** **RBT: L1, L2**	08
Module – 4	
Knowledge Management: Introduction to Knowledge Management, Organizational Learning andTransformation, Knowledge Management Activities, Approaches to Knowledge Management, InformationTechnology (IT) In Knowledge Management, Knowledge Management Systems Implementation. **Text Book 1: Chapter 11** **RBT: L1, L2**	08

Module – 5	
Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of ExpertSystems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems,Benefits, Limitations, and Critical Success Factors of Expert Systems. **Text Book 1: Chapter 12** **RBT: L1, L2**	08
Course outcomes: The students should be able to:	
• Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework. • Describe the significance of 106omputerized Decision Support, apply the basics of mathematics to understand the mathematical modelling behind decision support. • Explain Data warehousing , its architecture and Extraction, Transformation, and Load (ETL) Processes. • Analyze the importance of knowledge management and explain its activities, approaches and its implementation. • Describe the Expert systems and analyze its development , discuss areas suitable forapplication of experts system.	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Textbooks:	
1. Business Intelligence and Analytics: Systems for decision support, RameshSharda,DursunDelden, Efraim Turban, Pearson Tenth edition	
Reference Books:	
1. Data Mining Techniques. ForMarketing, Sales and CustomerRelationshipManagementBerry M.&Linoff G. Wiley Publishing Inc 2004 2. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media,Inc2013	

INTRODUCTION TO BIG DATA ANALYTICS
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18CS751	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Interpret the data in the context of the business.
- Identify an appropriate method to analyze the data
- Show analytical model of a system

Module – 1	**Contact Hours**
Introduction to Data Analytics and Decision Making: Introduction, Overview of the Book, The Methods, The Software, Modeling and Models, Graphical Models, Algebraic Models, Spreadsheet Models, Seven-Step ModelingProcess.**Describing the Distribution of a Single Variable**:Introduction,Basic Concepts, Populations and Samples, Data Sets,Variables,and Observations, Types of Data, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Numerical Summary Measures, Numerical Summary Measures with StatTools,Charts for Numerical Variables, Time Series Data, Outliers and Missing Values,Outliers,Missing Values, Excel Tables for Filtering,Sorting,and Summarizing. **Finding Relationships among Variables**: Introduction, Relationships among Categorical Variables, Relationships among Categorical Variables and a Numerical Variable, Stacked and Unstacked Formats, Relationships among Numerical Variables, Scatterplots, Correlation and Covariance, Pivot Tables. **Textbook 1: Ch. 1,2,3** **RBT: L1, L2, L3**	08
Module – 2	
Probability and Probability Distributions:Introduction,Probability Essentials, Rule of Complements, Addition Rule, Conditional Probability and the Multiplication Rule, Probabilistic Independence, Equally Likely Events, Subjective Versus Objective Probabilities, Probability Distribution of a Single Random Variable, Summary Measures of a Probability Distribution, Conditional Mean and Variance, Introduction to Simulation. **Normal,Binormal,Poisson,and Exponential Distributions**:Introduction,The Normal Distribution, Continuous Distributions and Density Functions, The Normal Density,Standardizing:Z-Values,Normal Tables and Z-Values, Normal Calculations in Excel, Empirical Rules Revisited, Weighted Sums of Normal Random Variables, Applications of the Normal Random Distribution, The Binomial Distribution, Mean and Standard Deviation of the Binomial Distribution, The Binomial Distribution in the Context of Sampling, The Normal Approximation to the Binomial, Applications of the Binomial Distribution, The Poisson and Exponential Distributions, The Poisson Distribution, The Exponential Distribution. **Textbook 1: Ch. 4,5** **RBT: L1, L2, L3**	08

Module – 3	
Decision Making under Uncertainty:Introduction,Elements of Decision Analysis, Payoff Tables, Possible Decision Criteria, Expected Monetary Value(EMY),Sensitivity Analysis, Decision Trees, Risk Profiles, The Precision Tree Add-In,Bayes' Rule, Multistage Decision Problems and the Value of Information, The Value of Information, Risk Aversion and Expected Utility, Utility Functions, Exponential Utility, Certainty Equivalents, Is Expected Utility Maximization Used? **Sampling and Sampling Distributions**: Introduction, Sampling Terminology, Methods for Selecting Random Samples, Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, Multistage Sampling Schemes, Introduction to Estimation, Sources of Estimation Error, Key Terms in Sampling, Sampling Distribution of the Sample Mean, The Central Limit Theorem, Sample Size Selection, Summary of Key Ideas for Simple Random Sampling. **Textbook 1: Ch. 6,7** **RBT: L1, L2, L3**	08
Module – 4	
Confidence Interval Estimation: Introduction, Sampling Distributions, The t Distribution, Other Sampling Distributions, Confidence Interval for a Mean, Confidence Interval for a Total, Confidence Interval for a Proportion, Confidence Interval for a Standard Deviation, Confidence Interval for the Difference between Means, Independent Samples, Paired Samples, Confidence Interval for the Difference between Proportions, Sample Size Selection, Sample Size Selection for Estimation of the Mean, Sample Size Selection for Estimation of Other Parameters. **Hypothesis Testing**:Introduction,Concepts in Hypothesis Testing, Null and Alternative Hypothesis, One-Tailed Versus Two-Tailed Tests, Types of Errors, Significance Level and Rejection Region, Significance from p-values, Type II Errors and Power, Hypothesis Tests and Confidence Intervals, Practical versus Statistical Significance, Hypothesis Tests for a Population Mean, Hypothesis Tests for Other Parameters, Hypothesis Tests for a Population Proportion, Hypothesis Tests for Differences between Population Means, Hypothesis Test for Equal Population Variances, Hypothesis Tests for Difference between Population Proportions, Tests for Normality, Chi-Square Test for Independence. **Textbook 1: Ch. 8,9** **RBT: L1, L2, L3**	08
Module – 5	
Regression Analysis: Estimating Relationships: Introduction, Scatterplots : Graphing Relationships, Linear versus Nonlinear Relationships,Outliers,Unequal Variance, No Relationship,Correlations:Indications of Linear Relationships, Simple Linear Regression, Least Squares Estimation, Standard Error of Estimate, The Percentage of Variation Explained:R-Square,Multiple Regression, Interpretation of Regression Coefficients, Interpretation of Standard Error of Estimate and R-Square, Modeling Possibilities, Dummy Variables, Interaction Variables, Nonlinear Transformations, Validation of the Fit. **Regression Analysis**: Statistical Inference:Introduction,The Statistical Model, Inferences About the Regression Coefficients, Sampling Distribution of the Regression Coefficients, Hypothesis Tests for the Regression Coefficients and p-Values, A Test for the Overall Fit: The ANOVA Table,Multicollinearity,Include/Exclude Decisions, Stepwise Regression,Outliers,Violations of Regression Assumptions,Nonconstant Error Variance,Nonnormality of Residuals,Autocorrelated Residuals ,Prediction. **Textbook 1: Ch. 10,11** **RBT: L1, L2, L3**	08

Course outcomes: The students should be able to:

- Explain the importance of data and data analysis
- Interpret the probabilistic models for data
- Define hypothesis, uncertainty principle
- Evaluate regression analysis

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. S C Albright and W L Winston, Business analytics: data analysis and decision making, 5/e Cenage Learning

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577
2. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966

PYTHON APPLICATION PROGRAMMING
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18CS752	**IA Marks**	40
Number of Lecture Hours/Week	3:0:0	**Exam Marks**	60
Total Number of Lecture Hours	40	**Exam Hours**	03

CREDITS – 03

Course Objectives: This course will enable students to

- Learn Syntax and Semantics and create Functions in Python.
- Handle Strings and Files in Python.
- Understand Lists, Dictionaries and Regular expressions in Python.
- Implement Object Oriented Programming concepts in Python
- Build Web Services and introduction to Network and Database Programmingin Python.

Module – 1	**Contact Hours**
Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions **Textbook 1: Chapters 1 – 4** **RBT: L1, L2, L3**	08
Module – 2	
Iteration, Strings, Files **Textbook 1: Chapters 5– 7** **RBT: L1, L2, L3**	08
Module – 3	
Lists, Dictionaries, Tuples, Regular Expressions **Textbook 1: Chapters 8 – 11** **RBT: L1, L2, L3**	08
Module – 4	
Classes and objects, Classes and functions, Classes and methods **Textbook 2: Chapters 15 – 17** **RBT: L1, L2, L3**	08
Module – 5	
Networked programs, Using Web Services, Using databases and SQL **Textbook 1: Chapters 12– 13, 15** **RBT: L1, L2, L3**	08

Course Outcomes: After studying this course, students will be able to

- Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

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)
2. Allen B. Downey, **"Think Python: How to Think Like a Computer Scientist",** 2ndEdition, Green Tea Press, 2015. (http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Download pdf files from the above links)

Reference Books:

1. Charles Dierbach, **"Introduction to Computer Science Using Python",**1st Edition, Wiley India Pvt Ltd, 2015. ISBN-13: 978-8126556014
2. Gowrishankar S, Veena A, **"Introduction to Python Programming",** 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
3. Mark Lutz, **"Programming Python",**4th Edition, O'Reilly Media, 2011.ISBN-13: 978-9350232873
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, **"Data Structures and Algorithms in Python",**1stEdition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176
5. ReemaThareja, **"Python Programming Using Problem Solving Approach",** Oxford university press, 2017. ISBN-13: 978-0199480173

INTRODUCTION TO ARTIFICIAL INTELLIGENCE
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18CS753	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Identify the problems where AI is required and the different methods available
- Compare and contrast different AI techniques available.
- Define and explain learning algorithms

Module – 1	**ContactHours**
What is artificial intelligence?, Problems, Problem Spaces and search **TextBook1: Ch 1, 2** **RBT: L1, L2**	08

Module – 2	
Knowledge Representation Issues, Using Predicate Logic, Representing knowledge using Rules, **TextBoook1: Ch 4, 5 and 6.** **RBT: L1, L2**	08
Module – 3	
Symbolic Reasoning under Uncertainty, Statistical reasoning **TextBoook1: Ch 7, 8** **RBT: L1, L2**	08
Module – 4	
Game Playing, Natural Language Processing **TextBoook1: Ch 12 and 15** **RBT: L1, L2**	08
Module – 5	
Learning, Expert Systems. **TextBook1: Ch 17 and 20** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Identify the AI based problems
- Apply techniques to solve the AI problems
- Define learning and explain various learning techniques
- Discuss on expert systems

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. E. Rich , K. Knight & S. B. Nair – Artificial Intelligence, 3/e, McGraw Hill.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
4. Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford University Press-2015

INTRODUCTION TO DOT NET FRAMEWORK FOR APPLICATION DEVELOPMENT
(OPEN ELECTIVE)
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18CS754	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- Inspect Visual Studio programming environment and toolset designed to build applications for Microsoft Windows
- Understand Object Oriented Programming concepts in C# programming language.
- Interpret Interfaces and define custom interfaces for application.
- Build custom collections and generics in C#
- Construct events and query data using query expressions

Module – 1	**Contact Hours**
Introducing Microsoft Visual C# and Microsoft Visual Studio 2015: Welcome to C#, Working with variables, operators and expressions, Writing methods and applying scope, Using decision statements, Using compound assignment and iteration statements, Managing errors and exceptions **T1: Chapter 1 – Chapter 6** **RBT: L1, L2**	08
Module – 2	
Understanding the C# object model: Creating and Managing classes and objects, Understanding values and references, Creating value types with enumerations and structures, Using arrays **Textbook 1: Ch 7 to 10** **RBT: L1, L2**	08
Module – 3	
Understanding parameter arrays, Working with inheritance, Creating interfaces and defining abstract classes, Using garbage collection and resource management **Textbook 1: Ch 11 to 14** **RBT: L1, L2**	08
Module – 4	
Defining Extensible Types with C#: Implementing properties to access fields, Using indexers, Introducing generics, Using collections **Textbook 1: Ch 15 to 18** **RBT: L1, L2**	08
Module – 5	
Enumerating Collections, Decoupling application logic and handling events, Querying in-memory data by using query expressions, Operator overloading **Textbook 1: Ch 19 to 22** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Build applications on Visual Studio .NET platform by understanding the syntax and semantics of

C#

- Demonstrate Object Oriented Programming concepts in C# programming language
- Design custom interfaces for applications and leverage the available built-in interfaces in building complex applications.
- Illustrate the use of generics and collections in C#
- Compose queries to query in-memory data and define own operator behaviour

Question paper pattern:

The question paper will have TEN questions.
There will be TWO questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. John Sharp, Microsoft Visual C# Step by Step, 8th Edition, PHI Learning Pvt. Ltd. 2016

Reference Books:

1. Christian Nagel, "C# 6 and .NET Core 1.0", 1st Edition, Wiley India Pvt Ltd, 2016. Andrew Stellman and Jennifer Greene, "Head First C#", 3rd Edition, O'Reilly Publications, 2013.
2. Mark Michaelis, "Essential C# 6.0", 5th Edition, Pearson Education India, 2016.
3. Andrew Troelsen, "Prof C# 5.0 and the .NET 4.5 Framework", 6th Edition, Apress and Dreamtech Press, 2012.

AI AND ML APPLICATION DEVELOPMENT LABORATORY
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AIL76	**CIE Marks**	40
Number of Contact Hours/Week	0:2:2	**SEE Marks**	60
Total Number of Lab Contact Hours		**Exam Hours**	3 Hrs

Credits – 2

Course Learning Objectives: This course will enable students to:

- Explore the knowledge of AI and ML concepts and practice to groom students into well-informed application developers.
- Demonstrate the knowledge of human cognition, Artificial Intelligence, Machine Learning and data engineering for designing intelligent systems
- Apply computational knowledge and project development skills to provide innovative solutions.
- Strong practice in AI and ML programming through a variety of AI and ML problems.
- Develop AI and ML applications using front-end and back-end tools

Descriptions (if any): 1. The programs can be implemented in either JAVA or Python.

2. Data sets can be taken from standard repository

Part A

1. Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions.
2. Develop a program to apply K-means algorithm to cluster a set of data stored in .CSV file. Use the same data set for clustering using **EM algorithm**. Compare the results of these two algorithms and comment on the quality of clustering.
3. Implement the non-parametric **Locally Weighted Regressionalgorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs
4. Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate data sets
5. Demonstrate **Genetic algorithm** by taking a suitable data for any simple application.
6. Demonstrate **Q learning** algorithm with suitable assumption for a problem statement.

PART B

Mini Project

- Use Java, C#, PHP, Python, or any other similar front-end tool. Developed mini projectns must be demonstrated on desktop/laptop as a stand-alone or web based application
- Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.
- Indicative areas include: health care, education, agriculture, banking, library, agent based systems, registration systems, industry, reservation systems, facility management, super market etc.,Similar to but not limited to:

  Handwritten Digit Recognition
  Prediction of Cardiac Arrhythmia type using Clustering and Regression Approach
  Hybrid Regression Technique for House Prices Prediction
  An Iris Recognition Algorithm for Identity Authentication
  An Approach to Maintain Attendance using Image Processing Techniques
  Unconstrained Face Recognition
  Vehicle Number Plate Detection System
  Detection of Fake News
  Stock Prediction using Linear Regression
  Prediction of Weather Report
  Analyzing Bike Sharing Trends
  Sentiment Analysis for Movie Reviews
  Analyzing and Recommendations of Music Trends
  Forecasting Stock and Commodity Prices
  Diabetes Prediction
  Speech Recognition
  Spam Detection using neural Networks in Python
  Combining satellite imagery and to predict poverty

Conduct of Practical Examination:

- Experiment distribution

- For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
- For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.

- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Subjected to change in accordance with university regulations)*
  s) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  t) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

NEURAL NETWORKS AND DEEP LEARNING **(Effective from the academic year 2018 -2019)** **SEMESTER – VIII**			
Subject Code	18AI81	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			

Course Learning Objectives: This course will enable students to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Execute performance metrics of Deep Learning Techniques.

Module – 1	**Contact Hours**
Introduction to ANN: Biological to Artificial neuron, Training an MLP, Training a DNN with TensorFlow , Fine tuning NN HyperParametersUp and Running with TensorFlow **Chapter 9 and 10**	08
Module-2	
Deep Neural network: Introduction, Vanishing Gradient problems, Reusing Pretrained layers, Faster optimizers, avoiding over fitting through regularization **Chapter 11**	08
Module-3	
Distributing Tensor flow across devices and servers: Multiple devices on a single machine, multiple servers, parallelizing NN on a Tensor Flow cluster **Convolution Neural Network**: Architecture of the visual cortex, Convolutional layer, Pooling layer, CNN architecture	08

Chapter 12 and 13	
Module-4	
Recurrent Neural Network: Recurrent neurons, Basic RNN in Tensor Flow, Training RNN , Deep RNNs, LSTM Cell, GRU Cell, NLP **Chapter 14**	08
Module-5	
Autoencoders: Efficient data representation, Performing PCA, Stacked autoencoders, Unsupervised pretraining using SA, Denoising, Sparse autoencoders, variational and other autoencoders. **Reinforcement Learning:** Learning to optimize rewards, policy search, Introduction to OpenAI Gym, Neural network polices, Evaluating actions, Policy gradients, Markov decision processes, TDL and Q-learning, Learning to play Ms.Pac-man using Deep Q Learning **Chapter 15 and 16**	08

Course outcomes: The students should be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Execute performance metrics of Deep Learning Techniques.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Hands on Machine Learning with Scikit-Learn &TensorFlow, AurelienGeron, O'Reilly, 2019

Reference Books:

1. Deep Learning Lan Good fellow and YoshuaBengio and Aaron CourvilleMIT Press2016.
2. Neural Networks and Deep Learning, Charu C. Aggarwal, Springer International Publishing, 2018

SYSTEM MODELLING AND SIMULATION (Effective from the academic year 2018 -2019) SEMESTER – VIII			
Subject Code	18AI821	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS –3			

Course Learning Objectives: This course will enable students to:

- Explain the basic system concept and definitions of system;
- Discuss techniques to model and to simulate various systems;
- Analyze a system and to make use of the information to improve the performance.

Module 1	**Contact Hours**
Introduction: When simulation is the appropriate tool and when it is not appropriate, Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system; Types of Models, Discrete-Event System Simulation Simulation examples: Simulation of queuing systems. **General Principles.** **Textbook 1: Ch. 1, 2, 3.1.1, 3.1.3** **RBT: L1, L2, L3**	08
Module 2	
Statistical Models in Simulation :Review of terminology and concepts, Useful statistical models,Discrete distributions. Continuous distributions,Poisson process, Empirical distributions. **Queuing Models:**Characteristics of queuing systems,Queuingnotation,Long-run measures of performance of queuing systems,Long-run measures of performance of queuing systems cont…,Steady-state behavior of M/G/1 queue, Networks of queues, **Textbook 1: Ch. 5,6.1 to 6.3, 6.4.1,6.6** **RBT: L1, L2, L3**	08
Module 3	
Random-NumberGeneration: Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers,Tests for Random Numbers, **Random-Variate Generation:** ,Inverse transform technique Acceptance-Rejection technique. **Textbook 1: Ch. 7,8.1, 8.2** **RBT: L1, L2, L3**	08
Module 4	
Input Modeling: Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models. **Estimation of Absolute Performance:** Types of simulations with respect to output analysis ,Stochastic nature of output data, Measures of performance and their estimation, **Textbook 1: Ch. 9, 11.1 to 11.3** **RBT: L1, L2, L3**	08
Module 5	
Measures of performance and their estimation,Output analysis for terminating simulations Continued..,Output analysis for steady-state simulations. **Verification, Calibration And Validation:** Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation models,Calibration and validation of models, Optimization via Simulation.	08

Textbook 1: Ch. 11.4, 11.5, 10 **RBT: L1, L2, L3**	
Course Outcomes: The student will be able to :	
• Explain the system concept and apply functional modeling method to model the activities of a static system • Describe the behavior of a dynamic system and create an analogous model for a dynamic system; • Simulate the operation of a dynamic system and make improvement according to the simulation results.	
Question Paper Pattern:	
• The question paper will have ten questions. • Each full Question consisting of 20 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Textbooks:	
1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5 th Edition, Pearson Education, 2010.	
Reference Books:	
1. Lawrence M.Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course, Pearson Education, 2006. 2. Averill M. Law: Simulation Modeling and Analysis, 4 th Edition, Tata McGraw-Hill, 2007	

SOFT AND EVOLUTIONARY COMPUTING (Effective from the academic year 2018 -2019) SEMESTER – VIII			
Subject Code	18AI822	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			

Course Learning Objectives: This course will enable students to:

- Describe the basics of Soft computing
- Explain the process Fuzzy &Genetic Algorithm to solve the optimization problem.
- Analyse the Neuro Fuzzy system for clustering and classification.
- Illustrate the process of swarm intelligence system to solve real world problems.

Module – 1	**Contact Hours**
Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. **Introduction to classical sets and fuzzy sets:** Classical relations and fuzzy relations, Membership functions. **T1: Chapter 1 and 7& 8**	08
Module – 2	
Fuzzification and Defuzzification **T1: Chapter 9 & 10**	08
Module – 3	
Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, Operators, Stopping conditions for GA flow. **T1: Chapter 15.1 To 15.10** **RBT: L1, L2**	08
Module – 4	
Swarm Intelligence System: Introduction, background of SI, Ant colony system Working of ant colony optimization, ant colony for TSP. **T2: 8.1 to 8.5** **RBT: L1, L2**	08
Module – 5	
Unit commitment problem, particle Swarm Intelligence system Artificial bee colony system, Cuckoo search system. **T2: 8.6 to 8.9** **RBT: L1, L2**	08

Course outcomes: The students should be able to:

- Implement machine learning through neural networks.
- Design Genetic Algorithm to solve the optimization problem.
- Develop a Fuzzy expert system.

- Model Neuro Fuzzy system for clustering and classification

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Principles of Soft computing, Shivanandam, Deepa S. N, Wiley India, 2011/Reprint2014
2. Soft Computing with MATLAB Programming, N. P. Padhy, S.P. Simon, Oxford, 2015.

Reference Books:

1. Neuro-fuzzy and soft computing, .S.R. Jang, C.T. Sun, E. Mizutani, Phi (EEE edition), 2012
2. Soft Computing, SarojKaushik, SunitaTiwari, McGrawHill, 2018

ROBOTIC PROCESS AUTOMATION DESIGN & DEVELOPMENT
(Effective from the academic year 2018 -2019)
SEMESTER – VII

Subject Code	18AI823	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs

CREDITS –3

Course Learning Objectives: This course will enable students to:

- To understand basic concepts of RPA
- To DescribeRPA,where it can be applied and how it is implemented
- To Describe the different types of variables,Control Flow and data manipulation techniques
- To Underst and Image,Text and DataTables Automation
- To Describe various types of Exceptions and strategies to handle

Module – 1	**Contact Hours**
RPA Foundations- 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. **Textbook 1: Ch 1, Ch 2** **RBT:L1,L2**	08
Module – 2	
RPA Platforms- 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. **Textbook 2: Ch 1, Ch 2** **RBT: L1, L2**	08
Module – 3	
Sequence, Flowchart, and Control Flow-Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step 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** **RBT:L1,L2**	08
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. **Text book 2: Ch 5** **RBT:L1,L2**	08
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 **Text book 2: Ch 8** **Text book 1: Ch 13** **RBT:L1,L2**	08

Course outcomes: The students should be able to:

- ToUnderstand the basicconcepts of RPA
- To Describe various components and platforms of RPA
- To Describe the different types of variables,control flow and data manipulation techniques
- To Understand various control techniques and OCR in RPA
- To Describe varioustypes and strategies to handle exceptions

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

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 Books:

1. Frank Casale,Rebecca Dilla,Heidi Jaynes,Lauren Livingston,"Introductionto 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
https://www.uipath.com/rpa/robotic-process-automation

MODERN INFORMATION RETRIEVAL (Effective from the academic year 2018 -2019) SEMESTER – VIII			
Subject Code	18AI824	**CIE Marks**	40
Number of Contact Hours/Week	3:0:0	**SEE Marks**	60
Total Number of Contact Hours	40	**Exam Hours**	3 Hrs
CREDITS – 03			

Course Learning Objectives: This course will enable students to:

- To learn the classical techniques of Information Retrieval and extract meaningful patterns from it.
- To get an insight into practical algorithms of textual document indexing, relevant ranking, web mining, text analytics and their performance evaluations.
- To acquire the necessary experience to design, and implement applications using Information Retrieval systems

Module – 1	**Contact Hours**
Introduction: Basic Concepts – Retrieval Process – Modeling – Classic Information Retrieval – Set Theoretic, Algebraic and Probabilistic Models. **Text Book 1: Chapter 1, Chapter 2**	08
Module – 2	
Retrieval Techniques: Structured Text Retrieval Models –Retrieval Evaluation – Word Sense Disambiguation. **Text Book 1: Chapter 3**	08
Module – 3	
Querying: Languages – Key Word based Querying – Pattern Matching – Structural Queries – Query Operations – User Relevance Feedback – Local and Global Analysis **Text Book 1: Chapter 4, Chapter 5**	08
Module – 4	
Text Operations: Document Pre-processing – Clustering – Text Compression - Indexing and Searching – Inverted files – Boolean Queries – Sequential searching – Pattern matching. **Text Book 1: Chapter 7, Chapter 8**	08
Module – 5	
User Interface&Applications: User Interface and Visualization – Human Computer Interaction – Access Process – Starting Points – Query Specification - Context – User relevance Judgment – Interface for Search. Searching the Web – Challenges – Characterizing the Web – Search Engines – Browsing – Metasearchers – Online IR systems – Online Public Access Catalogs. **Text Book 1: Chapter 10, Chapter 13, Chapter 14**	08

Course outcomes: The students should be able to:

- Apply information retrieval principles to locate relevant information in large collections of data
- Implement features of retrieval systems for web-based search tasks.
- Apply the common algorithms and techniques for information retrieval related to document indexing and query processing
- Demonstrate a thorough understanding and solid knowledge of the principles and techniques of

human-computer interaction

- Implement graphical user interfaces with modern software tools
- Develop and design interactive software systems applications for real time applications
- Design and develop web applications for the effective informational retrieval

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Textbooks:

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, Modern Information Retrieval, Pearson Education Asia, 2012.

Reference Books:

1. G.G. Chowdhury, Introduction to Modern Information Retrieval, Second Edition, Neal- Schuman Publishers, 2010.