M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 & ISO 14001:2015 Certified Institution
Thalavapalayam, Karur - 639 113.

CURRICULUM AND SYLLABUS

REGULATION 2018

B.Tech- Computer Science and Business Systems

Semester I to VI

BOARD OF
COMPUTER SCIENCE
& BUSINESS SYSTEMS
20 [illegible] 2022

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CURRICULUM AND SYLLABUS

REGULATION 2018

Programme: B.Tech – Computer Science and Business Systems

Vision of the Department:

To produce competent industry relevant education, skilful research, technical and innovative computer science professionals acquaintance with managerial skills, human and social values.

Mission of the Department:

M1: To impart technical knowledge through innovative teaching, research, and consultancy.

M2: To develop and to promote student ability thereby to compete globally through excellence in education.

M3: To facilitate the development of academic-industry Collaboration.

M4: To produce competent engineers with professional ethics, technical competence and a spirit of innovation and managerial skills.

Programme Educational Objectives (PEOs):

PEO1: To acquire technical knowledge and proficiency required for the carrier advancement and higher education in the contemporary areas of computer science, business systems and various issues in the society.

PEO2: To apply their competency in design and development of innovative solutions to adapt various emerging technological challenges for real world problems.

PEO3: To demonstrate leadership qualities with high ethical standards and collaborated with other industries for the socio-economical growth of the country.

Mapping of Programme Educational Objectives with Mission of the Department:

PEOs / Department Mission Statements	M1	M2	M3	M4
PEO1	3	3	2	3
PEO2	3	2	2	2
PEO3	3	3	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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Programme Outcomes (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

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

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

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

PSO1: Ability to apply the analytical and business skills to provide sustainable solutions as an engineer/researcher for the real-time applications using Machine Learning, Internet of Things and Data analytics.

PSO2: Ability to practice ethical and human values with soft-skills qualities in computer science and business disciplines to emerge as an entrepreneur for the growth and development of the society.

Mapping of Programme Educational Objectives with Programme Outcomes and Programme Specific Outcomes:

PEOs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	2	2	2	3	2	2	3	3	1	2	3	2	3	2
PEO2	2	2	3	2	2	3	3	2	2	3	2	3	3	1
PEO3	3	3	2	3	3	1	1	3	3	2	3	1	1	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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Programme Articulation

Semester	Course Code	Course Name	POs												PSOs	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
I	18MAB103T	Discrete Mathematics	✓	✓											✓	
I	18MAB104T	Calculus, Statistics and Probability	✓	✓		✓								✓	✓	
I	18PYB102J	Physics for Computing Science	✓	✓	✓						✓	✓			✓	
I	18EEB102J	Principles of Electrical Engineering	✓	✓	✓											
I	18CBB101J	Problem Solving and C Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I	18CBH101J	Business Communication & Value Science – I		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
I	18LEM101T	Constitution of India							✓	✓	✓	✓	✓	✓		
I		Induction Program														
II	18MAB105T	Linear Algebra	✓	✓	✓	✓		✓					✓	✓	✓	
II	18MAB106J	Statistical Methods	✓	✓	✓	✓	✓	✓					✓	✓	✓	
II	18ECB101J	Principles of Electronics	✓	✓	✓	✓	✓	✓				✓			✓	
II	18CBC101J	Data Structures & Algorithms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
II	18MBS101T	Fundamentals of Economics	✓	✓					✓				✓	✓		
II	18CBH102J	Business Communication & Value Science – II		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓
II	18LEM102T	Value Education	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
II	18GNM101L	Physical & Mental Health using Yoga						✓						✓		
III	18CBC201T	Formal Language and Automata Theory	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	
III	18CBC202T	Computer Organization & Architecture	✓	✓	✓	✓	✓								✓	✓
III	18CBC203T	Object Oriented Programming	✓	✓	✓	✓								✓	✓	✓
III	18CBC204J	Computational Statistics	✓	✓	✓	✓				✓				✓	✓	✓
III	18CBC205J	Software Engineering	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓
III	18MAB209T	Operations Research	✓	✓										✓	✓	

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Semester	Course Code	Course Name	POs												PSOs	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
III	18CBC206L	Object Oriented Programming Laboratory	✓	✓	✓	✓	✓						✓		✓	✓
III	18MBM201L	Competencies in Social Skills	✓								✓	✓				
III / IV	18CYM201T	Environmental Science		✓		✓		✓	✓	✓						
IV	18CBC207T	Database Management Systems	✓	✓	✓	✓									✓	✓
IV	18CBC208J	Operating Systems	✓	✓												✓
IV	18CBC209J	Software Design with UML	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IV	18CBH103J	Business Communication & Value Science – III									✓	✓		✓		
IV	18MBS201T	Fundamentals of Management	✓	✓					✓				✓	✓		✓
IV	18MBS202T	Introduction to Innovation, IP Management & Entrepreneurship	✓	✓					✓				✓	✓		✓
IV	18CBC210L	Database Management Systems Laboratory	✓	✓	✓	✓	✓								✓	✓
IV	18MBM202L	Critical and Creative Thinking Skills	✓									✓				
III / IV	18LEM103T	Indian Tradition and Heritage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

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Structure of Curriculum

S.No.	Category	Credits
1	Humanities and Social Sciences courses (H)	11
2	Basic Science courses including basics of Electrical / Electronics / Computer courses (B)	32
3	Engineering Science courses including Management/Innovation & Entreprenurship course (S)	28
4	Professional core courses (C)	61
5	Professional Elective courses relevant to chosen specialization/branch (E)	22
6	Open Electives - Electives offered to other Departments (O)	-
7	Project work, Minor project, seminar and internship in industry or elsewhere (P)	7
8	Mandatory Courses (M) [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	4
	Total Credits	165

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1. Humanities and Social Sciences courses (H)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18CBH101J	Business Communication & Value Science – I	2	0	2	3
2	18CBH102J	Business Communication & Value Science – II	2	0	2	3
3	18CBH103J	Business Communication & Value Science – III	1	0	2	2
4	18CBH104J	Business Communication & Value Science – IV	2	0	2	3
					Total Credits	11

L-Lecture T-Tutorial P-Practical

2. Basic Science courses including basics of Electrical / Electronics / Computer courses (B)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18MAB103T	Discrete Mathematics	3	1	0	4
2	18MAB104T	Calculus, Statistics and Probability	3	0	0	3
3	18MAB105T	Linear Algebra	3	1	0	4
4	18MAB106J	Statistical Methods	3	0	2	4
5	18PYB102J	Physics for Computing Science	3	0	2	4
6	18EEB102J	Principles of Electrical Engineering	2	0	2	3
7	18ECB101J	Principles of Electronics	2	0	2	3
8	18CBB101J	Problem Solving and C Programming	3	0	2	4
9	18MAB209T	Operations Research	3	0	0	3
					Total Credits	32

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3. Engineering Science courses including Management/Innovation & Entreprenurship course (S)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18MBS101T	Fundamentals of Economics	2	0	0	2
2	18MBS201T	Fundamentals of Management	2	0	0	2
3	18MBS202T	Introduction to Innovation, IP Management & Entrepreneurship	3	0	0	3
4	18MBS301T	Financial & Cost Accounting	2	0	0	2
5	18MBS302T	Business Strategy	2	0	0	2
6	18MBS303J	Design Thinking	2	0	2	3
7	18MBS304T	Financial Management	2	0	0	2

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
8	18MBS401T	Marketing Research & Marketing Management	2	0	0	2
9	18MBS402T	Human Resource Management	2	0	0	2
10	18MBS403J	Services Science & Service Operational Management	3	0	2	4
11	18MBS404J	IT Project Management	3	0	2	4
					Total Credits	28

L-Lecture T-Tutorial P-Practical

4. Professional core courses (C)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18CBC101J	Data Structures & Algorithms	3	0	2	4
2	18CBC201T	Formal Language and Automata Theory	3	1	0	4
3	18CBC202T	Computer Organization & Architecture	3	0	0	3
4	18CBC203T	Object Oriented Programming	3	0	0	3
5	18CBC204J	Computational Statistics	3	0	2	4
6	18CBC205J	Software Engineering	3	0	2	4
7	18CBC206L	Object Oriented Programming Laboratory	0	0	2	1
8	18CBC207T	Database Management Systems	3	0	0	3
9	18CBC208J	Operating Systems	3	0	2	4
10	18CBC209J	Software Design with UML	3	0	2	4
11	18CBC210L	Database Management Systems Laboratory	0	0	2	1
12	18CBC301T	Design and Analysis of Algorithms	3	0	0	3
13	18CBC302J	Compiler Design	3	0	2	4
14	18CBC303L	Design and Analysis of Algorithms Laboratory	0	0	2	1
15	18CBC304T	Computer Networks	3	0	0	3
16	18CBC305J	Information Security	3	0	2	4
17	18CBC306J	Artificial Intelligence	3	0	2	4
18	18CBC307L	Computer Networks Laboratory	0	0	2	1
19	18CBC401J	Usability Design of Software Applications	2	0	2	3
20	18CBC402J	IT Workshop Skylab / Matlab	2	0	2	3
					Total Credits	61

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5. Professional Elective Courses relevant to chosen specialization/branch (E) (Any 6 Courses)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1		Elective - 1	3	0	2	4
2		Elective – 2	3	0	2	4
3		Elective – 3	3	0	0	3
4		Elective – 4	3	0	2	4
5		Elective – 5	3	0	0	3
6		Elective - 6	3	0	2	4
					Total Credits	22

S.No	Course Code	Course Name	Hours / Week			C
			L	T	P	
		Elective – 1				
1	18CBE001J	Coversational Systems	3	0	2	4
2	18CBE002J	Cloud, Microservices and Application	3	0	2	4
3	19CBE003J	Machine Learning	3	0	2	4
		Elective - 2				
4	18CBE004J	Robotics and Embedded Systems	3	0	2	4
5	18CBE005J	Modern Web Applications	3	0	2	4
6	18CBE006J	Data Mining and Analytics	3	0	2	4
		Elective - 3				
7	18CBE007T	Cognitive Science and Analytics	3	0	0	3
8	18CBE008T	Introduction to IoT	3	0	0	3
9	18CBE009T	Cryptology	3	0	0	3
		Elective - 4				
10	18CBE010J	Quantum Computation and Quantum Information	3	0	2	4
11	18CBE011J	Advanced Social, Text and Media Analytics	3	0	2	4
12	18CBE012J	Mobile Computing	3	0	2	4
		Elective - 5				
13	18CBE013T	Behavioral Economics	3	0	0	3
14	18CBE014T	Computational Finance and Modelling	3	0	0	3
15	18CBE015T	Psychology	3	0	0	3
		Elective - 6				
16	18CBE016J	Enterprise Systems	3	0	2	4
17	18CBE017J	Advance Finance	3	0	2	4
18	18CBE018J	Image Processing and Pattern Recognition	3	0	2	4

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6. Open Electives - Electives offered to other Departments (O)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18CBO001T	Usability Design of Software Applications	3	0	0	3
2	18CBO002T	IT Workshop Skylab / Matlab	3	0	0	3
3	18CBO003T	Software Design with UML	3	0	0	3
4	18CBO004T	Modern Web Applications	3	0	0	3
5	18CBO005T	Data Mining and Analytics	3	0	0	3
					Total Credits	15

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7. Project work, minor project, seminar and internship in industry or elsewhere (P)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18CBP301L	Mini Project	0	0	2	1
2	18CBP401L	Project Evaluation I	0	0	4	2
3	18CBP402L	Project Evaluation II	0	0	8	4
					Total Credits	7

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8. Mandatory Courses (M)

S.No.	Course Code	Course Name	Hours / Week			C
			L	T	P	
1	18LEM101T	Constitution of India	1	0	0	Nil
2	18LEM102T	Value Education	1	0	0	Nil
3	18GNM101L	Physical & Mental Health using Yoga	0	0	2	Nil
4		Induction Program	2	0	0	Nil
5	18MBM201L	Competencies in Social Skills	0	0	2	1
6	18MBM202L	Critical and Creative Thinking Skills	0	0	2	1
7	18CYM201T	Environmental Science	1	0	0	Nil
8	18LEM103T	Indian Tradition and Heritage	1	0	0	Nil
9	18MBM301L	Analytical and Logical Thinking Skills	0	0	2	1
10	18MBM302L	Employability Skills and Practices	0	0	2	1
11	18LEM301T	Indian Art Forms	1	0	0	Nil
12	18LEM302T	Self Development and Entrepreneurship	1	0	0	Nil
	Total Credits					4

L-Lecture T-Tutorial P-Practical

B.Tech. – Computer Science and Business Systems

Semester I							
S.No	Category	Course Code	Course Name	Hours / Week			C
				L	T	P	
1	B	18MAB103T	Discrete Mathematics	3	1	0	4
2	B	18MAB104T	Calculus, Statistics and Probability	3	0	0	3
3	B	18PYB102J	Physics for Computing Science	3	0	2	4
4	B	18EEB102J	Principles of Electrical Engineering	2	0	2	3
5	B	18CBB101J	Problem Solving and C Programming	3	0	2	4
6	H	18CBH101J	Business Communication & Value Science – I	2	0	2	3
Mandatory Courses							
7	M	18LEM101T	Constitution of India	1	0	0	Nil
8	M		Induction Program	2	0	0	Nil
						Total Credits	21

Semester II							
S.No.	Category	Course Code	Course Name	Hours / Week			C
				L	T	P	
1	B	18MAB105T	Linear Algebra	3	1	0	4
2	B	18MAB106J	Statistical Methods	3	0	2	4
3	B	18ECB101J	Principles of Electronics	2	0	2	3
4	C	18CBC101J	Data Structures & Algorithms	3	0	2	4
5	S	18MBS101T	Fundamentals of Economics	2	0	0	2
6	H	18CBH102J	Business Communication & Value Science – II	2	0	2	3
Mandatory Courses							
7	M	18LEM102T	Value Education	1	0	0	Nil
8	M	18GNM101L	Physical & Mental Health using Yoga	0	0	2	Nil
						Total Credits	20

Semester III							
S.No.	**Category**	**Course Code**	**Course Name**	**Hours / Week**			**C**
				L	**T**	**P**	
1	C	18CBC201T	Formal Language and Automata Theory	3	1	0	4
2	C	18CBC202T	Computer Organization & Architecture	3	0	0	3
3	C	18CBC203T	Object Oriented Programming	3	0	0	3
4	C	18CBC204J	Computational Statistics	3	0	2	4
5	C	18CBC205J	Software Engineering	3	0	2	4
6	B	18MAB209T	Operations Research	3	0	0	3
			Laboratory Course				
7	C	18CBC206L	Object Oriented Programming Laboratory	0	0	2	1
			Mandatory Courses				
8	M	18MBM201L	Competencies in Social Skills	0	0	2	1
9	M	18CYM201T / 18LEM103T	Environmental Science / Indian Tradition and Heritage	1	0	0	Nil
					Total Credits		**23**

Semester IV							
S.No.	**Category**	**Course Code**	**Course Name**	**Hours / Week**			**C**
				L	**T**	**P**	
1	C	18CBC207T	Database Management Systems	3	0	0	3
2	C	18CBC208J	Operating Systems	3	0	2	4
3	C	18CBC209J	Software Design with UML	3	0	2	4
4	H	18CBH103J	Business Communication & Value Science – III	1	0	2	2
5	S	18MBS201T	Fundamentals of Management	2	0	0	2
6	S	18MBS202T	Introduction to Innovation, IP Management & Entrepreneurship	3	0	0	3
			Laboratory Course				
7	C	18CBC210L	Database Management Systems Laboratory	0	0	2	1
			Mandatory Courses				
8	M	18MBM202L	Critical and Creative Thinking Skills	0	0	2	1
9	M	18LEM103T / 18CYM201T	Indian Tradition and Heritage / Environmental Science	1	0	0	Nil
					Total Credits		**20**

Semester V				Hours / Week			C
S.No.	Category	Course Code	Course Name	L	T	P	
1	B C	18CBC301T	Design and Analysis of Algorithms	3	0	0	3
2	C	18CBC302J	Compiler Design	3	0	2	4
3	S	18MBS301T	Financial & Cost Accounting	2	0	0	2
4	S	18MBS302T	Business Strategy	2	0	0	2
5	S	18MBS303J	Design Thinking	2	0	2	3
6	E		Elective I - Professional / open	3	0	2	4
			Laboratory Course				
7	B C	18CBC303L	Design and Analysis of Algorithms Laboratory	0	0	2	1
8	P	18CBP301L	Mini Project	0	0	2	1
			Mandatory Courses				
9	M	18MBM301L	Analytical and Logical Thinking Skills	0	0	2	1
10	M	18LEM301T / 18LEM302T	Indian Art Forms / Self Development and Entrepreneurship	1	0	0	Nil
				Total Credits			21

Semester VI				Hours / Week			C
S.No.	Category	Course Code	Course Name	L	T	P	
1	C	18CBC304T	Computer Networks	3	0	0	3
2	C	18CBC305J	Information Security	3	0	2	4
3	C	18CBC306J	Artificial Intelligence	3	0	2	4
4	S	18MBS304T	Financial Management	2	0	0	2
5	H	18CBH104J	Business Communication & Value Science – IV	2	0	2	3
6	E		Elective II - Professional / open	3	0	2	4
			Laboratory Course				
7	C	18CBC307L	Computer Networks Laboratory	0	0	2	1
			Mandatory Courses				
8	M	18MBM302L	Employability Skills and Practices	0	0	2	1
9	M	18LEM301T / 18LEM302T	Indian Art Forms / Self Development and Entrepreneurship	1	0	0	Nil
				Total Credits			22

Semester VII							
S.No	Category	Course Code	Course Name	Hours / Week			C
				L	T	P	
1	C	18CBC401J	Usability Design of Software Applications	2	0	2	3
2	C	18CBC402J	IT Workshop Skylab / Matlab	2	0	2	3
3	S	18MBS401T	Marketing Research & Marketing Management	2	0	0	2
4	S	18MBS402T	Human Resource Management	2	0	0	2
5	E		Elective III } Professional or open	3	0	0	3
6	E		Elective IV	3	0	2	4
			Laboratory Course				
7	P	18CBP401L	Project Evaluation I	0	0	4	2
				Total Credits			19

Semester VIII							
S.No.	Category	Course Code	Course Name	Hours / Week			C
				L	T	P	
1	S	18MBS403J	Services Science & Service Operational Management	3	0	2	4
2	S	18MBS404J	IT Project Management	3	0	2	4
3	E		Elective V	3	0	0	3
4	E		Elective VI	3	0	2	4
			Laboratory Course				
5	P	18CBP402L	Project Evaluation II	0	0	8	4
				Total Credits			19

L-Lecture T-Tutorial P-Practical

Total Credits

Semester	Credits
1	21
2	20
3	23
4	20
5	21
6	22
7	19
8	19
Total	**165**

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Regulation 2018		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB103T	DISCRETE MATHEMATICS	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Understand the fundamental concepts of propositions by various discrete structure techniques
2	Understand discrete structures of many levels and to know the principle of counting
3	Model situations in a mathematical way and derive useful results

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Demonstrate the concepts of logic to test the validity of a program and to arrive at inferences on logical structures
CO2	Demonstrate the concepts of Boolean algebra in analysing logic gates
CO3	Obtain the perception in the area of sets and the knowledge about functions
CO4	Use the counting principles in implementing various programmes
CO5	Apply the concepts of Graph Theory to the real world problems

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO (Avg)	3	2	-	-	-	-	-	-	-	-	-	-	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	MATHEMATICAL LOGIC	9+3
Propositional calculus - Propositions - Connectives, Syntax; Semantics – Truth assignments - Truth tables - Validity and satisfiability - Tautology; Adequate set of connectives; Equivalence - Normal forms; Compactness - Resolution; Formal reducibility - Natural deduction system - Axiom system; Soundness - Completeness.		
UNIT II	**BOOLEAN ALGEBRA**	**9+3**
Introduction of Boolean algebra - Truth table - Basic logic gate - Basic postulates of Boolean algebra - Principle of duality - Canonical form -Karnaugh map.		
UNIT III	**ABSTRACT ALGEBRA**	**9+3**
Set - Types of sets – Set operation; Relation - Equivalence Relation; Algebraic System - Groups – Sub groups – Homomorphism – Cosets - Lagrange's theorem – Ring and Field (definition).		
UNIT IV	**COMBINATORICS**	**9+3**
Basic counting - Balls and bins problems - Generating functions - Recurrence relations. Proof techniques - Principle of mathematical induction - Pigeonhole principle.		
UNIT V	**GRAPH THEORY**	**9+3**
Graphs and digraphs – Complement – Isomorphism - Connectedness – Reachability - Adjacency matrix -Eulerian paths and circuits in graphs and digraphs - Hamiltonian paths and circuits in graphs and tournaments - trees; Planar graphs - Euler's formula -Dual of a planer graph - Independence number and clique number - Chromatic number - Statement of Four-color theorem.		

Text Book (s)	
1	C. L. Liu, Elements of Discrete Mathematics, Second Edition, McGraw Hill, New Delhi, 1985.
2	Lu Zhongwan, Mathematical Logic for Computer Science, 2nd Edition ,World Scientific, Singapore, 1998.

Reference (s)	
1	R. A. Brualdi, Introductory Combinatorics, 5th Edition , North-Holland, New York, 2009.
2	N. Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, Englewood Cliffs, 2016.
3	E. Mendelsohn, Introduction to Mathematical Logic, Second Edition, Van-Nostrand, London, 1979.
4	I. N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, 1975.
5	M. Morris Mano,Digital Logic & Computer Design, 1st Edition, Pearson, 2016.

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Regulation 2018		**Semester I**	**Total Hours**			**60**
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
B	18MAB104T	CALCULUS, STATISTICS AND PROBABILITY	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Provide basic tools of calculus for the purpose of modelling Engineering Problems
2	Equip the students in using Statistical techniques to solve problems
3	Analyze the various data by different statistical techniques
4	Study the basic probability concepts
5	Understand and have a well – founded knowledge of standard distributions which can describe real life phenomena

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Apply the concept of differentiation to solve maxima and minima problems
CO2	Solve problems involving integration using different methods
CO3	Collect, analyse and process the data for various purposes
CO4	Solve problems involving conditional probability and moments
CO5	Use various distributions that arise in data analysis

CO-PO Mapping

COs	**POs**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	-	1	-	-	-	-	-	-	-	1	3	-
CO5	3	3	-	1	-	-	-	-	-	-	-	1	3	-
CO (Avg)	3	2.4	-	1	-	-	-	-	[illegible]	-	[illegible]	1.4	2.4	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	DIFFERENTIAL CALCULUS	9+3
Limits and Derivatives - Differentiation – Rules of Differentiation – Maxima and Minima of single variable.		
UNIT II	**INTEGRAL CALCULUS**	**9+3**
Definite and Indefinite integrals – Integration by parts - Double and Triple integrals in Cartesian form – Area and Volume.		
UNIT III	**INTRODUCTION TO STATISTICS**	**9+3**
Definition of Statistics - Basic objectives - Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondarydata. Population and Sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, Graphical representation, Frequency curves. Descriptive measures - Central tendency and Dispersion.		
UNIT IV	**PROBABILITY**	**9+3**
Concept of experiments, sample space, event - Definition of Combinatorial Probability, Conditional Probability, Bayes' Theorem (Statement only) - Expected values and moments: mathematical expectation and its properties (Statements only), Moments (including variance) and their properties, interpretation, Moment generating function – Two dimensional random variables: Joint distributions - Marginal and conditional distributions.		
UNIT V	**PROBABILITY DISTRIBUTIONS**	**9+3**
Discrete and Continuous distributions:Binomial, Poisson and Geometric distributions, Uniform, Exponential, and Normal distributions.		

Text Book (s)	
1	B.S.Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publication, Delhi, 2017.
2	Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Third Edition, John Wiley & Sons, 2003.

Reference (s)	
1	S. M. Ross, A first course in Probability, 9th Edition, Prentice Hall, 2012.
2	I. R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, 9th Edition, Pearson, 2017.
3	A. M. Mood, F.A. Graybill and D.C. Boes, Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill Education, 2001.
4	A. M. Gun, M.K. Gupta and B. Dasgupta, Fundamentals of Statistics, Vol. I & II, World Press, 2013 & 2017.
5	Peter V. O'Neil, Advanced Engineering Mathematics, Seventh Edition, Thomson Learning, 2011.

Regulation 2018		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18PYB102J	PHYSICS FOR COMPUTING SCIENCE	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	create insights to the concepts of optical effects
CLR-2	identify the significance of quantum theory
CLR-3	analyze the working principle of lasers and optical fibers
CLR-4	utilize the concepts in physics for the understanding of engineering and technology
CLR-5	understand the fundamentals of thermodynamics

Course Outcome (s) (Cos):
At the end of this course, learners will be able to:

CO1	analyse the behavior of different types of harmonic oscillations
CO2	explain the concept of interference,diffraction and polarisation
CO3	ellobrate the basic principles of Quantum mechanics
CO4	elucidate the structure of different crystal systems
CO5	explain the different types of laser and their applications

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	1	-	-	-	-
CO2	3	2	1	-	-	-	-	-	1	1	-	-	-	-
CO3	3	1	1	-	-	-	-	-	1	1	-	-	-	-
CO4	3	2	1	-	-	-	-	-	1	1	-	-	-	-
CO5	3	1	1	-	-	-	-	-	1	1	-	-	1	-
CO (Avg)	3.00	1.60	1	-	-	-	-	-	1.00	1.00	-	-	1.00	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	OSCILLATIONS	9
Oscillation: Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring mass system. Resonance-definition., damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor		
UNIT II	**WAVE OPTICS**	**9**
Interference-principle of superposition-young's experiment: Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction- Fresnel's half period zone and zone plate - Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence. **Polarization of light:** Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.		
UNIT III	**QUANTUM MECHANICS**	**9**
Quantum Mechanics: Introduction- Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, Compton effect, time independent and time dependent Schrodinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box.		
UNIT IV	**CRYSTALLOGRAPHY & THERMODYNAMICS**	**9**
Crystallography: Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures. Semiconductor Physics - conductor, semiconductor and Insulator; Basic concept of Band theory. **Thermodynamics:** Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.		
UNIT V	**LASER AND FIBER OPTICS**	**9**
Laser and Fiber optics: Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers;, applications of lasers in engineering. Fiber optics, Acceptance angle and Numerical aperature, Types of optical fibers, Applications of fiber - Optical fiber communications system-Optical sensors.		
For Further Reading: (not for Exaninations) **Basic Idea of Electromagnetisms:** Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium.		

LIST OF EXPERIMENTS	15
1. Magnetic field along the axis of current carrying coil – Stewart and Gee 2. Determination of Hall coefficient of semi-conductor 3. Determination of Plank constant 4. Determination of wave length of light by Laser diffraction method 5. Determination of wave length of light by Newton's Ring method 6. Determination of laser and optical fiber parameters 7. Determination of Stefan's Constant 8. Determination of band gap of a semiconductor 9. Determination of moment of interia of a wire using torisional pendulum	

Text books	
1	Concepts of Modern Physics, (Fifth Edition) A Beiser, McGraw Hill International, 1995
2	Fundamentals of Physics, David Halliday, Robert Resnick and Jearl Walker, Wileyplus, 2013

References:	
1.	Optics, (Fifth Edition) AjoyGhatak, Tata McGraw Hill, 2012
2.	University Physics, Sears &Zemansky, Addison-Wesley. 1999
3.	Fundamentals of Optics, (Third Edition) Jenkins and White, McGraw-Hill, 1957

Regulation 2018		Semester I	Total Hours			45
			Hours / Week			
Category	Course Code	Course Name	L	T	P	C
B	18EEB102J	PRINCIPLES OF ELECTRICAL ENGINEERING	2	0	2	3

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Introduce the basic concepts of electrical circuits and its terminology.
2	Understand the various theorems to solve DC circuits
3	Learn the basic concepts of AC circuits
4	Understand the importance of electrostatic field and electromagnetic field in electromechanical energy conversions.
5	Provide knowledge on measuring devices / sensors, transducers and electrical wiring.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Explain the basic concepts and terminology of electrical circuits.
CO2	Analyze the DC circuit using various network theorems
CO3	Analyze the transient response of AC circuits with R-L-C parameters.
CO4	Analyze the Static and dynamic characteristics of Electro-static and Electromagnetic fields.
CO5	Demonstrate the measurement of various electrical quantities in AC and DC systems with the necessary sensors and devices.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3	3	3	-	-	-	-	-	-	-	-	-	-	-

1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

UNIT I	**INTRODUCTION**	**6**
Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff's laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.		
UNIT II	**DC CIRCUITS**	**6**
Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.		
UNIT III	**AC CIRCUITS**	**6**
AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (λ-Δ&λ-λ).		
UNIT IV	**ELECTROSTATICS AND ELECTRO-MECHANICS**	**6**
Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion.		
UNIT V	**MEASUREMENTS AND SENSORS**	**6**
Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices & system.		
For Further Reading - Principle of batteries, types, construction and application, Magnetic material and B-H Curve, Basic concept of indicating and integrating instruments.		

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LIST OF EXPERIMENTS 15

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits
2. Determination of resistance temperature coefficient
3. Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem)
4. Simulation of R-L-C series circuits for XL>XC , XL< XC
5. Simulation of Time response of RC circuit
6. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
7. Demonstration of measurement of electrical quantities in DC and AC systems.

Text Book (s)

1	*A Textbook of Electrical Technology*, (vol. I) (23rd Edition), B. L. Theraja& A. K.Theraja, S.Chand and Company Ltd., New Delhi, 2012.
2	*Basic Electrical Engineering (Revised Edition)*, V. K. Mehta, S. Chand and Company Ltd., New Delhi, 2012.

Reference (s)

1	*Electric Machinery(Seventh Edition),* A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill, 2020.
2	*Theory and problems of Basic Electrical Engineering,* (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd., 2004.
3	*Basic Electrical Engineering (Third Edition)*, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2018.
4	*Introduction to Electrodynamics (Fourth Edition)*, D. J. Griffiths, Cambridge University Press, 2017.
5	*Engineering Circuit Analysis (Eighth Edition),* William H. Hayt, Jack E. Kemmerly & Steven M Durbin, Tata McGraw Hill, 2013.
6	*Fundamentals of Electrical and Electronics Engineering (Second Edition),* Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd, 2007.

Regulation 2018		Semester I	Total Hours			60
			Hours / Week			C
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	
B	18CBB101J	PROBLEM SOLVING AND C PROGRAMMING	3	0	2	4

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Know the fundamental concepts of programming to solve problems.
2	Understand various operations and controls mechanisms in C programming
3	Learn about arrays, functions and pre-processor directives in C.
4	Understand the concept of pointers in C.
5	Learn the basics of structures and various file operations.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Explain the algorithm, flowchart and C constructs for solving problems in Mathematical and Engineering application.
CO2	Develop C programs using different types of operators, expressions and control structures.
CO3	Use the concept of arrays, modules and recursive functions to solve real world problems.
CO4	Explain the concept of pointers using C program.
CO5	Write programs using Structures, Unions and explain various file operations.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	2	1	1	2	2	-	2	1	2	3	2	2	1
CO3	3	3	2	2	2	2	2	2	2	2	3	2	2	1
CO4	3	2	2	2	2	2	2	2	2	2	2	2	2	1
CO5	3	2	2	2	2	2	2	2	2	2	2	2	2	1
CO (Avg)	3	2.4	1.75	1.75	2	2	2	2	1.75	2	2.4	2	2	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	**GENERAL PROBLEM SOLVING AND INTRODUCTION TO C**	**9**
	Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops-Imperative languages- Introduction to C- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes (Little Endian, Big Endian), Constants, Declarations, proper variable naming and Hungarian Notation - Standard I/O, Formatted Output – printf, Variable length argument list, Formatted Input – scanf Statements	
UNIT II	**OPERATORS, EXPRESSIONS AND CONTROL FLOW**	**9**
	Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, if-else if, switch, Loops – while, do, for, break and continue, goto-structured and unstructured programming.	
UNIT III	**ARRAYS AND FUNCTIONS**	**9**
	Arrays, Multi-dimensional array and Row/column major formats, Strings, Functions and Program Structures, Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, C Pre-processors, Standard Library Functions and return types.	
UNIT IV	**POINTERS**	**9**
	Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, Character Pointers and Functions, Pointer Arrays; Pointer to Pointer, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, Complicated declarations.	
UNIT V	**STRUCTURES AND FILES**	**9**
	Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields, File access, Error Handling- including exit, perror and error.h, Line Input and Output, Miscellaneous functions.	
	LIST OF EXPERIMENTS	**15**

1. Algorithm and flowcharts of small problems like GCD B
2. Structured code writing with:
   - i) Small but tricky codes
   - ii) Proper parameter passing
   - iii) Command line Arguments
   - iv) Variable parameter
   - v) Pointer to functions
   - vi) User defined header
   - vii) Make file utility
   - viii) Multi file program and user defined libraries
   - ix) Interesting substring matching / searching programs
   - x) Parsing related assignments

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Contents for Further Reading
Unix system Interface: File Descriptor, Low level I/O – read and write, Open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator Programming Method: Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility

Text Book (s)	
1	B. W. Kernighan and D. M. Ritchi, "The C Programming Language", Second Edition, Pearson Education, 2016.
2	B. Gottfried, "Programming in C", Fourth Edition, Schaum Outline Series, 2018.

Reference (s)	
1	Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill, 2017.
2	Yashavant Kanetkar, "Let Us C", Fifteenth Edition, BPB Publications, 2017.

Regulation 2018		Semester I	Total Hours			45
			Hours / Week			
Category	Course Code	Course Name	L	T	P	C
H	18CBH101J	BUSINESS COMMUNICATION & VALUE SCIENCE – I	2	0	2	3

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Introduce them to key concepts of values, life skills and business communication.
CLR-2	Motivate students to look within and create a better version of self.
CLR-3	Focus on the development of basic fluency in English, usage of vocabulary in the technical field.
CLR-4	Strengthen reading and official written communication skill.
CLR-5	Understand what life skills are and their importance in leading a happy and well-adjusted life.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Recognize the need for life skills and values.
CO2	Recognize own strengths and opportunities
CO3	Recognize the importance of words
CO4	Understand the basic tenets of communication and apply the basic communication practices in different types of communication.
CO5	Apply the life skills to different situations

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	1	1	2	1	2	3	3	2	2	3	-	-
CO2	-	1	-	1	1	1	2	2	3	1	1	3	-	-
CO3	-	2	2	2	2	1	1	3	3	2	3	3	-	-
CO4	-	1	1	-	-	1	1	2	3	2	1	3	-	-
CO5	-	1	2	-	2	1	2	2	3	1	2	3	-	-
CO (Avg)	-	1.2	1.5	1.33	1.75	1	1.6	2.4	3	1.6	1.8	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**HUMAN VALUES AND BUSINESS COMMUNICATION**	**6**
	Values – Self exploration – Values of individuals: Self Introduction-Presentation on favourite personality and the skills and values they demonstrate – Self-work with immersion(Interviewing Community Workers) and narrate what you think are the values that drive them – Writing: newspaper report– record conversation between a celebrity and an interviewer - Self-awareness; Stress management-Team Work	
UNIT II	**BASIC GRAMMAR AND COMMUNICATION**	**6**
	Parts of Speech - Applications of tenses - Sentence formation, sentence structure, Common Errors-Voices – Questioning-Barriers of Communication; Effective Communication; Verbal and Non – Verbal- Pronunciation- Toastmaster Speech -Importance of Listening Skills; Listening vs Hearing; Types of Listening; SWOT Analysis	
UNIT III	**VOCABULARY ENRICHMENT**	**6**
	Vocabulary Enrichment: Word formation: - Synonyms, antonyms, abbreviations - compound words –single word substitution- Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, significant abbreviations formal business vocabulary.	
UNIT IV	**READING AND WRITING SKILLS**	**6**
	Reading articles – Summary writing, Story writing - writing your comprehensive CV - Create a podcast on a topic. E-Mail Writing.	
UNIT V	**LIFE SKILL**	**6**
	Life Skills: Movie based learning – identifying skills and values - critical life skills - appreciation of diversity - Multiple Intelligences - Leadership Quality- Dealing with Ambiguity-Motivating the People - Community service – work with an NGO and make a presentation.	
	LAB ACTIVITIES	**15**
	1. Presentation on the persona of any well-known person & Role-Play 2. Conversation between celebrity 3. Newspaper Report 4. Create a Podcast on a topic 5. Skit Based Communication 6. Listening Responding to audio 7. Working with an NGO and making a presentation 8. Join a trek –Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation 9. Create a musical using the learning from.	

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Text Book (s)	
There are no prescribed texts for semester 1-there will be handouts and reference links shared.	
Reference (s)	
1	Alan Mc'carthy and O'dell, "English vocabulary in use". Cambridge University Press,2017
2	APAART: Speak Well 1 (English language and communication)
3	APAART: Speak Well 2 (Soft Skills)
4	Dr.SarojHiremath, "Business Communication". Nirali Prakashan,2018
Web References	
1	Train your mind to perform under pressure- Simon sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2	Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3	Will Smith's Top Ten rules for success https://www.youtube.com/watch?v=bBsT9omTch0
Online References	
1	https://www.coursera.org/learn/learning-how-to-learn
2	https://www.coursera.org/specializations/effective-business-communication

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Regulation 2018		Semester I	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM101T	CONSTITUTION OF INDIA	1	0	0	NIL

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Utilize the citizen's rights
CLR-2	Utilize the basic citizen's fundamental rights of freedom of speech, expression, equality, religion and privacy
CLR-3	Identify the Indian constitutional framework with union parliament, government and their functions and citizen's rights
CLR-4	Utilize the States functionality and provisions for the betterment of the individual and society
CLR-5	Identify the emergency provisions, the functions of election and public service commissions, identify the tax system

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Identify the basic provisions in the Indian constitution
CO2	List the fundamental rights, rights to equality, freedom, religion, culture, education and the right against exploitation
CO3	Identify the fundamental duties of the Union of India, President, Vice-President, Union Ministers and Parliament functions
CO4	Identify the power of states, its legislature, Governors role and the state judiciary
CO5	List the special provisions and functionality of election commission, public service commission, individual tax and GST

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	2	3	3	3	-	3	-	-
CO2	-	-	-	-	-	-	2	3	3	3	-	3	-	-
CO3	-	-	-	-	-	-	2	3	3	3	2	3	-	-
CO4	-	-	-	-	-	-	2	3	3	3	2	3	-	-
CO5	-	-	-	-	-	-	2	3	3	3	2	3	-	-
CO (Avg)	-	-	-	-	-	-	2	3	3	3	2	[illegible]	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	**INDIAN CONSTITUTION**	3
Meaning of the Constitution law and Constitutionalism- Historical perspective of the Constitution of India- Salient features and characteristics of the Constitution of India Citizenship- Scheme of the fundamental rights- Scheme of the Fundamental Duties and its legal status		
UNIT II	**FUNDAMENTAL RIGHTS**	3
The Directive Principles of State Policy- Scheme of the Fundamental Right to Equality- Scheme of the Fundamental Right to certain Freedom under Article 19- Scope of the Right to Life and Personal Liberty under Article 21- Union Government, Union Legislature (Parliament)- Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive		
UNIT III	**POWERS AND FUNCTIONS OF CENTRAL GOVERNMENT**	3
President of India (with Powers and Functions)- Prime Minister of India (with Powers and Functions) - Union Judiciary (Supreme Court)- Jurisdiction of the Supreme Court - State Government, Legislature, Legislative Assembly, Legislative Council- Powers and Functions of the State Legislature, State Executive- Governor of the State (with Powers and Functions)		
UNIT IV	**POWERS AND FUNCTIONS OF STATE GOVERNMENT**	3
The Chief Minister of the State (with Powers and Functions)- State Judiciary (High Courts) Union Territory, Panchayat, Municipality- Scheduled and Tribal Areas- Co-operative Societies Consumer Rights - Consumer Protection Act		
UNIT V	**POWERS AND FUNCTIONS OF ELECTION AND SERVICE COMMISSION**	3
Local Self Government – Constitutional Scheme in India-Emergency Provisions : National, President Rule, Financial Emergency - Election Commission of India (with Powers and Functions) - The Union Public Service Commission (with Powers and Functions) - Amendment of the Constitutional Powers and Procedure -Income Tax, Goods and Services Tax		
Text Book (s)		
NIL		
Reference (s)		

1	Durgadas Basu, Introduction to the Constitution of India, Lexis- Nexis, 2015
2	Subash C Kashyap, Our Parliament, National Books Trust, 2011
3	Kaushal Kumar Agarwal, India's No 1 book on Tax : Simple Language Advanced Problems: Income Tax, Kindle, 2017
4	Vivek K R Agarwal, GST Guide for students: Making GST – Good and Simple Tax, Neelam Book House, 2017

Regulation 2018		Semester I	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M		INDUCTION PROGRAM	2	0	0	Nil
MODULE – MATHS						10
Set Theory, Relations and Functions - Differential and Integral Calculus - Matrices and Determinants - Complex Numbers - Differential Equations - Analytical Geometry & Vector Algebra - Trigonometry – Probability - Statistics						
MODULE – PHYSICS						10
Mechanics - Mechanical Properties of Solids and Fluids - Waves and Oscillations - Electricity and Magnetism - Electromagnetic Signal - Optics - Semiconductor Electronics - Modern Physics - Atomic and Nuclear Physics						
MODULE - UNIVERSAL HUMAN VALUES						10
Understanding the Need, Basic Guidelines, Content & Process for Value Education- Process of Self-Exploration-Happiness-Understanding the Human being as Co-existence of the Self and the Body-The Body as an Instrument of the Self-Understanding Harmony in the Self-Understanding Prosperity and Health-Harmony in the Family-Trust-Respect- Justice-Harmony in society						

Regulation 2018		Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB105T	LINEAR ALGEBRA	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Analyze and solve a linear system of equations using Matrix Algebra techniques
2	Understand the concepts of independence, basis and dimensions in vectorspaces
3	Have well founded knowledge in inner product spaces and orthogonality
4	Compute and apply Eigen values and Eigen vectors
5	Apply the concepts of linear algebra in the field of computer science

Course Outcome (s) (Cos):
At the end of this course, learners will be able to:

CO1	Implement the various matrix techniques in solving the system of linear equations
CO2	Use the concept of vector spaces to predict an orthonormal basis
CO3	Orthonormalize a set of vectors in an inner product space using Gram-Schmidt orthogonalisation and decompose a given matrix using QR decomposition
CO4	Solve the problems of linear transformations using Eigen values and Eigen vectors
CO5	Perform dimensionally reduction on the given data using Singular value decomposition and Principal component analysis

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	-	-	-	1	2	2	-
CO2	3	2	1	1	-	1	-	-	-	-	1	2	2	-
CO3	3	2	1	1	-	1	-	-	-	-	1	2	2	-
CO4	3	2	2	1	-	1	-	-	-	-	1	2	2	-
CO5	3	2	2	1	-	1	-	-	-	-	1	2	2	-
CO (Avg)	3	2	1.4	1	-	1	-	-	-	-	1	2	2	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

REVIEW		
Introduction to Matrices and Determinants - Solution of system of linear equations by Cramer's rule - Inverse of a Matrix (using determinant)		
UNIT I	**MATRICES**	**9 + 3**
Vectors and Linear combinations - Rank of a matrix - Solution of system of linear equations by Gaussian Elimination, Gauss Jordan and LU Decomposition methods.		
UNIT II	**VECTOR SPACE**	**9 + 3**
Vector Space: Linear combination – Linear independence – Basis – Dimension - Simple problems		
UNIT III	**INNER PRODUCT SPACE**	**9 + 3**
Innerproduct – Norm – Angle - Orthogonality: Definition and simple problems - Projections – Gram-Schmidt orthogonalization and QR decomposition (theorems not included).		
UNIT IV	**EIGENVALUE PROBLEMS**	**9 + 3**
Linear transformations – Range, Kernel and problems - Eigenvalues and Eigenvectors - Hermitian and Unitary matrices (simple problems).		
UNIT V	**PRINCIPAL COMPONENT ANALYSIS**	**9 + 3**
Positive definite matrices – Cayley-Hamilton theorem - Singular value decomposition and Principal component analysis using the covariance method - Introduction to their applications in Image Processing and Machine Learning (problems not included).		
Text Book (s)		
1	B.S.Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publication, Delhi, 2017.	
2	Howard Anton, Chris Rorres, Elementary Linear Algebra – Applications version, Ninth Edition, John Wiley & Sons, 2005.	
Reference (s)		
1	Michael. D. Greenberg, Advanced Engineering Mathematics,Second Edition, Pearson Education, 2002.	
2	Gilbert Strang,Introduction to Linear Algebra, 5th Edition, Wellesley Publishers, 2016.	
3	R. C. Gonzalez & R. E. Woods, Digital Image Processing, 4th Edition, Pearson Education, 2018.	
4	https://machinelearningmastery.com/introduction-matrices-machine-learning/	

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Regulation 2018		Semester II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	18MAB106J	STATISTICAL METHODS	3	0	2	4

Prerequisite Course (s)

CALCULUS, STATISTICS AND PROBABILITY

Course Objective (s):
The purpose of learning this course is to:

1	Have a well – founded knowledge of statistical techniques and methods of estimation
2	Gain the knowledge on test of hypothesis and how they relate to engineering applications
3	Know the fundamental concepts of Non parametric inference
4	Understand the basic concepts of design of experiments and linear statistical models
5	Understand how to use statistical models in forecasting
6	Develop the skills in writing programme language using R

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Apply the concept of sampling distribution and estimation theory in forecasting
CO2	Identify the right test statistic to test the hypothesis formulated from the given data
CO3	Use the appropriate non parametric hypothesis testing procedures based on inferences
CO4	Apply the concepts of correlation, regression using R Programming and design experiments
CO5	Develop the model for the given time series and estimate the required forecasting
CO6	Explore the features of R language to implement statistical tests for the given data

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	1	-	-	-	-	2	2	2	-
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	-
CO3	3	3	2	3	2	1	-	-	-	-	2	2	3	-
CO4	3	3	2	3	2	1	-	-	-	-	2	2	3	-
CO5	3	3	3	3	2	1	-	-	-	-	2	2	3	-
CO6	3	3	-	3	-	1	-	-	-	-	2	2	3	-
CO (Avg)	3	3	2.4	3	2	1	-	-	-	-	2	2	2.8	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I | SAMPLING TECHNIQUES AND ESTIMATION THEORY | 9

Random sampling – Sampling from finite and infinite populations – Estimates and standard error (sampling with replacement and sampling without replacement) – Sampling distribution of sample mean – Stratified random sampling. Estimation: Point estimation – Criteria for good estimates (unbiasedness, consistency) – Methods of estimation including maximum likelihood estimation. Sufficient Statistic: Concept and examples – Complete sufficiency, their application in estimation – Central limit theorem (Excluding proof).

UNIT II | TESTING OF HYPOTHESIS | 9

Concept and formulation – Type I and Type II errors – Procedures of Testing: Large Samples: Tests for single mean, difference of means and single proportion - Small samples – Student's t test: Tests for single mean and difference of means - F test: Test for equality of variances - Chi-Square test: Tests for Goodness of fit and Independence of attributes.

UNIT III | NON PARAMETRIC INFERENCE | 9

Comparison with parametric inference – Use of order statistics – Sign test – Wilcoxon signed rank test – Mann-Whitney test – Run test – Kolmogorov-Smirnov test – Spearman's and Kendall's test – Tolerance region (Simple problems only).

UNIT IV | DESIGN OF EXPERIMENTS AND LINEAR STATISTICAL MODELS | 9

Analysis of variance: Completely Randomized Design – Randomized Block Design. Simple Linear regression and correlation –Least Squares method – Rank correlation.

UNIT V | BASICS OF TIME SERIES ANALYSIS AND FORECASTING | 9

Stationary – ARIMA Models: Least Square method and maximum likelihood Identification – Estimation – Forecasting.

R STATISTICAL PROGRAMMING LANGUAGE: LIST OF EXPERIMENTS | 15

1. Introduction to R, Functions, Control flow and Loops
2. Working with Vectors and Matrices
3. Reading in and Writing Data
4. Working with Data
5. Manipulating Data
6. Simulation
7. Linear Model
8. Data Frame
9. Graphics in R

FOR FURTHER READING:

Multiple regression and multiple correlation, Neyman Pearson lemma, Procedures of Testing: Large samples – Variance.

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Text Book (s)	
1	Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Third Edition, John Wiley & Sons, 2003.
2	Chris Chatfield, The Analysis of Time Series: An Introduction, 6th Edition, Chapman and Hall/CRC, 2003.
3	Garrett Grolemund, Hands-on Programming with R, 1st Edition, O'Reilly, 2014.
Reference (s)	
1	D.C.Montgomery & E.A.Peck & G.G.Vining, Introduction to Linear Regression Analysis, 5th Edition, Wiley, 2012.
2	A.M.Mood, F.A.Graybill & D.C.Boes, Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, 2001.
3	N.Draper & H.Smith, Applied Regression Analysis, 3rd Edition, Wiley, 1998.
4	Jared P.Lander, R for Everyone: Advanced Analytics and Graphics, 2nd Edition, Addison-Wesley Professional, 2017.

Regulation 2018		Semester II	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
B	18ECB101J	PRINCIPLES OF ELECTRONICS	2	0	2	3

Prerequisite Course (s)

Discrete Mathematics
Statistics, Probability and Calculus
Fundamentals of Physics
Principles of Electrical Engineering

Course Objective (s): The purpose of learning this course is to

1	Study the operation of semiconductor diodes and their characteristics.
2	Acquire knowledge about the operation and characteristics of BJT under various configurations.
3	Introduce the structure and terminal characteristics of FET and MOSFET.
4	Understand the concepts of feedback and operational amplifiers with its applications
5	Gain knowledge about digital logic circuits

Course Outcome (s) (COs):

CO1	Demonstrate the characteristics of the diode.
CO2	Analyse the BJT terminal characteristics and its utilization.
CO3	Develop a high degree of familiarity with the FET and MOSFET
CO4	Design suitable amplifiers for any specific applications
CO5	Construct simple digital logic circuits

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	-
CO2	3	3	2	-	1	-	-	-	-	-	-	-	3	-
CO3	3	3	2	-	1	1	-	-	-	1	-	-	3	-
CO4	3	3	2	1	1	1	-	-	-	-	-	-	3	-
CO5	3	3	2	1	1	1	-	-	[illegible]	[illegible]	-	-	3	-
CO (Avg)	3.00	3.00	2.00	1.00	1.00	0.6	-	[illegible]	[illegible]	1.00	-	[illegible]	3.00	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	SEMICONDUCTORS DIODES AND CIRCUITS	6
Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers **Diodes and Diode Circuits:** Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.		
UNIT II	**BIPOLAR JUNCTION TRANSISTORS**	**6**
Formation of PNP / NPN junctions, transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor. Biasing and Bias stability: calculation of stability factor.		
UNIT III	**FIELD EFFECT TRANSISTORS**	**6**
Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations		
UNIT IV	**FEED BACK AMPLIFIER AND OPERATIONAL AMPLIFIERS**	**6**
Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplifier and its terminal properties.		
UNIT V	**DIGITAL ELECTRONICS FUNDAMENTALS**	**6**
Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers.		
CASE STUDY		
Bipolar Junction Transistors: Energy band diagram, current amplification factors for CB and CE modes **Field Effect Transistors**: CMOS: Basic Principles **Feed Back Amplifier, Oscillators and Operational Amplifiers**: Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator. **Digital Electronics Fundamentals:** Flip-flops, Shift registers, Counters.		

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LIST OF EXPERIMENTS	15

1. Characteristics of PN junction diode and Zener diode.
2. Design of DC voltage regulator using zener diode.
3. Design of Rectifier with and without filter.
4. Characteristics of BJT, FET.
5. Design of CE amplifier.
6. Study of OP-AMP circuits: Inverting and Non-inverting Amplifier.
7. Implementation of basic logic functions using combinational circuits.

Text Book(s)	
1	Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits: Theory and Application", 7th Edition, Oxford University Press, 2017.
2	Jacob millman, Christos halkias, Chetan parikh,"Millman's Integrated Electronics "McGraw Hill education (India) Private Limited,2010
3	M. Morris Mano, "Digital Logic & Computer Design", Pearson India Education Services, 2016.

Reference(s)	
1	Robert L. Boylestad, Louis Nashelsky. "Electronic Devices and Circuit Theory", 8th Edition, Pearson Education Limited, 2002.
2	Ben Streetman, Sanjay Banerjee ,"Solid State Electronic Devices", 6th Edition, 2002.
3	Albert Paul Malvino and David J.Bates,"Electronic Principle",7th Edition, Tata McGraw-Hill, 2008.
4	D Schilling, C Belove, T Apelewicz, R Saccardi , "Electronics Circuits: Discrete & Integrated", 3rd Edition, Tata McGraw- Hill, 2008.
5	Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Edition, Tata McGraw- Hill, 2009.
6	S. Salivahanan, N. Suresh Kumar and A.Vallavaraj, " Electronics Devices & Circuits",2nd Edition,Tata McGraw- Hill,2007
7	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 10thEdition, Pearson Education Limited, 2009.

Regulation 2018		Semester II	Total Hours			60
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
C	18CBC101J	DATA STRUCTURES & ALGORITHMS	3	0	2	4

Prerequisite Course (s)

Programming in C

Course Objective (s):

The purpose of learning this course is to:

1	Know various operations on the data structures, and algorithm complexities.
2	Study about linear data structures and its operations.
3	Learn about tree data structures and apply it for various applications
4	Know about graph data structures and apply it for solving different applications
5	Understand various searching, sorting and hashing techniques.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand various operations on the data structures with time and space complexity analysis of an algorithm.
CO2	Describe the concept of linear data structures like array, linked list, stack, queue and its applications.
CO3	Apply the concept of tree data structures for various applications.
CO4	Understand and apply the concept of graph data structures for complex applications.
CO5	Explain about the computations of various searching, sorting and hashing techniques.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	1	-	-	-	2	3	1	3	-
CO2	3	2	1	1	1	1	-	-	1	2	3	2	2	1
CO3	3	3	2	2	2	2	2	-	1	2	3	2	2	1
CO4	3	3	2	2	2	2	2	-	1	2	3	2	2	1
CO5	3	2	1	1	1	-	-	-	1	2	2	2	2	1
CO (Avg)	3	2.6	1.8	1.4	1.6	1.2	0.4	-	0.4	2	2.8	1.8	1.2	0.8

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	BASIC TERMINOLOGIES AND INTRODUCTION TO ALGORITHM	9
Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction.		
UNIT II	**LINEAR DATA STRUCTURE**	**9**
Array, Stack, Queue, Linked-list and its types, Various Representations, Operations and Applications of Linear Data Structures.		
UNIT III	**NON-LINEAR DATA STRUCTURE - TREES**	**9**
Trees, Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree.		
UNIT IV	**NON-LINEAR DATA STRUCTURE - GRAPHS**	**9**
Graphs - Various Representations, Directed, Undirected GraphOperations, Breadth First search, Depth First Search, Minimum Spanning Tree, Prims and Kruskals Algorithm, complexity analysis, Applications of Non-linear Data Structures.		
UNIT V	**SEARCHING, SORTING AND HASHING**	**9**
Sequential Search, Binary Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing.		
	LIST OF EXPERIMENTS	**15**

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file.
7. Linear and Binary Search algorithms.
8. Selection, Insertion, Merge, Quick Sort

Contents for Further Reading

Definition, File Organization: Sequential, Direct, Indexed Sequential, Hashed and various types of accessing schemes.

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Text Book (s)	
1	E. Horowitz and S. Sahni, Fundamentals of Data Structures,Second Edition,Universities Press, 2008.
2	V. Aho, J.E. Hopcroft and J. D. Ullman, "Data Structures and Algorithms", 1st Edition,Pearson India, 2002.
Reference (s)	
1	Donald E. Knuth, "The Art of Computer Programming: Volume 1: Fundamental Algorithms", 3rd edition, Addison Wesley,2008.
2	Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd edition, MIT Press, 2010
3	Pat Morin, "Open Data Structures: An Introduction (Open Paths to Enriched Learning)", 31st ed. Edition, UBC Press, 2013.

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Regulation 2018		**Semester II**	**Total Hours**			**30**
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
S	18MBS101T	FUNDAMENTALS OF ECONOMICS	2	0	0	2

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Familiarize the students with the basic concept of microeconomics.
2	Make student understand the demand and supply analysis in business applications.
3	Familiarize students with the production and cost structure under different stages of production.
4	Understand the pricing and output decisions under various market structures.
5	Help students understand and apply the various decision tools to understand the market structure.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Explain about principles of Demand and Supply.
CO2	Describe and explain about Consumer Behavior.
CO3	Gain knowledge on the Theory of Production.
CO4	Understands the concept of National Income and its Components.
CO5	Understands about the Monetary and Fiscal Policy.

CO-PO Mapping

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	-
CO2	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
CO4	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-
CO5	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-
CO (Avg)	1	1	-	-	-	-	1	-	-	[illegible]	1	1	-	1	-

1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

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UNIT I	**MICROECONOMICS - PRINCIPLES OF DEMAND AND SUPPLY**	**6**
Principles of Demand and Supply - Supply Curves of Firms - Elasticity of Supply - Demand Curves of Households - Elasticity of Demand - Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve) - Welfare Analysis - Consumers' and Producers' Surplus - Price Ceilings and Price Floors.		
UNIT II	**MICROECONOMICS - CONSUMER BEHAVIOUR**	**6**
Consumer Behavior - Axioms of Choice - Budget Constraints and Indifference Curves - Consumer's Equilibrium - Effects of a Price Change, Income and Substitution Effects -Derivation of a Demand Curve - Applications - Tax and Subsidies – Intertemporal Consumption - Suppliers' Income Effect.		
UNIT III	**MICROECONOMICS - THEORY OF PRODUCTION**	**6**
Theory of Production - Production Function and Iso - quants - Cost Minimization - Cost Curves - Total, Average and Marginal Costs - Long Run and Short Run Costs - Equilibrium of a Firm Under Perfect Competition - Monopoly and Monopolistic Competition		
UNIT IV	**MACROECONOMICS - NATIONAL INCOME**	**6**
National Income and its Components - GNP, NNP, GDP, NDP - Consumption Function – Investment - Simple Keynesian Model of Income Determination and the Keynesian Multiplier - Government Sector - Taxes and Subsidies - External Sector - Exports and Imports		
UNIT V	**MACROECONOMICS - MONEY**	**6**
Money – Definitions - Demand for Money -Transactionary and Speculative Demand - Supply of Money - Bank's Credit Creation Multiplier - Integrating Money and Commodity Markets - IS, LM Model - Business Cycles and Stabilization - Monetary and Fiscal Policy - Central Bank and the Government - The Classical Paradigm - Price and Wage Rigidities - Voluntary and Involuntary Unemployment.		

Text Book (s)

1	Pindyck, Robert S., and Daniel L. Rubinfeld, Microeconomics, Eighth Edition ,Pearson.
2	Macroeconomics, by Rudiger Dornbusch, ,StanleyFischer and Startz 12th Edition Sep 7 2017.
3	Economics, Paul Anthony Samuelson, William D. Nordhaus. 19th Edition 2018

Reference (s)

1	Intermediate Microeconomics: A Modern Approach, Hal R, Varian 9th Edition 2014. W.W.Norton Company.
2	Principles of Macroeconomics, N. Gregory Mankiw 9th Edition.

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Regulation 2018		Semester II	Total Hours			45
			Hours / Week			
Category	Course Code	Course Name	L	T	P	C
H	18CBH102J	BUSINESS COMMUNICATION & VALUE SCIENCE – II	2	0	2	3

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Develop effective writing, reading, presentation and group discussion skills
CLR-2	Introduce the organizational concepts and theory dedicated to a social cause.
CLR-3	Help students identify personality traits and evolve as a better team player.
CLR-4	Introduce them to key concepts of a) Morality b) Behavior and beliefs c) Diversity &Inclusion
CLR-5	Motivate students to adopt social activities.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Understand and use tools of structured written communication
CO2	Develop materials to create an identity for an organization dedicated to a social cause
CO3	Identify individual personality types and role in a team.
CO4	Understand the basic concepts of Morality and Diversity
CO5	Organize an event to generate awareness and get support for a cause

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	2	-	1	1	-	3	3	-	3	-	2
CO2	-	-	2	-	-	2	2	2	3	1	-	3	-	2
CO3	-	1	1	-	-	1	1	1	3	3	3	3	-	2
CO4	-	1	1	-	-	2	2	2	3	2	2	3	-	2
CO5	-	-	1	-	-	2	1	-	3	2	3	3	–	2
CO (Avg)	-	1	1.33	2	-	1.6	1.4	1.66	3	2.2	2.66	3	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	LAUNCHING E MAGAZINE	6
Writing: Good and bad writing - Common errors, punctuation rules, use of words - writing techniques of Catherine Morris and Joanie McMahon's – Creating and launching E-magazine. **Speaking:** Icebreaker - Participating in 'Join Hands Movement' - Individual identification of social issues – addressing social issues - **Reading:** Sharing the learning points from GD – SATORI –Report writing on Discussion.		
UNIT II	**FORMULATING AN ORGANIZATIONAL STRUCTURE**	**6**
Each group forming an NGO - create vision, mission, value statement, and tagline and design a logo. Introduction to basic presentation skills & ORAI app - Groups to present their NGOs – Presentation recording and sharing the findings from recording. **Writing:** individual write up for E- magazine and evaluation - preparation and publication of second episode of E Magazine. Speed Reading session: Introduction to skimming and scanning; SATORI – Join the dots		
UNIT III	**TEAM PLAY**	**6**
Ad campaign - Brain storming session - discussing and exploring the means of articulating and amplifying the social issue their NGOs are working for - Designing skits: write the script articulating the message of their respective NGOs - Promote the play through a social media and gather audience - Enact the play - reviews. Group Activity: Prepare and publish the third episode of the E Magazine. Berbin's 8 Team roles and Lindgren's big 5 personality traits – SATORI joining dots.		
UNIT IV	**DIVERSITY AND INCLUSION**	**6**
Learn from movies - film on diversity – discussion on key take away of the film - Theory to connect and concept of empathy. Create story – Group activity – a person's life affected by the social issue – narration of story in first person - Feedbacks by other groups. Research on a book, incident or film based on the topic of your respective NGO - Write a review in a blog on the topics they are covering in their research. Diversity & Inclusion - Different forms of Diversity in our society - Debate on diversity with an angle of ethics, morality and respect for individual. Prepared speech - Every student will narrate the challenges faced by a member of a diverse group. Video recording interviews of people from diverse groups with 5 questions. Touch the target, film: 'The Fish and I' by BabakHabibifar. Discussion on TCS values, Respect for Individual and Integrity. Preparation of final episode of the E Magazine. Revisit your resume: Include your recent achievements in your resume. SATORI .		
UNIT V	**ORGANIZING AWARENESS CAMPAIGN**	**6**
Project- 1) Each team to look for an NGO/ social group in the city which is working on the issue their college group is supporting. 2) Spend **a day with the NGO/ social group** to understand exactly how they work and the challenges they face. 3) Render voluntary service to the group for one day 4) Invite the NGO/ social group to address their university students for couple of hours. Plan the entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with the NGO spokesperson 5) The groups to present their experience of **a day with the NGO** and inspire students to work for the cause.		

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LAB ACTIVITIES	15

1. Group Discussion
2. Create the magazine
3. Launching an E Magazine
4. Prepare and Publish the Second Episode of the E Magazine
5. Enact and Read out the Script of a Skit
6. Promote the Play in Social Media
7. Presentation
8. Prepare and Publish the Third Episode of the E Magazine
9. Narrating a Story
10. Writing a Review in a Blog
11. Debate
12. Giving Persuasive Speech
13. A day with NGO and Share the Experience

Text Book (s)

There are no prescribed texts for semester 2 - there will be handouts and reference links shared

Reference (s)

1	Abundance: The Future is Better Than You Think; Peter H. Diamandis and Steven Kotler; Published: 21 Feb, 2012; Publisher: Free Press
2	Advertising & IMC: Principles and Practice; Sandra Moriarty, Nancy D. Mitchell, William D. Wells; Published: 15 June 2016; Publisher: Pearson Education India
3	Forge Your Future: Candid, Forthright, Inspiring ; Dr. A.P.J Abdul Kalam; Publishing year: 2014
4	Guiding Souls : Dialogues on the purpose of life; Dr. A.P.J Abdul Kalam ;Publishing Year-2005; Co-author--Arun Tiwari
5	Start With Why: How Great Leaders Inspire Everyone to Take Action; Simon Sinek; Published: 6 October 2011; Publisher: Penguin
6	The Family and the Nation; Dr. A.P.J Abdul Kalam; Publishing year: 2015; Co-author: Acharya Mahapragya
7	The Scientific India: A twenty First Century Guide to the World around Us; Dr. A.P.J Abdul Kalam; Publishing year: 2011; Co-author- Y.S.Rajan

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Web References	
1	ETHICS FUNDAMENTALS AND APPROACHES TO ETHICS https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf
2	A Framework for Making Ethical Decisions https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions
3	Five Basic Approaches to Ethical Decision http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf
Online References	
1	https://youtu.be/CsaTslhSDI
2	https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3	https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4	https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5	https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

Regulation 2018		Semester II	Total Hours			30
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
M	18LEM102T	VALUE EDUCATION	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Connect the learners to their potential, identify their potential to create a new positive world
CLR-2	Analyze the merits and demerits of different educational systems. Identify the different systems of education
CLR-3	Draw attention towards the weaknesses they are susceptible to and inspire them through positive models
CLR-4	Instill a sense of professional ethics which help them develop a safe comfortable and prosperous society
CLR-5	Cultivate a spirit of willing accommodation in an increasingly diverse world

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Equipped with an awareness of their positive energy and power
CO2	Identify the meaning of 'education'; have a clear and better understanding in taking education crowd/people.
CO3	Assess their weaknesses; understand risks involved and rectify them through learning from positive and negative instances
CO4	Realize their professional responsibilities
CO5	Acquire the required values in an expanding pluralistic world not be swept off their feet due to the rapid changes

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	-	2	3	-	3	3	3	-	3	1	-
CO2	2	3	2	-	3	3	2	2	3	3	-	3	1	-
CO3	2	-	-	-	2	3	2	2	3	3	-	3	1	-
CO4	2	2	-	-	3	3	3	3	3	3	-	3	1	-
CO5	2	-	-	-	3	3	3	3	3	3	-	3	1	-
CO (Avg)	2.00	2.33	2.00	-	2.6	3	2.57	2.6	3	3	-	3	1	-

1: Slight (Low) **2: Moderate (Medium)** **Substantial (High)**

UNIT I	VISIONS FOR YOUTH	6
Introduction (Quiz) - Two speeches by great personalities (Oral presentations) - Quotes, proverbs relating to the power and potential of youth, Excerpts: Wings of Fire (Collecting proverbs highlighting the potential of youth) - Two news articles highlighting the initiatives for social causes by youth (Role play in a similar context) - One song exhibiting the positive energy of youth (Discussion on the song)		
UNIT II	**YOUTH AND EDUCATION**	**6**
Meaning and the significance of education (Brainstorming) - Overview of different (traditional, modern) educational systems (Debate) - Role of youth in education, Urban and Rural set up, dissemination (Student presentations) - Designing and framing educational curriculum and materials (Students' Presentation based on write ups) -The pressing challenges in current educational system (Collage Design)		
UNIT III	**YOUTH AND SOCIETY**	**6**
Need for social values in the present context (Poem – "Where the mind is without fear", Write up on various instances from real life) - Individual and group behaviour, respect for others (Case study on recent happenings) - Civic sense, bullying-substance abuse, uses of expletives (Case study on recent happenings) - Hero worship, gender insensitivity moral policing (Case study on recent happenings) - Positive contribution by youth in promoting social welfare (Short videos followed by discussions)		
UNIT IV	**YOUTH AS PROFESSIONALS**	**6**
Introduction to professional values (Brainstorming through visual cues) - Engineering societies in India (Quiz) - Challenges to be addressed by Engineers in India (Case Study) - Challenges in different sectors: agriculture (Case Study) - Challenges in different sectors: urban development, environment (Group activity (oral and written)) - Challenges in different sectors: sustainable development, cyber security (Case Study – from Newspapers)		
UNIT V	**YOUTH IN PLURALISTIC SOCIETY**	**6**
Introduction to pluralistic society, forces of globalization (Group Discussion) - Science and technology intercultural proximity (Narration of stories from various religions to illustrate the oneness of humanity) - Positive, Negative impact: religion, politics, gender, economic status, aesthetics (Discussion on "To Kill a Mocking Bird") - Values required to live in a global society (Poster presentation on festivals of various religions) - Learning the etiquettes of various societies (Poster presentation on festivals of various religions) - Success of pluralistic society, enliven the society, religious harmony through literary (Writing the aspects of pluralistic society based on the text).		

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Text Book (s)	
Nil	
Reference (s)	
1	Kalam, APJ Abdul. Wings of Fire: AN Autobiography of APJ Abdul Kalam. Ed. Sangam Books Ltd., 1999
2	"Banaras Hindu University Speech" and "To Students". The Voice of Truth. General Editor Shriman Narayan. Navajivan Publishing House. pp. 3-13 and pp. 425-30. www.mkgandhi.org
3	Piroda, Sam. "Challenges in Science and Technology". www.nfdindia.org/loc19.htm
4	Thomas A Address to VTU Students by Narayana Murthy. https://www.karnataka.com/personalities/narayana-murthy/vtu-address-2006/
5	World Economic forum. "India's top 7 challenges from skills to water scarcity"

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Regulation 2018		Semester II	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18GNM101L	PHYSICAL & MENTAL HEALTH USING YOGA	0	0	2	Nil

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Provide Deeper insight into the curriculum of Yogic Sciences along with practical applications of Yoga
CLR-2	Intend that students should get familiar with the poses if Yogasanam.
CLR-3	Promote positive health in the Student through Yoga and enabling and imparting skill in them to practice and apply Yogic
CLR-4	Practice for Health to general public and teach Yoga for Total personality development and spiritual evolution.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Increase the muscle strength
CO2	Improve respiration, energy and vitality.
CO3	Maintain a balanced metabolism and weight reduction.
CO4	Maintain cardio and circulatory health.
CO5	Improve athletic performance and protection from injury.

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO (Avg)	-	-	-	-	-	1	-	-	-	-	-	2	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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	Introduction	**6**
	- Human Body – Meaning and its Importance in Yoga - Definition of Anatomy and Physiology - Cell: Structure & Function	
	General Information, Different parts, Structure, Function and Effect of Yogic Practices.	**24**
	- Tissues: Types, Structure & Function - Musculo-Skeletal System - Digestive System - Excretory System - Respiratory System - Circulatory System - Nervous System - Endocrinal System	

Text/ Reference (s) Books	
1	Shirley Telles – A Glimpse of the Human Body The structure and Functions, Swami Vivekananda Yoga Prakashana, Bangalore.
2	Makarand Madhukar Gore – Anatomy and Physiology of Yogic Practices, motilal Banarsidass, New Delhi, 2007.
3	Anne Waugh, Allison Grant – Iross and Wilson Anatomy and Physiology in Health & Illness, Churchill Livingstone; 2010.

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Regulation 2018		Semester III	Total Hours			60
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
C	18CBC201T	FORMAL LANGUAGE AND AUTOMATA THEORY	3	1	0	4

Prerequisite Course (s)

Basics of Discrete Mathematics- Sets and Relations

Course Objective (s):
The purpose of learning this course is to:

1	Know the fundamental concepts of formal language and expressions.
2	Understand the relation between regular expression and finite automata.
3	Learn the languages for pushdown automata for recognizing a language.
4	Know the concept of linear bound automata, Turing machine and their computational capability.
5	Understand the basics of undecidable problems and complexity theory.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Explain the concepts in formal language and automata theory.
CO2	Explain regular expression and its equivalence with finite automata.
CO3	Utilize the push down automata to recognize a given language.
CO4	Explain the capability of linear bound automata and Turing machine in solving a recursive problem.
CO5	Elucidate the undecidablity of various problems and concepts of complexity theory.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	2	-
CO2	3	2	2	1	1	-	-	-	-	-	2	2	2	-
CO3	3	2	2	1	1	-	-	-	-	-	-	-	2	-
CO4	3	2	2	1	1	-	-	-	-	-	-	-	2	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO (Avg)	3	2	1.8	1	1	-	-	-	-	-	0.4	0.4	2	-

1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

<table>
<tr><td><b>UNIT I</b></td><td><b>INTRODUCTION TO FINITE AUTOMATA</b></td><td><b>9+3</b></td></tr>
<tr><td colspan="3">Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages, deterministic finite automata (DFA), nondeterministic finite automata (NFA) and equivalence with DFA, Finite Automata with Epsilon Transitions.</td></tr>
<tr><td><b>UNIT II</b></td><td><b>REGULAR EXPRESSIONS AND LANGUAGES</b></td><td><b>9+3</b></td></tr>
<tr><td colspan="3">Regular expressions and languages, finite automata and equivalence with regular expressions, regular grammars and equivalence with finite automata, properties of regular languages, Kleene's theorem, pumping lemma for regular languages, Myhill-Nerode theorem and its uses, minimization of finite automata.</td></tr>
<tr><td><b>UNIT III</b></td><td><b>CONTEXT-FREE LANGUAGES, PUSHDOWN AUTOMATA,</b></td><td><b>9+3</b></td></tr>
<tr><td colspan="3">Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.</td></tr>
<tr><td><b>UNIT IV</b></td><td><b>LINEAR BOUNDED AUTOMATA AND TURING MACHINES</b></td><td><b>9+3</b></td></tr>
<tr><td colspan="3">Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, Nondeterministic TMs and equivalence with deterministic TMs.</td></tr>
<tr><td><b>UNIT V</b></td><td><b>UNDECIDABILITY</b></td><td><b>9+3</b></td></tr>
<tr><td colspan="3">Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages, P and NP, NP- completeness</td></tr>
<tr><td colspan="3"><b>Contents for Further Reading</b></td></tr>
<tr><td colspan="3">Unrestricted grammars and equivalence with Turing machines, TMs as enumerators.
<b>Basic Introduction to Complexity:</b> Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, Cook's Theorem, other NP -Complete problems.</td></tr>
</table>

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Text Book (s)	
1	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, 2009.
2	Peter Linz, "An Introduction to formal Languages and Automata", 6th Edition, Jones & Bartlett Pub, 2016.
Reference (s)	
1	John C.Martin, "Introduction to Languages and the Theory of Computation", Fourth Edition, McGraw Hill Education, 2010.
2	Harry R.Lewis, Christos U.Papadimitriou, Elements of the Theory of Computation, Prentice Hall India Learning Private Limited; Second edition, 2002.
Web Resource (s)	
1	http://gaia.cs.umass.edu/ntu_socket
2	http://www.cs.bilgi.edu.tr/~mgencer/coursemat/NP-LectureNotes.pdf
3	www.jflap.org/
4	automatonsimulator.com/
5	http://www.jflap.org/tutorial/grammar/bruteforceCFG/index.html
6	https://turingmachinesimulator.com/
7	http://weitz.de/pump/
8	https://nptel.ac.in/courses/106104028/
9	https://nptel.ac.in/courses/106103070/

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Regulation 2018		Semester III	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC202T	COMPUTER ORGANIZATION & ARCHITECTURE	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Recognize the basic structure of a digital computer and representation of non-numeric data.
2	Learn different arithmetic operations and organization of control unit.
3	Study memory organization, different ways of communication with I/O devices and parallel processors.
4	Understand the concept of pipelining and its impact in processor design.
5	Learn the hierarchical memory system.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Discuss the functionalities of various blocks of a digital computer and express the data representation.
CO2	Illustrate the logic design of Arithmetic and control Unit.
CO3	Infer the concepts of memory system, concurrence access in parallel processors and classify the approaches for I/O communication.
CO4	Distinguish hazards in pipelining and outline its impact in the performance of the processors.
CO5	Determine the performance of different types of memory.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	2	-
CO2	3	2	3	1	2	-	-	-	-	-	-	-	2	-
CO3	3	2	2	1	3	-	-	-	-	-	-	-	3	-
CO4	3	1	2	1	2	-	-	-	-	-	-	-	3	-
CO5	3	1	2	1	2	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]
CO (Avg)	3	1.6	2.2	1	2	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION TO COMPUTER ARCHITECTURE**	9
Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs. Data representation: Signed number representation, fixed and floating-point representations, character representation.		
UNIT II	**COMPUTER ARITHMETIC**	9
Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and- add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.		
UNIT III	**CONTROL UNIT AND PIPELINING**	9
Introduction to x86 architecture. CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.		
UNIT IV	**PERIPHERAL DEVICES AND THEIR CHARACTERISTICS**	9
Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB.		
UNIT V	**MEMORY ORGANIZATION AND SYSTEM DESIGN**	9
Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies. Memory system design: Semiconductor memory technologies, memory organization.		

Text Book (s)	
1	Morris Mano, “Computer System Architecture” 3rd Edition, Prentice Hall of India, New Delhi, 2014.

Reference (s)	
1	David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Elsevier, 5th Edition 2013.
2	Carl Hamacher, Zvonko Vranesic, SafwatZaky, Naraig Manjikian, “Computer Organization and Embedded Systems” McGraw-Hill, 6th Edition 2014.
3	John P. Hayes, Computer Architecture and Organization, McGraw-Hill ,3rd Edition,2013.
4	William Stallings, “Computer Organization and Architecture – Designing for Performance”, 10th Edition, Pearson Education, 2015.
5	Vincent P. Heuring and Harry F. Jordan,” Computer System Design and Architecture”, Prentice Hall, 2 nd Edition, 2004.

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Regulation 2018		Semester III	Total Hours			45
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
C	18CBC203T	OBJECT ORIENTED PROGRAMMING	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To explain the difference between object oriented programming and procedural programming.
2	To build C++ classes using appropriate encapsulation and design principles.
3	To introduce advanced C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling, etc.
4	To apply object oriented concepts to solve bigger computing problems.
5	Develop C++ applications using OOP concepts, files, templates and exceptions.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Understand the concepts and relative merits of C++.
CO2	Implement programs using object oriented concepts such as encapsulation, inheritance and polymorphism.
CO3	Implement stream I/O, templates and operator overloading.
CO4	Develop applications with concepts of files, templates and exceptions.
CO5	Understand Object Oriented Design and Modeling.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	3	2	3	2
CO2	3	3	3	3	3	-	-	-	-	-	3	2	3	2
CO3	3	3	3	3	3	-	-	-	-	-	3	2	3	2
CO4	3	3	3	3	3	-	-	-	-	-	3	2	2	2
CO5	2	3	3	3	3	-	-	-	-	-	3	2	2	2
CO (Avg)	2.8	3	3	3	3	-	-	-	-	-	3	2	2	[illegible]

1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)

UNIT I	**PROCEDURAL PROGRAMMING**	**9**
An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (C-way), Library Functions (*string, math, stdlib*), Command line arguments, Pre-processor directive - Some difference between C and C++: Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator,Inline Functions in contrast to macro, default arguments		
UNIT II	**CONCEPTS OF OBJECT ORIENTED PROGRAMMING**	**9**
Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object - More extensions to C in C++ to provide OOP Facilities: Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception)		
UNIT III	**ESSENTIALS OF OBJECT ORIENTED PROGRAMMING**	**9**
Operator overloading – Inheritance: Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling		
UNIT IV	**GENERIC PROGRAMMING**	**9**
Template concept, class template, function template, template specialization - Input and Output: Streams, Files, Library functions, formatted output.		
UNIT V	**OBJECT ORIENTED DESIGN AND MODELLING**	**9**
UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design		

Text Book (s)	
1	The C++ Programming Language, Bjarne Stroustrup, Addison Wesley.
2	C++ and Object-Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd.

Reference (s)	
1	Programming – Principles and Practice Using C++, Bjarne Stroustrup, Addison Wesley.
2	The Design and Evolution of C++, Bjarne Stroustrup, Addison Wesley.

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Regulation 2018		**Semester III**	**Total Hours**			60
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
B	18CBC204J	COMPUTATIONAL STATISTICS	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Understand the fundamental concepts of Python & implementation of Data Visualization.
2	Use the fundamental concepts of computational statistical models and multivariate regression in applications.
3	Understand the basic concepts of Discriminant analysis and Principal component analysis
4	Gain knowledge in the concepts of Factor Analysis.
5	Understand the fundamental concepts of Clustering and Segmentation Analysis.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Utilize the introductory, concepts of Python and Data Visualization techniques in Computational Statistics.
CO2	Understand the basic concepts of Statistical techniques and multivariate regression models.
CO3	Acquire knowledge in the basic concepts of Discriminant analysis and Principal component analysis.
CO4	Have the well founded knowledge in the concepts of factor analysis.
CO5	Implement the Clustering Analysis concept.

CO-PO Mapping

Cos	**Pos**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	-	-	2	1	3	3
CO2	3	3	3	2	2	-	-	-	-	-	2	1	3	1
CO3	3	3	3	2	2	-	-	-	-	-	2	1	3	1
CO4	3	3	3	2	2	-	-	-	-	-	2	1	3	1
CO5	2	3	3	2	2	-	-	1	-	-	2	1	3	1
CO (Avg)	3	3	3	2	2	-	-	1	-	[illegible]	2	1	3	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	PYTHON CONCEPTS AND DATA VISUALIZATION	11
Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Constructors, Text & Binary Files - Reading and Writing. Visualization in Python: Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.		
UNIT II	MULTIVARIATE NORMAL DISTRIBUTION AND MULTIVARIATE REGRESSION	9
Multivariate Normal Distribution: Multivariate Normal Distribution, Conditional Distribution, Estimation of parameters. Multiple Linear Regression Model: Standard multiple regression models collinearity, outliers, non-normality and autocorrelation, Multivariate Regression: Parameter estimation, Multivariate Analysis of variance and covariance.		
UNIT III	DISCRIMINANT ANALYSIS AND PRINCIPAL COMPONENT ANALYSIS	9
Discriminant Analysis: Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties. Principal Component Analysis: Principal components, Algorithm for conducting principal component analysis, H-plot.		
UNIT IV	FACTOR ANALYSIS	8
Factor Analysis: Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.		
UNIT V	CLUSTER ANALYSIS	8
Clustering and Segmentation Analysis: Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering. K-Means Clustering.		
	LIST OF EXPERIMENTS	15

1. Basic Python Programs
2. Program using String Operations
3. Program on python Data structures
4. Perform various numpy operations and special functions
5. Draw statistical graphics using seaborn
6. Implement k-means, logistic and time series algorithm using Scikit-learn
7. Multi Variable analysis with regression in python
8. Factor analysis with python
9. Data Aggregation in python
10. Visualization in python using Altair

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Text Book (s)	
1	An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley Series in Probability and Statistics (Third Edition), 2003.
2	Applied Multivariate Data Analysis, Vol I & II, J.D. Jobson, Springer, 1991.
3	Beginning Python: From Novice to Professional, Magnus Lie Hetland, Edition, 2005

Reference (s)	
1	The Foundations of Factor Analysis, A.S. Mulaik, Chapman and Hall/CRC, 2009
2	Introduction to Linear Regression Analysis, D.C. Montgomery and E.A. Peck.
3	Python for Data Analysis, Wes Mc Kinney.
4	Programming Python, Mark Lutz.
5	Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.

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Regulation 2018(R)		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC205J (R)	SOFTWARE ENGINEERING	3	0	2	4

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Gain knowledge about various phases in software development life cycle.
2	Implement the basic of software requirements, project management and cost estimation.
3	Learn the metrics and models used to estimate the software quality and reliability.
4	Understand the various methodologies in software design using case tools.
5	Analyze various testing strategies used to identify faults and failures in software development.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Explain the various phases in a software development life cycle.
CO 2	Elucidate the software requirement specification and cost estimation for a project management.
CO 3	Utilize the metrics and models for estimating the software quality and reliability.
CO 4	Develop software using object oriented case tools for a real time application.
CO 5	Explain various testing techniques used in verification and validation of a software.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	2	2	1	1	1
CO2	3	3	2	2	1	1	1	2	2	2	2	2	2	1
CO3	3	3	3	2	1	1	1	2	2	2	2	2	2	1
CO4	3	3	3	2	2	1	1	2	2	2	2	2	2	1
CO5	3	3	2	2	2	1	-	2	2	2	2	2	2	1
CO (Avg)	3	2.8	2.2	1.8	1.4	1	1	2	2	2	2	1.8	1.8	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT 1	**Introduction**	9
	Introduction: Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline, Software Engineering Historical Development from Jackson Structured Programming to Agile Development.	
UNIT 2	**Software Project Management and Agile Software Engineering**	9
	Basic concepts of life cycle models – different models and milestones; software project planning – identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management. **Agile Software Engineering:** Concepts of Agile Methods, Extreme Programming;Agile Process Model - Scrum, Feature; Scenarios and Stories.	
UNIT 3	**Software Quality Management and Software Requirements Analysis**	9
	Software quality; Garvin's quality dimensions, McCall's quality factor, ISO 9126 quality factor; Software Quality Dilemma; Introduction to Capability Maturity Models (CMM and CMMI); Introduction to software reliability, reliability models and estimation. **Software Requirements** Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics-based control methods; measures of code and design quality.	
UNIT 4	**Object Oriented Analysis, Design and Construction**	9
	Concepts: The principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object oriented metrics.	
UNIT 5	**Software Testing**	9
	Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection; Unit Testing, Integration Testing, System Testing and Acceptance Testing.	
	Total Periods	**45**
LIST OF EXPERIMENTS		**15**
	Development of requirement specification, function oriented design using SA/SD, object-oriented design using UML, test case design, implementation using c++ and testing use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle.	

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Text Book (s)	
1	Ian Sommerville, Software Engineering,Tenth edition,pearson education,2017
2	Roger S.Pressman and Bruce Maxim, Software Engineering – A Practitioner's Approach, Ninth Edition, Mc Graw-Hill Education,2019
Reference (s)	
1	Ivar Jacobson, Object Oriented Software Engineering: A Use Case Driven Approach,First Edition,2007
2	Shari Lawrence Pfleeger and Joanne M. Atlee, Software Engineering: Theory and Practice, Fourth Edition, Pearson Education India, 2011.
3	D. E. Knuth, "The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3", Third Edition, Mathematical Science Publishers, 1997.
4	Michael A. Nielsen and Isaac L. Chuang ,"Quantum Computation and Quantum Information",2006

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Regulation 2018		Semester III	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC205J	SOFTWARE ENGINEERING	3	0	2	4

Prerequisite Course (s)

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Gain knowledge about the various phases in a software development life cycle.
2	Understand the basic of software requirements, project management and cost estimation.
3	Learn the metrics and models used to estimate the software quality and reliability.
4	Understand the various methodologies in software design using case tools.
5	Learn various testing strategies used to identify faults and failures in software development.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Explain the various phases in a software development life cycle.
CO2	Elucidate the software requirement specification and cost estimation for a project management.
CO3	Utilize the metrics and models for estimating the software quality and reliability.
CO4	Develop software using object oriented case tools for a real time application.
CO5	Explain various testing techniques used in verification and validation of a software.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	1	2	2	2	2	2	2	1
CO2	3	3	2	2	2	1	1	2	2	2	2	2	2	1
CO3	3	3	2	2	2	1	1	2	2	2	2	2	2	1
CO4	3	3	3	2	2	1	1	2	2	2	2	2	2	1
CO5	3	3	2	2	2	1	1	2	2	2	2	2	2	1
CO (Avg)	3	2.8	2.2	2	2	1.2	1	2	2	2	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I INTRODUCTION 9

Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline, Basic concepts of life cycle models – different models and milestones.

UNIT II SOFTWARE PROJECT MANAGEMENT AND COST ESTIMATION 9

Software project planning – identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort, Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets, requirements documentation through use cases. Software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting, introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management.

UNIT III SOFTWARE QUALITY AND RELIABILITY 9

Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm model. Introduction to software reliability, reliability models and estimation, introduction to software metrics and metrics based control methods, measures of code and design quality.

UNIT IV OBJECT ORIENTED ANALYSIS, DESIGN AND CONSTRUCTION 9

Introduction to UML, Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object oriented construction principles, object oriented metrics.

UNIT V SOFTWARE TESTING 9

Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

Contents for Further Reading

Software quality models like FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI).

LIST OF EXPERIMENTS 15

Development of requirements specification, function oriented design using SA/SD, object-oriented design using UML, test case design, implementation using C++ and testing. Use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle. Develop the software using software engineering methodology and for each experiment prepare the following documents

- Problem Analysis and Project Planning.
- Software Requirement Analysis.

- Data Modelling.
- Software Development and Debugging
- Software Testing.

1. Course Registration System
2. Student marks analysing system
3. Online ticket reservation system
4. ATM system
5. Stock maintenance
6. Quiz System
7. Expert system to prescribe the medicines for the given symptoms
8. Remote computer monitoring

Text Book (s)	
1	Ian Sommerville, Software Engineering, Tenth Edition, Pearson Education, 2017
2	Roger S. Pressman and Bruce Maxim, Software Engineering – A Practitioner's Approach, Ninth Edition, Mc Graw-Hill Education, 2019.

Old edition

old edition

Reference (s)	
1	Ivar Jacobson, Object Oriented Software Engineering: A Use Case Driven Approach, First Edition, 2007.
2	Shari Lawrence Pfleeger and Joanne M. Atlee, Software Engineering: Theory and Practice, Fourth Edition, Pearson Education India, 2011.
3	Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Development Process, First Edition, Addison-Wesley, 2012.

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Regulation 2018		Semester III	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
B	18MAB209T	OPERATIONS RESEARCH	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Apply the fundamental concepts of operations research and solving techniques in linear programming to the decision - making processes in Management and Engineering
2	Acquire the knowledge in Optimization techniques in Transportation and Assignment problems and apply in decision making problems
3	Analyze the results and propose recommendations for CPM,PERT techniques and Inventory models
4	Understand and apply the methodologies of the Queueing theory
5	Apply the simulation techniques in Management and Engineering

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Understand the basic concepts of operational research techniques from the verbal description of the real system
CO2	Understand the mathematical tools that are needed to solve optimization problems for transhipment problems.
CO3	Understand the concepts of network use PERT and CPM techniques to plan, schedule and control project activities
CO4	Identify and apply the queuing methodologies to optimize the result of the waiting line
CO5	Understand the fundamental concepts related to random number generation in simulation techniques

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	2	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
CO (Avg)	2.6	2.2	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I — LINEAR PROGRAMMING — 9

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Basic concepts, Special cases – infeasibility, unboundedness, redundancy and degeneracy, Sensitivity analysis. Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations. Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

UNIT II — TRANSPORTATION AND ASSIGNMENT PROBLEMS — 9

TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced &unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.

AP - Examples, Definitions – decision variables, constraints, formulation, Balanced &unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

UNIT III — PERT – CPM AND INVENTORY CONTROL — 9

Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off. Inventory Control: Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed orderquantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness.

UNIT IV — QUEUING THEORY — 9

Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behavior ,Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures.

UNIT V — SIMULATION METHODOLOGY — 9

Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

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Text Book (s)	
1	Operations Research: An Introduction. H.A. Taha, Pearson, 10th Edition, 2017.
Reference (s)	
1	Linear Programming. K.G. Murthy.
2	Linear Programming. G. Hadley
3	Principles of OR with Application to Managerial Decisions. H.M. Wagner.
4	Introduction to Operations Research. F.S. Hiller and G.J. Lieberman.
5	Elements of Queuing Theory. Thomas L. Saaty.
6	Operations Research and Management Science, Hand Book: Edited By A. Ravi Ravindran
7	Management Guide to PERT/CPM. Wiest& Levy.
8	Modern Inventory Management. J.W. Prichard and R.H. Eagle

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Regulation 2018		Semester III	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC206L	OBJECT ORIENTED PROGRAMMING LABORATORY	0	0	2	1

Prerequisite Course (s)

Programming Fundamentals

Course Objective (s):
The purpose of learning this course is to:

1	To study about different UML diagrams.
2	To familiarize with constructors, inheritance, polymorphism, templates and exception handling.
3	To develop applications using files in C++.
4	Able to make use of objects and classes for developing programs.
5	Able to use various object oriented concepts to solve different problems.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Understand the different UML diagrams.
CO2	Apply object oriented programming concepts to solve real time problems.
CO3	Employ the concepts of constructors, inheritance and polymorphism.
CO4	Develop software applications using templates, exception handling and files in C++.
CO5	Apply virtual and pure virtual function & complex programming situations.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	2	-	3	2
CO2	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	2
CO4	3	3	3	3	3	-	-	-	-	-	3	-	2	2
CO5	3	3	3	3	3	-	-	-	-	-	3	-	3	2
CO (Avg)	3	3	3	3	3	-	-	-	-	-	2.8	-	2.8	2.2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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LIST OF EXPERIMENTS	30
1. Study of different UML diagrams	
2. Programs on concept of classes and objects	
3. Programs using friend functions	
4. Programs using static polymorphism	
5. Programs using constructors	
6. Programs using inheritance	
7. Programs on dynamic polymorphism	
8. Programs on exception handling	
9. Programs on generic programming using template function & template class	
10. Programs on file handling	

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Regulation 2018		Semester III	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM201L	COMPETENCIES IN SOCIAL SKILLS	0	0	2	1

Prerequisite Course (s)
NIL

Course Objective (s):
The purpose of learning this course is to:

1	To sharpen problem solving skill and to improve thinking capability of the students.
2	To hone soft skill and analytical ability of students.
3	To engage learners in using language purposefully and cooperatively.
4	To expertise the writing and presentation skill to fulfill the corporate expectations.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Students should be able to solve both analytical and logical problems in an effective manner.
CO2	Students can design and deliver information in a proper manner.
CO3	Presentation skills of students will be improved individually as well as a team member.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3	-	-	-	-	-	-	-	2	2	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**Module - 1**	**6**
Aptitude: Coding & Decoding - Direction Sense Test. **Communication:** Self-Introduction and SWOT analysis - Letter writing - types.		
UNIT II	**Module - 2**	**6**
Aptitude: Venn Diagrams - Data Interpretation. **Communication:** Phrasal verbs - Voice of Valluvar.		
UNIT III	**Module - 3**	**6**
Aptitude: Averages. **Communication:** Idioms and Phrases - Skits.		
UNIT IV	**Module - 4**	**6**
Aptitude: Time and Distance - Problems on Trains. **Communication:** Prefix/Suffix - Root words - Adjectives - JAM (Extempore Speech).		
UNIT V	**Module - 5**	**6**
Aptitude: Clocks & Calendars. **Communication:** Homophones - Frame Tales.		

Text Book (s)	
1	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

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Regulation 2018		Semester III / IV	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18CYM201T	ENVIRONMENTAL SCIENCE	1	0	0	-

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To demonstrate in-depth knowledge within environmental engineering and an awareness of social, economic, political, and environmental impacts of engineering practices.
2	To have competence for working with multi-disciplinary teams to arrive at solutions to environmental engineering problems.
3	To get solutions which will minimize the negative impact of human activities on the environment and to protect human health.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Improve fundamental knowledge of the inter-relationships between the built environment and natural systems.
CO2	Characterize and mitigate man-made hazards like nuclear hazards. Understand the principles involved in the generation of different forms of energy.
CO3	Improve the reliability, performance, disaster-management of natural calamities and solid waste and water supplies and treatment processes.
CO4	Understand the source, effects and control measure of various environmental pollution.
CO5	Apply information technology in the control of human population, women and child welfare.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	2	-	-	-	3	3	-	-	-	-	-	-	-
CO3	-	2	-	2	-	3	3	-	-	-	-	-	-	-
CO4	-	2	-	-	-	3	3	2	-	-	-	-	-	-
CO5	-	2	-	2	-	3	3	-	-	-	-	-	-	-
CO (Avg)	-	2.00	-	2.00	-	3.00	3.00	2.00	-	-	-	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	**ENVIRONMENT& BIODIVERSITY**	**3**
Definition-types of environment, components of environment, scope-importance of environmental studies- Bio diversity-definition-value of biodiversity-Threats to biodiversity - India a mega diversity nation-endangered and endemic species of India-conservation of biodiversity.		
UNIT II	**ENERGY SOURCES**	**3**
Energy resources- Growing energy needs- Renewable and Nonrenewable energy sources- Use of alternate energy sources - Nuclear Energy- Alternative energy fuels-power alcohol-Bio diesel (preparation, properties &uses)		
UNIT III	**SOCIAL ISSUES AND ENVIRONMENT**	**3**
Environment ethics – Climate change – Global warming – Acid rain – Ozone layer depletion – Nuclear accidents-holocaust. Solid waste management - Rain water Harvesting-watershed management		
UNIT IV	**ENVIRONMENTAL POLLUTION & ACTs**	**3**
Source, types, effects & control- Air pollution -Water pollution – Soil pollution – Marine pollution and Plastic Pollution -The Environment (Protection) Act - Air (Prevention and control of pollution) Act - Water (Prevention and control of pollution) Act- Role of individual in prevention of pollution.		
UNIT V	**HUMAN POPULATION AND ENVIRONMENT**	**3**
Sustainable development – Urban Population growth and distribution – Population explosion – Family Welfare Program –Women and child welfare- Role of information technology in environment and human health- case studies		

Text Book (s)	
1	Dr.J.P.Sharma, "Environmental studies", Laxmi Publications(p) Ltd, New Delhi.
2	Miller "Environmental Science" 11th Edition, Cengage Learning India Private Limited, New Delhi, (2006).

Reference (s)	
1	Master. G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt Ltd., (2004)
2	Dr.A.Ravikrishnan " Environmental Science and Engineering " Sri Krishna publications, Chennai(2015)
3	P.Anandan, R.Kumaravelan "Environmental Science and Engineering" Scitech Publication (India) Pvt. Ltd, Chennai, Reprint 2009.

Regulation 2018		Semester IV	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC207T	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To discuss the fundamentals of data models to conceptualize and depict a database system using ER diagram.
2	To illustrate the relational database implementation using SQL with effective relational database design concepts.
3	To explain the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure.
4	To demonstrate Query evaluation and optimization techniques.
5	To introduce the concepts of Database Security, Object Oriented, Data Warehousing and Data Mining.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Distinguish database systems from file systems and describe data models and DBMS architecture.
CO2	Identify the basic issues of transaction processing and concurrency control.
CO3	Demonstrate with understanding of SQL Programming language and normalization theory.
CO4	Practice the query evaluation techniques, query optimization and familiar with basic database storage structures and access techniques.
CO5	Analyze and derive an information model expressed in the form of an entity relation diagram and transform into a relational database schema.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	1	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	1	-	2	2
CO3	3	3	3	2	-	-	-	-	-	-	1	-	2	2
CO4	3	3	3	2	-	-	-	-	-	-	1	-	2	2
CO5	3	3	3	2	-	--	-	-	-	-	1	-	2	2
CO (Avg)	3	3	2.8	2	-	-	-	-	-	-	1		2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION**	**9**
Introduction to Database: Hierarchical, Network and Relational Models - Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML)		
UNIT II	**DATA MODELS**	**9**
Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations - Relational query languages: Relational algebra, Tuple and domain relational calculus,SQL3, DDL and DML constructs, Open source and Commercial DBMS – MYSQL MongoDB, ORACLE, DB2, SQL server		
UNIT III	**RELATIONAL DATABASE DESIGN**	**9**
Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design - Query processing and optimization: Evaluation of relational algebra expressions, Queryequivalence, Join strategies, Query optimization algorithms		
UNIT IV	**STORAGE STRATEGIES**	**9**
Indices, B-trees, Hashing - Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery		
UNIT V	**DATABASE SECURITY**	**9**
Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection - Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.		

Text Book (s)	
1	Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.
2	Principles of Database and Knowledge – Base Systems, Vol 1 by J. D. Ullman.

Reference (s)	
1	Fundamentals of Database Systems. R. Elmasri and S. Navathe.
2	Foundations of Databases. Serge Abiteboul, Richard Hull, Victor Vianu.

Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC208J	OPERATING SYSTEMS	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To recognize the fundamentals of operating systems.
2	To describe the mechanisms of OS to handle processes and threads and their Communication.
3	To discuss the principles of concurrency and Deadlocks.
4	To identify the mechanisms involved in memory management and its schemes.
5	To identify I/O management, File systems and security issues.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Identify the basic concepts and design issues of operating systems.
CO2	Apply Process management concepts including scheduling, Inter process communication, deadlocks and multithreading in real world problems.
CO3	Apply concepts of memory management including Virtual Memory and Page Replacement to the issues that occur in Real time applications.
CO4	Apply the concept of Concurrent Programming.
CO5	Identify issues related to IO hardware, file system and disk management.

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	-	-	1	-	1	-
CO2	3	2	2	1	1	-	-	-	-	-	1	-	1	-
CO3	3	2	2	1	1	-	-	-	-	-	1	-	2	-
CO4	3	2	2	1	1	-	-	-	-	-	1	-	2	-
CO5	3	2	2	1	1	-	-	-	-	-	1	-	2	-
CO (Avg)	3	2.2	2	1	1	-	-	-	-	-	1	-	1.6	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	INTRODUCTION	9
Concept of Operating Systems (OS), Generations of OS, Typesof OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS		
UNIT II	**PROCESSES, THREAD, PROCESS SCHEDULING**	**9**
Processes: Definition, Process Relationship, Different states of a Process, Process Statetransitions, Process Control Block (PCB), Context switching - Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads - Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers - Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time - Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF		
UNIT III	**INTER-PROCESS COMMUNICATION**	**9**
Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem - Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery		
UNIT IV	**CONCURRENT PROGRAMMING**	**9**
Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery - Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction - Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Localityof reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, PageReplacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Notrecently used (NRU) and Least Recently used (LRU)		
UNIT V	**I/O HARDWARE, FILE AND DISK MANAGEMENT**	**9**
I/O devices, Device controllers, Direct Memory Access, Principles of I/O - File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance - Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. **Case study:** UNIX OS file system, shell, filters, shell programming, programm[illegible] the standard I/O, UNIX system calls.		

LIST OF EXPERIMENTS	**15**

1. Analysis and Synthesis of Basic Linux Commands
2. Programs using Shell Programming
3. Implementation of Unix System Calls
4. Simulation and Analysis of Non pre-emptive and Pre-emptive CPU Scheduling Algorithms
5. Simulation of Producer – Consumer Problem using Semaphores and Implementation of Dining Philosopher's Problem to demonstrate Process Synchronization
6. Simulation of Banker's Algorithm for Deadlock Avoidance
7. Analysis and Simulation of Memory Allocation and Management Techniques
8. Implementation of Page Replacement Techniques
9. Simulation of Disk Scheduling Algorithms
10. Implementation of File organization Techniques.

Text Book (s)	
1	Operating System Concepts Essentials. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.
2	Operating Systems: Internals and Design Principles. William Stallings

Reference (s)	
1	Operating System: A Design-oriented Approach. Charles Patrick Crowley.
2	Operating Systems: A Modern Perspective. Gary J. Nutt.
3	Design of the Unix Operating Systems. Maurice J. Bach.
4	Understanding the Linux Kernel, Daniel Pierre Bovet, Marco Cesati.

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Regulation 2018		Semester IV	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC209J	SOFTWARE DESIGN WITH UML	3	0	2	4

Prerequisite Course (s)

Software Engineering

Course Objective (s):
The purpose of learning this course is to:

1	Know the importance of modeling in the software development life cycle.
2	Understand the object-oriented analysis approach for system requirement and analysis.
3	Identify the elements required for characterization and design of an interactive model.
4	Understand the design methods for building user interface UML system.
5	Learn to interface the UML design with a database application system.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Exemplify the software development process models and standards in software development.
CO2	Elucidate use case design and its association with requirement analysis.
CO3	Explain the design and dependencies of an object oriented model using interaction diagrams.
CO4	Apply various software design methods and components to develop an interactive system.
CO5	Explain the UML design for building an interface for real-time database application.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	1	1	1	1	2	1
CO2	3	2	2	2	1	1	-	-	2	2	2	1	2	1
CO3	3	3	3	2	1	1	-	-	2	2	2	1	2	1
CO4	3	3	3	2	1	1	-	-	2	2	2	1	2	1
CO5	3	2	1	1	1	-	-	-	1	1	1	1	2	1
CO (Avg)	3	2.4	2	1.8	1	0.6	-	-	1.6	1.6	1.6			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION TO UML METHOD AND LANGUAGE**	**9**
Software development process: The Waterfall Model vs. The Spiral Model -The Software Crisis, description of the real world using the Objects Model - Classes, inheritance and multiple configurations - Quality software characteristics - Description of the Object Oriented Analysis process vs. the Structure Analysis Model - Introduction to the UML Language: Standards, Elements of the language, General description of various models, The process of Object Oriented software development, Description of Design Patterns, Technological Description of Distributed Systems		
UNIT II	**REQUIREMENTS ANALYSIS USING CASE MODELING**	**9**
Analysis of system requirements, Actor definitions, Writing a case goal, Use Case Diagrams, Use Case Relationships - Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams- Description of goal, Defining UML Method, Operation, Object Interface, Class - Sequence Diagram, Finding objects from Flow of Events, Describing the process of finding objects using a Sequence Diagram, Describing the process of finding objects using a Collaboration Diagram		
UNIT III	**THE LOGICAL VIEW DESIGN STAGE**	**9**
Static Structure Diagrams: The Class Diagram Model, Attributes descriptions, Operations descriptions, Connections descriptions in the Static Model, Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity - Package Diagram Model: Description of the model, White box, black box, Connections between packagers, Interfaces, Create Package Diagram, Drill Down		
UNIT IV	**DYNAMIC MODEL**	**9**
State Diagram / Activity Diagram: Description of the State Diagram, Events Handling, Description of the Activity Diagram, Exercise in State Machines - Component Diagram Model: Physical Aspect, Logical Aspect, Connections and Dependencies, User face, Initial DB design in a UML environment		
UNIT V	**DEPLOYMENT MODEL**	**9**
Processors, Connections, Components, Tasks, Threads, Signals and Events		
	LIST OF EXPERIMENTS	**15**
To develop a mini-project by following the 9 exercises listed below. 1. To develop a problem statement. 2. Identify Use Cases and develop the Use Case model. 3. Identify the conceptual classes and develop a domain model with UML Class diagram. 4. Using the identified scenarios find the interaction between objects and represent them using UML Sequence diagrams. 5. Draw relevant state charts and activity diagrams. 6. Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation. 7. Develop and test the Technical services layer. 8. Develop and test the Domain objects layer. 9. Develop and test the User interface layer.		

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Suggested domains for Mini-Project:

1. Passport automation system.
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system

Text Book (s)	
1	Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: using UML, Patterns, and Java", Pearson, 3rd Edition, 2013
2	Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education, 3rd Edition, 2005

Reference (s)	
1	Erich Gamma, Richard Helm, Ralph Johnson, John M. Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software", Pearson, 2012
2	Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", 7th Edition, Tata McGraw Hill, 2015
3	Martin Fowler, Kendall Scott, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Addison Wesley, 3rd Edition, 2003
4	Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Ph.D., Jim Conallen Kelli A. Houston, "Object Oriented Analysis and Design with Applications", Addision - Wesely, 3rd Edition, 2007
5	Freeman, Eric & Robson, Elisabeth, "Head First Design Patterns" 1st Edition, O'Reilly, 2004

Regulation 2018		Semester IV	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18CBH103J	BUSINESS COMMUNICATION & VALUE SCIENCE – III	1	0	2	2

Prerequisite Course (s)

Basic Knowledge of English (Verbal and written) Completion of all units from semesters1, 2 and 3.

Course Objective (s):
The purpose of learning this course is to:

CLR-1	Introduce self-analysis techniques like SWOT &TOWS.
CLR-2	Introduce the key concepts of pluralism, cultural spaces and sensitise the cross-cultural communication.
CLR-3	Develop the Science of Nation building.
CLR-4	Understand Artificial Intelligence in daily life.
CLR-5	Develop technical writing skills.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Apply & analyze the basic principles of SWOT & life positions, understand, analyze and leverage the power of motivation in real life.
CO2	Analyze, Understand pluralism in cultural spaces, concepts of global and glocal, roles and relations of different genders, diverse cultures of India, cross cultural communication and Identify the common mistakes made in cross-cultural communication.
CO3	Apply the Science of Nation building.
CO4	Understand Artificial intelligence and recognize its impact in daily life.
CO5	Identify the best practices of technical writing and apply technical writing in real life scenarios.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	1	-	2	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	-	-	-
CO (Avg)	-	-	-	-	-	-	-	-	1.25	1.6	-	1.25	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	SWOT AND TOWS	6
	REUNION – Recap activity on the earlier learning - Summarize the basic principles of SWOT and Life Positions – Apply SWOT in real life scenarios - Pat your back activity – strength will be written by others – Create your SWOT – SWOT Vs. TOWS The Balancing Act- Group Presentations on what are the strengths they have identified to survive in the VUCA World- Recognize how motivation helps real life – Motivation Stories - Maslow's Theory – Leverage motivation in real life scenarios –Scenario based activity on identifying and leveraging motivation.	
UNIT II	PLURALISM, CROSS CULTURE AND GENDER AWARENESS	6
	Identifying Pluralism in cultural spaces - Rivers of India - Awareness and respect for pluralism in cultural spaces -Differentiate between the different cultures of India- Rhythms of India (Cultures in India) - Define the terms global, glocal and translocational- Differentiate between global, glocal and translocational culture- Debate on Global and global impacts- Cross – cultural communication – Recognize the implications of cross - cultural communication - Apply cross cultural communication – Identify the common mistakes made in cross – cultural communication- Gender awareness –Gender awareness campaign – Differentiate between the roles and relations of different genders – Quiz Time	
UNIT III	ROLE OF SCIENCE IN NATION BUILDING	6
	Role of science in nation building - Introduce the topic and discuss the role of scientists and mathematicians from ancient India – Summarize the role of science in nation building – Role of science in pre and post - independence.	
UNIT IV	ARTIFICIAL INTELLIGENCE	6
	Define AI (Artificial Intelligence) - "Voice of the Future" Activity- Recognize the importance of AI-AI in Everyday Life- -Design your college in the year 2090- Communicating with machines -debate related to Artificial Intelligence in the presence of an external moderator.	
UNIT V	TECHNICAL WRITING	6
	Introduction to technical writing- Basic rules of technical writing through examples- Identify the best practices of technical writing- Practice activity on technical writing- Apply technical writing in real-life scenarios- Applying technical writing in profession-Assessment on technical writing on certain topic- Project- Visit rural area/ underprivileged parts of city to address some of the local issues; if relevant, suggest a practical technology solution to the issues	
	LAB ACTIVITIES	15

1. SWOT Vs TOWS
2. The Balancing act TED talks on Biomimicry and stories
3. You tube video on Maslow's Theory
4. Rhythms of India (Cultures in India)- Presentation
5. Cross-Cultural Communication (Debate & Group Discussion)
6. Role of Science in Nation Building
7. Role of Science in Nation Building (Post-Independence)
8. AI in everyday life (Presentation)
9. Design your college in the year 2090
10. Technical Article writing

Text Book (s)

There are no prescribed texts for semester 4-there will be handouts and reference links shared.

Reference (s)

1	Raman, Meenakshi and Sangeeta Sharma, Fundamentals of Technical Communication.(2014)
2	Fine, Lawrence G. The SWOT Analysis: Using your strength to overcome Weakness, Using Opportunities to Overcome Threats.(2009)
3	Gerald.J.Alred,Charles T. Brusaw,Walter E.Oliu,Bedford/St.Martin's Boston, Newyork, Handbook of Technical Writing .(2009)
4	Liz Hamp-Lyons and Ben Heasly, Study Writing,Cambridge University Pres.2006
5	Sanjay Kumar and PushpLata, Communication Skills.OxfordUniversity Press. 2011.
6	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. OxfordUniversity Press

Web References

1	Examples of Technical Writing for Students https://freelance-writing.lovetoknow.com/kinds-technical-writing
2	11 Skills of a Good Technical Writer https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a- good-technical writer/
3	13 benefits and challenges of cultural diversity in the workplace https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/

Online References

1	https://youtu.be/CsaTslhSDI
2	https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3	https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4	https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5	https://www.youtube.com/watch?app=desktop&v=7sLLEdBgYYY&feature=youtu.be

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Regulation 2018		Semester IV	Total Hours			30
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
S	18MBS201T	FUNDAMENTALS OF MANAGEMENT	2	0	0	2

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Understand the Management Theories.
2	Explain the Functions of Management.
3	Provide insights on Organizational Design and Organizational Behaviour.
4	Understand the Managerial Ethics.
5	Emphasize on Leadership and its aspects.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Apply the various Management Theories.
CO2	Identify the various Functions of Management.
CO3	Exhibit the apt Organizational Behaviour.
CO4	Follow the Managerial and Work Ethics.
CO5	Demonstrate Leadership Quality and Skills.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-	-	-	1	1	1	1
CO2	-	-	-	-	-	-	1	-	-	-	1	1	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO (Avg)	1	1	-	-	-	-	1	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]

1: Slight (Low) **2: Moderate (Medium)** **Substantial (High)**

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UNIT I	**MANAGEMENT THEORIES**	6
Concept and Foundations of Management-Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880)-Classical management Era (1880-1930)-Neo-classical Management Era (1930-1950)-Modern Management era (1950-on word)-Contribution of Management Thinkers - Taylor, Fayol and Elton Mayo.		
UNIT II	**FUNCTIONS OF MANAGEMENT**	6
Importance of Management-Planning-Organizing-Staffing-Directing-Controlling		
UNIT III	**ORGANIZATIONAL BEHAVIOUR AND DESIGN**	6
Introduction-Personality, Perception-Learning and Reinforcement-Motivation-Group Dynamics, Power &Influence-Work Stress and Stress Management Classical- Neoclassical and Contingency approaches to organizational design- Organizational theory and design-Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)		
UNIT IV	**MANAGERIAL ETHICS**	6
Ethics and Business- Ethics of Marketing & advertising-Ethics of Finance & Accounting, Decision – making .Frameworks-Business and Social Responsibility-International Standards-Corporate Governance-Corporate Citizenship-Corporate Social Responsibility		
UNIT V	**LEADERSHIP**	6
Concept-Nature-Importance-Attributes of a leader- Types of Leadership - developing leaders across the organization-Leadership Grid		

Text Book (s)	
1	Stephen Robbins, Mary Coulter ,David de Cenzo-Fundamentals of Management- 9th edition

Reference (s)	
1	Richard L. Daft, Understanding the Theory and Design of Organizations 11th Edition
2	Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior 18th edition

Regulation 2018		Semester IV	Total Hours			45
			Hours / Week			
Category	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
S	18MBS202T	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Introduction to the fundamentals of technology innovation, intellectual property rights and entrepreneurship.
2	Identifying and discovering market needs.
3	Understanding the management of innovation program.
4	Identifying the ways to create, protect, assertive and commercialize intellectual property.
5	Provide insights on opportunities and challenges for entrepreneurs.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Understand the fundamentals of innovation, intellectual property rights and Entrepreneurship.
CO2	Identify the different types of needs in the market.
CO3	Understand the concept of innovation.
CO4	Know about intellectual property.
CO5	Know about the opportunities and challenges for entrepreneurs.

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-	-	-	1	1	-	1
CO2	-	-	-	-	-	-	1	-	-	-	1	1	-	-
CO3	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	-	-	-	-	-	-	-	-	-	-	1	1	-	1
CO (Avg)	1	1	-	-	-	-	1	-	-	-	1	1	[illegible]	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO INNOVATION	9
Understanding Innovation- Nature of Innovation -Types of Innovation – Lifecycle of Innovation– Innovation Assessment – Challenges in Innovation–Co innovation and Open Innovation		
UNIT II	**INTELLECTUAL PROPERTY**	**9**
Intellectual Property-Intellectual Property Rights – Types of IPR – Lifecycle of IP– Balancing IP risks and Rewards- IP valuation- Measurement of Operational Risk		
UNIT III	**INTRODUCTION TO TECHNOLOGY ENTREPRENEURSHIP**	**9**
Understanding Technology Entrepreneurship-Opportunity Identification in Technology Entrepreneurship - Technology-driven Social Innovation and Entrepreneurship- Types of Technology Entrepreneurship-Technology Innovation: Two Case Studies		
UNIT IV	**FORECASTING**	**9**
Needs for Forecasting – Types of Forecasting – Forecasting Method – Forecasting Costs – Forecasting Error – Approaches		
UNIT V	**INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP: PRACTISING PRINCIPLES**	**9**
Market Research, Segmentation and Sizing –Product Positioning, Pricing, and Go-To-Market Strategy-Start-up Business Models-Innovation, Incubation and Entrepreneurship in Corporate Context - Manage Innovation, IP and Entrepreneurship Programs – Processes, Governance and Tools		

Text Book (s)	
1	Innovation, Intellectual Property and Entrepreneurship by Gopal Menon | G Hari Kishore | K Subodh Kumar |Volume 8 Issue 4

Reference (s)	
1	Entrepreneurial Development by SS Khanka 1st Edition
2	Intellectual Property and Innovation Management in Small Firms by Robert.A.Blackburn 1st Edition
3	Intellectual Property, Design Innovation and Entrepreneurship by Matthias Hilner 1st Edition

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Regulation 2018		**Semester IV**	**Total Hours**			**30**
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
C	18CBC210L	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	2	1

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To design database using ER diagram.
2	To illustrate the relational database implementation using SQL.
3	To demonstrate procedural extensions such as procedure, function, cursors and Triggers.
4	To develop application using front end and back end.
5	To explain cloud storage for real time systems.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Sketch ER diagrams for real world applications.
CO2	Select suitable SQL commands to manage the database.
CO3	Create databases using MongoDB.
CO4	Design front end and back end for enterprise applications.
CO5	Analyze and Select storage and recovery techniques of database system.

CO-PO Mapping

COs	**Pos**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	2
CO (Avg)	3	3	3	2.4	2.8	-	-	-	-	-	-	-	3	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

LIST OF EXPERIMENTS 30

1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views
7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)
8. Application Development using front end tools
9. Document Database creation using MongoDB
10. Study of Cloud Storage
    i)IT Training Group Database
    ii) Blood Donation System
    iii)Salary Management System
    iv)Traffic Light Information System

Regulation 2018		Semester IV	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18MBM202L	CRITICAL AND CREATIVE THINKING SKILLS	0	0	2	1

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To focus on listening, speaking, & writing skills through audio & video sessions.
2	To hone soft skill and analytical ability of students.
3	To overcome the fear in group communication and to provide the effective communication.
4	To expertise intelligible pronunciation, stress and intonation patterns.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Students can be able to solve both analytical and logical problems in an effective manner.
CO2	Students can demonstrate an ability to design and deliver messages.
CO3	The quality of student's communication with practical experience is improved.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO (Avg)	3	-	-	-	-	-	-	-	-	2	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**Module - 1**	6
Aptitude: Time and Work - Pipes and Cisterns. **Communication:** Sentence Pattern - Debate.		
UNIT II	**Module - 2**	6
Aptitude: Boats and Streams. **Communication:** Tenses and voices - Tech Talk.		
UNIT III	**Module - 3**	6
Aptitude: Problems on Ages - Probability **Communication:** Analogies - Biography.		
UNIT IV	**Module - 4**	6
Aptitude: Data sufficiency - Logical Puzzles. **Communication:** Punctuation - Connection.		
UNIT V	**Module - 5**	6
Aptitude: Mensuration. **Communication:** Preposition - News of the Week.		

Text Book (s)	
1✓	Dr.R.S.Aggarwal, "Quantitative Aptitude", S. Chand & Company Limited, 2015
2✓	Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non - Verbal Reasoning", S. Chand & Company Limited, 2015

Regulation 2018		Semester III / IV	Total Hours			15
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
M	18LEM103T	INDIAN TRADITION AND HERITAGE	1	0	0	-

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

CLR-1:	Make students understand the role and impact of culture in human life.
CLR-2:	Draw attention towards languages and literatures of ancient period.
CLR-3:	Cultivate secularism in students.
CLR-4:	Equip students with the knowledge of Indian art and architectural evolution over years.
CLR-5:	Make students identify Indian culture in abroad.

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO1	Understand the meaning of culture, trace the influence and significance of geographical features on Indian culture.
CO2	Develop an awareness of the variety of languages and literatures in India.
CO3	Recognise the characteristics of various religious movements in ancient India.
CO4	Identify the characteristics and various styles of Indian architecture and sculpture at different times.
CO5	Examine various modes through which Indian culture spread abroad.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	2	2	2	-	2	-	-
CO2	-	-	-	-	-	2	2	1	2	2	1	2	-	-
CO3	-	-	-	-	-	1	1	1	1	1	1	1	-	-
CO4	2	2	2	2	2	2	2	2	2	2	1	2	-	-
CO5	-	-	-	-	-	2	2	2	2	2	-	2	-	-
CO (Avg)	2	2	2	2	2	1.8	1.8	1.6	1.8	1.8	1	1.8	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	**HISTORY OF INDIAN CULTURE**	**2**
Characteristics of Indian Culture - Significance of Geography on Indian Culture -Society in India through ages- Ancient Period - Varna and Jati, family and marriage in India - Position of women in ancient India- Contemporary period; Caste system and communalism.		
UNIT II	**LITERATURE AND EDUCATION**	**4**
Evolution of script and languages in India : Harappan Script and Brahmi Script, Short History of the Sanskrit Literature: The Vedas, The Brahmanas and Upanishads and Sutras, Epics: Ramayana and Mahabharata & Puranas - History of Buddhist and Jain Literature in Pali, Prakrit and Sanskrit, Sangam Literature and Odia Literature.		
UNIT III	**RELIGION AND PHILOSOPHY**	**4**
Religion and Philosophy in India: Ancient Period: Pre-Vedic and Vedic Religion, Buddhism and Jainisim, Indian Philosophy - Vedanta and Mimansa school of Philosophy.		
UNIT IV	**ART AND ARCHITECTURE**	**2**
Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Budhhist Architecture, Medieval Architecture and Colonial Architecture, Indian Painting Tradition, Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India, Rise of modern theatre and Indian cinema.		
UNIT V	**SPREAD OF INDIAN CULTURE ABROAD**	**3**
Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World through ages.		

Reference (s)	
1	Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): *The Trading World of the Indian Ocean, 1500-1800* (*History of Science, Philosophy and Culture in Indian Civilization*, ed. by D.P. Chattopadhyaya, vol. III, 7), Pearson, Delhi, 2012.

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Regulation 2018		Semester V	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
C	18CBC301T	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3

Prerequisite course

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Learn and understand the algorithm analysis techniques and complexity notations.
2	Become familiar with the different algorithm design techniques for effective problem solving in computing.
3	Learn to apply the design techniques in solving various kinds of problems in an efficient way.
4	Understand the limitations of algorithm power.
5	Solve variety of problems using different approximation algorithms.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Understand the basic techniques such as space & time complexity, asymptotic notations for analyzing the algorithms
CO 2	Analyze the fundamentals of Algorithmic strategies for problem solving in computing.
CO 3	Apply the Graph and Tree algorithms on computing Problems.
CO 4	Determine the computability of an algorithms
CO 5	Choose the approximation algorithms, randomized algorithms for an optimization problem.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	1	1	3	2
CO2	2	3	2	2	-	-	-	-	-	-	1	1	3	3
CO3	2	3	2	2	-	-	-	-	-	-	1	1	3	3
CO4	2	3	2	2	-	-	-	-	-	-	1	1	3	3
CO5	1	2	2	2	-	-	-	-	-	-	1	1	3	3
CO	3	3	2	2	-	-	-	-	-	-	1	1	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	INTRODUCTION	9
Characteristics of Algorithm. Analysis of Algorithm: Performance Measurements of Algorithm, Time and Space Trade-Offs, Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.		
UNIT 2	FUNDAMENTALS OF ALGORITHMIC STRATEGIES	9
Brute-Force, Heuristics, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem Solving, Bin Packing, Knapsack, Travelling Salesman Problem.		
UNIT 3	GRAPH AND TREE ALGORITHMS	9
Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms; Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.		
UNIT 4	TRACTABLE, INTRACTABLE PROBLEMS	9
Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.		
UNIT 5	ADVANCED TOPICS	9
Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.		
	Total Periods	45

Text Book (s)

1	E. Horowitz and S. Sahni., "Fundamental of Computer Algorithms", Second Edition, Computer Science Press, 2008.
2	A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", Fourth edition, Pearson India, 2009.

Reference (s)

1	T. H. Cormen, C. E. Leiserson and R. L. Rivest, "Introduction to Algorithms", Third Edition, MIT Press, 2009.
2	S. Baase, "Computer Algorithms: Introduction to Design and Analysis", Third Edition, Pearson, 2000.
3	D.. E. Knuth, "The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3", Third Edition, Mathematical Science Publishers, 1997.
4	Michael A. Nielsen and Isaac L. Chuang ,"Quantum Computation and Quantum Information",2006
5	Anany Levitin," Introduction To The Design And Analysis Of Algorithm"3rd Edition, Pearson, 2012.

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Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC302J	COMPILER DESIGN	3	0	2	4

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Learn the design principles of a Compiler
2	Solve variety of problems using parsing techniques and different levels of translation
3	Identify the semantic analysis and symbol table.
4	Implement Architecture dependent code improvement
5	Analyze how to optimize and effectively generate machine codes.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Infer fundamentals of compiler and identify the relationships among different phases of the compiler.
CO 2	Apply the concepts of grammars and utilize different types of parsing techniques.
CO 3	Illustrate the Semantic Analysis and Symbol table.
CO 4	Construct Intermediate code generation and outline storage organization
CO 5	Examine various code optimization Techniques

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	-	2	-	-	-	-	-	-	-	3	-
CO2	3	3	3	1	2	-	2	-	-	2	-	2	3	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	1	-	-	2	-	-	-	-	2	3	-
CO5	3	3	3	1	-	-	2	-	-	2	-	2	3	-
CO	3	3	3	1	2	-	2	-	-	2	-	2	3	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	INTRODUCTION TO COMPILERS	9

Introduction- Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

UNIT 2	SYNTAX ANALYSIS	9

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL (1) grammars and top- down parsing, operator grammars, LR (O), SLR (1), LR (1), LALR (1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR (1) parser generator (yacc, bison).

UNIT 3	SEMANTIC ANALYSIS	9

Semantic Analysis- Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree, Symbol Table: Basic structure, symbol attributes and management.

UNIT 4	RUN-TIME ENVIRONMENT AND CODE GENERATION	9

Run-time environment- Procedure activation, parameter passing, value return, memory allocation,
Scope. Intermediate Code Generation: Translation of different language features, different types of intermediate forms. Register allocation and target code generation.

UNIT 5	CODE OPTIMIZATION	9

Code Improvement (optimization)- control-flow, data-flow dependence etc.; Local optimization,
Global optimization, loop optimization, peep-hole optimization etc Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory).

Total Periods	45

LIST OF EXPERIMENTS	15

1	Implementation of lexical analyzer using C and LEX TOOL
2	Implementation of a calculator that takes an expression (with digits, + and *), computes and prints its value, using YACC.
3	Implementation of Predictive parsing.
4	Implementation of Shift Reduce Parsing Algorithm.
5	Implementation of LR parsing.
6	Implementation of Symbol Table
7	Implementation of Three Address Code
8	Implementation of Code Optimization

Text Book (s)

1	Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers –Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.
2	Dick Grune Henri E.Bal,Ceriel J.H.Jacobs "Modern Compiler Design" ,Published ,2000

Reference (s)

1	Doug Brown, John Levine, and Tony Mason, "Lex & Yacc Second Edition, O'Reilly &Associates, 1995.
2	Steven S. Muchnick, Advanced Compiler Design and Implementationl, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.
3	V. Raghavan, Principles of Compiler Designl, Tata McGraw Hill Education Publishers,2010.
4	Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003.

Regulation 2018		Semester V	Total Hours			30
			Hours / Week			
Category	Course Code	Course Name	L	T	P	C
S	18MBS301T	FINANCIAL AND COST ACCOUNTING	2	0	0	2

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Understand the importance of financial and cost accounting in organization financial statements
2	Explain the corporate financial under different conditions and describe the financial statements in different manner.
3	Describe the main elements of Financial Accounting information – assets, liabilities, revenue and expenses
4	Fabricate Awareness about cost accounting, different types costing and cost management
5	Create an awareness about the importance and the usefulness of the accounting concepts and their managerial implications

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Remembering the importance and usefulness of the accounting concepts and their managerial implications.
CO 2	Illustrate the book keeping of account and learn about the cash and subsidiary book entry.
CO 3	Applying the financial statement concepts and its underlying principles & learn to interpret financial statement
CO 4	Analyzing the cash flow and fund flow statement by using its techniques and finding the difference between the cash and fund flow statement
CO 5	Interpret the costing accounting system , different types of costing and cost management

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	1	1	-	-	1	1	-	-	2	-	-	1
CO2	-	-	1	2	-	-	2	-	-	-	3	1	-	1
CO3	-	-	1	2	-	-	2	-	-	-	2	1	-	1
CO4	-	-	1	2	-	-	3	-	-	-	2	1	-	1
CO5	-	-	1	1	-	-	2	1	-	-	2	1	-	1
CO	-	-	1	2	-	-	3	1	-	-	3	1	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	**ACCOUNTING CONCEPTS**	**6**
Introduction-Techniques and Conventions, Financial Statements-Understanding & Interpreting Financial Statements.		
UNIT 2	**ACCOUNTING PROCESS**	**6**
Book Keeping, and Record Maintenance-Fundamental Principal and Double entry-Journal, Ledger, Trail Balance, Balance Sheet, Final Accounts –Cash Book and subsidiary Book-Rectification of Errors		
UNIT 3	**FINANCIAL STATEMENTS**	**6**
Form and Contents of Financial Statements, Analyzing and interpreting Financial Statements, Accounting Standards		
UNIT 4	**CASH FLOW AND FUND FLOW TECHINIQUES**	**6**
Introduction- How to prepare, Difference between them (cash flow and fund flow techniques)		
UNIT 5	**COSTING SYSTEMS**	**6**
Element of Cost-Cost behavior, Cost allocation, OH allocation- Unit costing, Process Costing, Job Costing-Absorption Costing, Marginal Costing, Cost Volume Profit Analysis-Budgets, ABC Analysis.		
	Total Periods	**30**

Text Book (s)

1	Robert N Anthony, David Hawkins, Kenneth Marchant, "Accounting: Texts and Cases, McGraw-Hill", 13th edition, 2017.
2	John Wiley & sons," Accounting Principles", published, 2007.

Reference (s)

1	Textbook of Financial Cost and Management Accounting by Periasami P,2010
2	Cost Accounting For Dummies – By Kenneth W. Boyd,2013
3	Fundamentals Of Cost Accounting – By William Lanen, Shannon Anderson Et.A1,2012
4	Cost Accounting Made Simple – By Mike Piper,2008

Regulation 2018		Semester V	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MBS302T	BUSINESS STRATEGY	2	0	0	2

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Expose students to various perspectives and concepts in the field of Business Strategy
2	The course would enable the students to understand the principles of strategy formulation, implementation and control in organizations
3	Help students develop skills for applying these concepts to the solution of business problems
4	Help students master the analytical tools of strategic management
5	Enhanced ability to identify strategic issues and design appropriate courses of action.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Understand the theory and concepts of strategic management.
CO 2	Understand the Internal environment firm's intellectual assets.
CO 3	Apply the External environment concept of strategy groups.
CO 4	Analyze complex, unstructured qualitative and quantitative problems using tools.
CO 5	Identify the strategic control and corporate governance business strategy.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	-	-	-	2	-	-	-	3	1	1	-
CO2	-	-	2	-	1	-	1	-	-	-	1	2	-	2
CO3	-	-	1	-	3	-	1	-	-	-	-	2	-	1
CO4	-	-	1	-	1	-	-	-	-	-	1	-	-	2
CO5	-	-	-	-	2	-	2	-	-	-	1	-	-	-
CO	1	-	2	-	2	-	2	-	-	-	2	2	1	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

20 MAY 2022

UNIT 1	INTRODUCTION TO STRATEGIC MANAGEMENT	6
Importance of strategic management- Vision and Objectives- School of thought in strategic Management-Strategy Content, Process and practice- Fit concept and configuration Perspective in Strategic Management.		
UNIT 2	INTERNAL ENVIRONMENT OF FIRM- RECOGNIZING A FIRM'S INTELLECTUAL ASSETS	6
Core competence as the root of Competitive advantage – Source of Sustained Competitive advantage-Business Processes and Capabilities-based approach to strategy.		
UNIT 3	EXTERNAL ENVIRONMENT OF FIRM-COMPETITIVE STRATEGY	6
Five forces of Industry Attractiveness that Shape Strategy-The Concept of Strategic Groups, and Industry life cycle- Generic Strategies and the Value Chain.		
UNIT 4	CORPORATE STRATEGY AND GROWTH STRATEGIES	6
The Motive for Diversification-Related and Unrelated Diversification-Business Portfolio Analysis-Expansion, Integration and Diversification-Strategic Alliances, Joint Ventures and Mergers and Acquisitions.		
UNIT-5	STRATEGY IMPLEMENTATION: STRUCTURE AND SYSTEMS	6
The 7's Frame Work-Strategic Control and Corporate Governance.		
	Total Periods	**30**

Text Book (s)

1	Robert M. Blackwell, "Grant Contemporary Strategic Management", 7th Edition,2012
2	W.Chain Kim & Renee Mauborgne "Blue Ocean Strategy" reviewed in 2015

Reference (s)

1	Blue Ocean Strategy, How to Create Uncontested Market Space and Make the Competition Irrelevant by W. Chan Kim and Renée Mauborgne,2005
2	The Story of Innovation and Customer Choice by Clayton M. Christensen, Karen Dillon, Taddy Hall and David S. Duncan,2019
3	Why Some Companies Make the Leap and Others Don't by Jim Collins,2001
4	"How Strategy Really Works" by A.G. Lafley and Roger L. Martin,2013

Regulation 2018		Semester V	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18MBS303J	DESIGN THINKING	2	0	2	3

Prerequisite course

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Recognize the importance of Design Thinking.
2	Use doodling and storytelling in presenting ideas and prototypes.
3	Develop value proposition statements as part of their presentations.
4	Recognize how Agile and DT complement each other to deliver customer satisfaction
5	Comprehend the applications of design thinking in politics & society, business, health & science and law.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Understand the empathize phase of Design Thinking.
CO 2	Understand the Knowledge on system thinking and its digital process.
CO 3	Apply the steps in the ideate phase of Design Thinking.
CO 4	Apply the prototype created through a Design Thinking process for online business.
CO 5	Analyze the applications of design thinking in politics, society, business, health, Science and law.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	3	2
CO2	2	2	1	-	-	-	-	-	-	1	1	2	3	2
CO3	2	2	-	-	-	-	-	-	-	-	-	1	3	2
CO4	2	2	1	-	-	-	-	-	-	-	-	1	3	2
CO5	2	2	2	-	-	-	3	-	3	2	-	1	3	2
CO	2	2	2	-	-	-	3	-	3	2	1	2	3	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	INTRODUCTION	6
Recognize the importance of Design Thinking - Design thinking and business – Design Thinking and product - Design thinking process.		
UNIT 2	CREATE PEARSONAS	6
Explanation on personas creation - Create personas in design phase - Importance of problem statements - Recognize the steps to create problem statements.		
UNIT 3	PROTOTYPE PHASES	6
Importance of prototype phase in design thinking - How to create prototype - Examples on prototype - Explanation on development of prototype.		
UNIT 4	TESTING PHASE	6
Introduction to testing phase - Recognize the best practices of the testing phase – Define Functional work - Recognize how design thinking can help in function work.		
UNIT 5	TECHNOLOGY CREATIVITY	6
Expanding the politics of civic engagement -.Managing Gridlocked Debates – Implementing a Strategic Technology Creativity in the Culinary Arts - Empathy as a means to innovate in a pharmaceutical company, Visioning, listening and diagramming at a university.		
	Total Periods	30

LIST OF EXPERIMENTS		15
1	Experimental activity on the products they like and dislike based on their experience - Identify the steps in the Design thinking process - Explanation of Stanford Model D -Steps in empathize phase of design thinking - Explanation on target activity	
2	Target activity related to empathy - Steps in immersion activity - Explanation on Moccasin walk -Steps in immersion activity - Flow charts and handouts -	
3	Moccasin walk activity on stepping in to the shoes of another person	
4	Immersion activity by groups - Define the problem statements - Define the key problem statements - Recognize the steps in the ideate phase of Design thinking - Idea on Six thinking hats	
5	Creating person a based on the immersion activity using A4 pages - Recognize how decoding can help to express ideas - Learn doodle - Importance of Storytelling- Importance of presenting ideas	
6	Peer review activity	
7	Six thinking hats game - Combining immersion and persona creation to create prototype - Defining problem statement and ideating to create prototypes - Define service value proposition - Create a value proposition statement	
8	Million dollar idea game - Visualization of the personnel - Understand Lean AEIOU - Know what is problem space - Know what is solution space	
9	Activity on doodling	
10	Story telling activity - Agile thinking definition - Define customer perception and expectations - Define Product and customer satisfaction - How design thinking and agile thinking complement each other to customer satisfaction	
11	Activity on prototyping - Learn the elements of systems thinking, Actual level and desired level - Review, gap and corrective action - Working of systems thinking & mindset of a system thinker - Differentiate system thinking and design thinking	
12	Test the prototype	

T3	Apply design thinking to create a prototype to improve any existing product or service - Problem definition - Groups need to complete all phases of Stanford design thinking model.
Textbooks(s)	
1	Michael Lewrick, Patrick Link, Larry Leifer, "The Design Thinking Toolbox", April 2020.
2	Falk-uebernickel ,Li jiang Walter Brenner,Britta Pukall,Therese Naef,Bern hard Schindlholzer "Design Thinking :The Handbook",publication August 2020
WEB RESOURCES	
1	Eyal - "Hooked by" – URL https://www.youtube.com/watch?v=iw1x0zos8Jo
2	Rod Judkins (2015) – "The Art of Creative Thinking" - Hachette Book Publishing
3	Senor and Saul singer (2011) – "Start-up Nation" - Twelve; Reprint edition
4	Simon Sinek – "Start with why" – URL https://www.youtube.com/watch?v=u4ZoJKF_VuA
5	laude Diderich (2020) – "Design Thinking for Strategy Innovation Towards Competitive Advantage" – Springer International Publishing
6	Kumar, DivyaZindani and J.PauloDavim (2020) – "Design Thinking to Digital Thinking" – Springer International Publishing
7	Michael Lewrick, Patrick Link and Larry Liefer (2018) – "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems" – Wiley
8	Pressman (2018) – "Design Thinking: A Guide to Creative Problem Solving forEveryone"–Routledge
9	Walter Brenner and Falk Uebernickel (2016) – "Design thinking for Innovation: Research and Practice" – Springer International Publishing
10	The Field Guide to Human Centered Design" – IDEO.org – First Edition , 2015
11	Roger L Martin (2009) – "The Design of Business: Why Design Thinking is the Next Competitive Advantage" – Harward Business School Press Web References

Regulation 2018		Semester V	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC303L	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY	0	0	2	1

Prerequisite course

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Learn the concept of Greedy techniques
2	Implement various Dynamic Programming techniques
3	Understand the optimization algorithms
4	Learn and implement Graph algorithms
5	Understand and implement the Back Tracking algorithms

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Design and implement greedy algorithms for job scheduling.
CO 2	Design and implement dynamic programming for finding the shortest path and knapsack Problem
CO 3	Design and implement optimization algorithm and randomization algorithm
CO 4	Design and implement graph algorithms for Tree-traversals.
CO 5	Design and implement back tracking algorithms to solve n queen's problem.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	1	1	3	2
CO2	2	2	2	2	-	-	-	-	-	-	1	1	3	3
CO3	2	2	2	2	-	-	-	-	-	-	1	1	3	3
CO4	2	2	2	2	-	-	-	-	-	-	1	1	3	3
CO5	1	2	2	2	-	-	-	-	-	-	1	1	3	3
CO	2	2	2	2	-	-	-	-	-	-	1	1	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

LIST OF EXPERIMENTS		15
1	Program to implement N-queens problem using backtrack method.	
2	Program for finding shortest path for multistage graph using dynamic programming.	
3	Implementation of Optimal merges patterns.	
4	Program to implement job sequencing with deadlines using greedy method	
5	Program to implement knapsack problem using greedy method	
6	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}.A suitable message is to be displayed if the given problem instance doesn't have a solution.	
7	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.	
8	Implement any scheme to find the optimal solution for the Traveling Sales Person problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.	
9	Compute the transitive closure of a given directed graph using Warshall's algorithm.	
10	Print all the nodes reachable from a given starting node in a digraph using BFS method.	

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Regulation 2018		Semester V	Total Hours			30
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
P	18CBP301L	MINI PROJECT	0	0	2	1

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Develop their own innovative prototype of ideas.
2	Train the students in preparing mini project reports and examination.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Identify and formulate a technical problem to reach substantiated conclusion using basic technical knowledge.
CO 2	Design/Develop prototype /model for societal needs applying the basic engineering knowledge.
CO 3	Evaluate the performance of the developed solution using appropriate techniques and tools.
CO 4	Apply management principles to function as a team.
CO 5	Communicate the technical information effectively.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO	3	3	3	3	3	3			3	3	3	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

Regulation 2018		Semester V	Total Hours			30
			Hours / Week			
Category	Course Code	Course Name	L	T	P	C
M	18MBM301L	ANALYTICAL AND LOGICAL THINKING SKILLS	0	0	2	1

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Sharpen problem solving skills and to improve thinking capability of the students
2	Drive the students to use language with great commitment and cooperation
3	Expertise the creative thinking and presentation skills to meet the company needs

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Solve both analytical and logical problems in a fruitful manner
CO 2	Organize and convey the information in such an incomparable way
CO 3	Improve their presentation skills

UNIT 1	Module – 1	6

Aptitude: Alligations or Mixtures - Blood Relations.
Communication: How to set Goals - Interpersonal Relationships - JOHARI Window - Work &Business Etiquette

UNIT 2	Module - 2	6

Aptitude: Partnership - Statement and Assumptions.
Communication: Transition to Corporate World - Career opportunities in Various Sectors and know your industry.

UNIT 3	Module - 3	6

Aptitude: Arithmetic and Geometric Progressions - Syllogisms.
Communication: Time Management - Anger and Stress Management - Conflict Management.

UNIT 4	Module - 4	6

Aptitude: Permutations and Combinations - Statements & Conclusions.
Communication: Launch a Product - Telephonic Etiquette.

UNIT 5	Module - 5	6

Aptitude: Geometric Problems.
Communication: Presentation Skills - Oral presentation and public speaking skills, Business presentations.

Total Periods 30

Text Book(s)

1	Dr.R.S.Agarwal "Quantitative Aptitude",S.Chand & Company Limited,2015
2	Dr.R.S.Agarwal, "A Modern approach to verbal & non-verbal Reasoning", S.Chand & company Limited, 2015.

BOARD OF COMPUTER SCIENCE & BUSINESS

UNIT 1	INDIAN ARTS	3
	Introduction to art (aesthetics, taste)- fine arts - applied arts –Terminology - Subject matter - Art as propaganda - Purposes/uses of art.	
UNIT 2	THEATRE & DRAMA	3
	History of Theatre and Drama- Traditional Theatre forms- Modern Theatre and its characteristics- Puppetry – different forms and elements of drama.	
UNIT 3	MUSICS AND DANCES OF INDIA	3
	Origin of Music and Dance- Classical music and Carnatic Music- Regional Music – Musical Instruments-Regional Classical Dances.	
UNIT 4	ARCHITECTURE, SCULPTURE, PAINTING	3
	History of architecture, sculpture, painting -Indo-Islamic Architecture- Temple Architecture– different types of Sculptures and its characteristics-Painting and its different styles.	
UNIT 5	LITERARY ARTS	3
	Ancient Indian Literature- Early Dravidian Literature- Medieval Literature- Modern Indian Literature-Contemporary Literature.	
	Total Periods	15

Text Book(s)

1	Partha Mitter ,"Indian Art",2001
2	Pratima Sheh, " Dictionary of Indian Art and Artists",2007

Reference (s)

1	Dhar, Parul Pandya, ed., " Indian Art History Changing Perspectives", New Delhi: D.K. Print world and National Museum Institute (Introduction), 2011,
2	Guha-Thakurta, Tapati, "The making of a new modern Indian art: Aesthetics and nationalism in Bengal", 1850-1920, Cambridge University Press, 1992
3	Huntington, Susan, " The Art of Ancient India: Hindu, Buddhist, Jain, Weatherhill", 1985
4	Mitter, Partha, "Indian Art, Oxford History of Art series", Oxford University Press, 2001

Regulation 2018		Semester V	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	18LEM302L	SELF DEVELOPMENT AND ENTREPRENEURSHIP	1	0	0	-

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Develop entrepreneurship and self-employment abilities to start any venture plan, use, and monitor and control resources optimally and economically.
2	Know the Micro, small and medium industries Registration Process.
3	Study about product selection and development.
4	Learn about the Project report preparation.
5	Analysis the Enterprise risk management.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Identify entrepreneurial quality.
CO 2	Know the entrepreneurial support agencies.
CO 3	Prepare project setup planning and project report
CO 4	Select appropriate agencies for technical and financial support.
CO 5	Explain SWOT analysis and strategies to achieve goals.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	1	1	1	1	-	1
CO2	-	1	-	-	-	2	1	1	1	2	2	1	-	1
CO3	1	3	-	-	-	-	2	1	1	1	2	1	-	1
CO4	-	1	-	-	-	1	2	1	1	1	2	1	-	1
CO5	2	1	-	-	-	-	1	-	1	1	1	1	-	1
CO	2	3	-	-	-	2	2	1	1	2	2	1	-	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	**INTRODUCTION TO SELF-EMPLOYMENT AND ENTREPRENEURSHIP DEVELOPMENT**	3
Introduction of self-employment – Characteristics- Creativity. Entrepreneurship development-Qualities of entrepreneur and Characteristics of Diploma holder as a self-employer like developing networking and personal contacts, importance of productivity, quality, cost consciousness and customers' satisfaction. Types of enterprise-Sole partnership -Partnership firm- Joint stock company- Co-operative society.		
UNIT 2	**ENTREPRENEURIAL SUPPORT AGENCIES**	3
Definition Micro, small and medium industries- Registration process of an enterprise with Government agencies-Name, type and role of state and national-level support agencies. Current state & National Level Promotional Schemes for establishment of new..		
UNIT 3	**PROJECT SET UP PLANNING**	3
Product Selection: importance- Product development stages. Process Selection: Factors affecting process selection - Technology lifecycle. Process Conversion-Capacity Planning: Basic method to assess / estimate capacity. Selection of location and layouts: Factors affecting selection of location - Objectives and types of plant layout.		
UNIT 4	**PROJECT PROPOSAL PLANNING**	3
7-M resources- Marketing- definition, need for enterprise, 4Ps channels- Market survey. Methods -Project report preparation for mechanical feature based product: Meaning of project planning and report: Feasibility study. Details required for preparing project plan. Project cost estimation.		
UNIT 5	**ENTERPRISE AND RISK MANAGEMENT**	3
Concept of risk in the context of enterprise/ project-Uncertainty and certainty of project elements-Decision making under risk-Methods of risk management-Strength, Weakness, Opportunity and Threat (SWOT) analysis.		
	Total Periods	15

Text Book(s)	
1	Cal Newport,"So Good They Can't Ignore You",2016
2	Greg McKeown, "Essentialism ",2014
Reference (s)	
1	Clifford and Bombak, JosephR. Momanso ,"Entrepreneurship & Venture Management",second edition,1986
2.	Karmakar.M.B. ,"Small Industries management",2009
3	Pradeep Khandwala, "Creativity",2014
4	R.K.Singal, S.K.Kataria Sons, "Entrepreneurship development and Management",2013

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Regulation 2018		**Semester VI**	**Total Hours**			**45**
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
C	18CBC304T	COMPUTER NETWORKS	3	0	0	3

Prerequisite courses

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Study the concepts of data communications and functions of different layers of ISO/OSI reference Architecture
2	Understand the error detection and correction methods and types of LAN.
3	Realize the concepts of sub netting and routing mechanisms.
4	Empathize with the different types of protocols and network components.
5	Gain Knowledge and configure Switches and Routers.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Infer the fundamentals of data communications and functions of layered architecture.
CO 2	Interpret LAN and various techniques for Bandwidth Utilization
CO 3	Apply the error detection and correction methods and understand the different network technologies in Data link layer and MAC.
CO 4	Analyze the various Network and Transport layer Protocols.
CO 5	Summarize the application layer protocols and also the use of cryptography and network security.

CO-PO Mapping

COs	**POs**												**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	1	-	-	-	-	-	1	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	1	-	-	-	-	-	-	-	-	3	2
CO5	3	2	1	1	1	-	-	-	-	1	-	-	3	2
CO	3	2	2	1	1	-	-	-	-	1	-	-	3	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	INTRODUCTION	9
Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures. **Data communication Components:** Representation of data and its flow, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media.		
UNIT II	**LAN AND BANDWIDTH UTILIZATION**	**9**
LAN: Wired LAN, Wireless LAN, Virtual LAN. **Techniques for Bandwidth utilization:** Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.		
UNIT III	**DATA LINK LAYER**	**9**
Data Link Layer and Medium Access Sub Layer: Fundamentals of Error Detection and Error Correction, Block coding- Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back– N ARQ, Selective Repeat ARQ, Sliding Window ,Piggybacking, Random Access, Multiple access protocols - PureALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA		
UNIT IV	**NETWORK AND TRANSPORT LAYER**	**9**
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP– Delivery, Forwarding and Unicast Routing protocols **Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms.		
UNIT V	**APPLICATION LAYER AND NETWORK SECURITY**	**9**
Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls. **Network Security**: Electronic mail, directory services and network management, Basic concepts of Cryptography.		
	Total Periods	**45**

Text Book (s).

1	Behrouz A. Forouzan, “Data communication and Networking Update ”, Tata McGraw-Hill,Fourth Edition
2.	William Stallings , “Data and Computer Communication”(10th Edition) ,2013

Reference (s)

1	Network Security, Kaufman, R. Perlman and M. Speciner, 22 April 2002
2	UNIX Network Programming, Vol. 1,2 & 3, W. Richard Stevens, 1990
3	Computer Networking: A Top-Down Approach (6th Edition),2012
4	Network Warrior (2nd Edition),2011

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UNIT I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE & PROBLEM SOLVING**	**9**

Problems of AI, AI technique, Tic -Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Defining the problem as state space search- production system-problem characteristics-issues in the design of search programs.

UNIT II	**SEARCH TECHNIQUES**	**9**

Problem solving agents, searching for solutions; uniform search strategies: breadth first search-depth first search- depth limited search-bidirectional search- comparing uniform search strategies. Heuristic search strategies Greedy best-first search- A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

UNIT III	**CONSTRAINT SATISFACTION PROBLEMS**	**9**

Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT IV	**KNOWLEDGE & REASONING**	**9**

Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge

UNIT V	**PROBABILISTIC REASONING & EXPERT SYSTEMS**	**9**

Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Representing and using domain knowledge, expert system shells, and knowledge Acquisition.

LIST OF EXPERIMENTS	**15**

1. Implement Water-Jug problem
2. Implement Monkey Banana Problem
3. Implement Hill Climbing algorithm.
4. Implementation of Constraint Satisfaction Problems.
5. Implementation of Greedy heuristic search algorithm
6. Implementation of Simulated Annealing Heuristic Search
7. Implementation of KNN for an application.
8. Implementation of SVM for an application.
9. Implementation of Decision Tree for an application
10. Implementation of simple chatbot for an application.

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UNIT I	INTRODUCTION	9
Overview of Security Parameters: Confidentiality-integrity and availability; Security violation and threat; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle..		
UNIT II	ACCESS CONTROL MODELS	9
Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and Spatio-temporal models.		
UNIT III	SECURITY POLICIES	9
Security Policies: Confidentiality policies, integrity policies, hybrid policies,non-interference and policy composition, International standards.		
UNIT IV	SYSTEM-DESIGN	9
Systems Design: Design principles, representing identity, control of access and information flow, Confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.		
UNIT V	LOGIC BASED SYSTEM	9
Logic-based System: Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications:-Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification. **Operating Systems Security:** Security Architecture, Analysis of Security in Linux/ Windows. **Database Security:** Security Architecture, Enterprise security, Database auditing.		
	Total Periods	**45**
	LIST OF EXPERIMENTS	**15**

1. Analysis of security in Unix/Linux.
2. Implement SHA-1 algorithm
3. Implement MD5 algorithm for practical applications.
4. Implementing Digital Signal Standard (DSS).
5. Crack-passwords using John the Ripper.
6. Demonstrate intrusion detection system (IDS) using Snort
7. Administration of users, password policies, privileges and roles

Text Book (s)

1	M. Bishop, Pearson Education, "Computer Security: Art and Science",November 2018
2	M. Stamp, "Information security Principles & practices",16th September 2021

Reference (s)

1	C.P. P fleeger , S.L. P fleeger, J. Margulies, "Security in Computing",January 2015
2	David Wheeler, "Secure Programming HOWTO",1999

Text Book(s)	
1.	Stuart Russell, "Artificial Intelligence – A Modern Approach", 3 Edition.2010
2	John D Kelleher, Brian Mac Namee, "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies",2015
Reference (s)	
1	Giarranto, "Expert Systems", VIKAS.2001
2	Patterson, "Introduction to artificial intelligence and Expert system", PHI.1997
3	Russell, pearson, "Artificial intelligence",1998
4	Russell & peter norvig, "Artificial intelligence : A modern approach",2005

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Regulation 2018		Semester VI	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MBS304T	FINANCIAL MANAGEMENT	2	0	0	2

Prerequisite courses

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Importance of Financial Management to make good business decisions
2	Significance of Financial market and its linkage with business
3	Long Term Sources available for a firm
4	Importance of Cost of Capital and Capital Structure for financing decisions
5	Importance of Liquidity and Dividend decisions

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Understand and learn the importance of financial management for financial decision making.
CO 2	Analyze the securities value and its Risk & Return.
CO 3	Discover basic understanding of various sources of finance.
CO 4	Apply Capital Budgeting and Working Capital Management.
CO 5	Apply working capital concepts to maintain liquidity and to learn the aspects of dividend Decisions.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	1	-	-	-	1	-	-	-	2	-	1	2
CO2	-	2	-	-	1	-		-	-	-	2	-	2	-
CO3	-	3	2	-	2	-	1	-	-	-	2	-	2	-
CO4	-	3	-	-	-	-	1	-	-	-	2	-	1	2
CO5	-	2	-	-	1	-	1	-	-	-	2	-	1	-
CO (Avg)	-	3	2	-	2	-	1	-	-	-	2	-	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	Introduction	6
Introduction to Financial Management - Goals of the firm - Financial Environments. **Time Value of Money:** Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.		
UNIT II	**Valuation of Securities and Risk & Return**	**6**
Valuation of Securities: Bond Valuation Preferred Stock-Valuation, Common Stock Valuation, Concept of Yield and YTM. **Risk and Return:** Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM)		
UNIT III	**Operating & Financial Leverage**	**6**
Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study. **Cost of Capital:** Concept, Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital 4L		
UNIT IV	**Capital Budgeting and Working Capital Management**	**6**
Capital Budgeting: The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods. **Working Capital Management:** Overview, Working Capital Issues, Financing-Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.		
UNIT V	**Cash and Accounts Receivable Management**	**6**
Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring. **Accounts Receivable Management:** Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period. 4L		
	Total Periods	**30**

Text Book (s)

1	Chandra, Prasanna ," Financial Management - Theory & Practice", 1 November 2007
2	Tata McGraw Hill, "Financial Management: Theory & Practice", 15th Edition,2015

Reference (s)

1	Srivastava, Misra, "Financial Management". OUP, Apr 26, 2012
2	Van Horne and Wachowicz , "Fundamentals of Financial Management", Prentice Hall/ Pearson Education.1998
3	Eugene F. Brigham, "Fundamentals of Financial Management ",2016
4	Taxmann, "Fundamentals of Financial Management: Concise Edition" , 9th edition,2017

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
H	18CBH104J	BUSINESS COMMUNICATION ANDVALUE SCIENCE – IV	2	0	2	3

Prerequisite courses

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Recognize the best practices of communicative writing
2	Understand the importance of emotional intelligence in personal and professional lives
3	Study the importance of corporate social responsibility (CSR)
4	Empathize with how stress impacts life and work
5	Use the best practices to manage stress & Public Speaking.

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO 1	Recognize the best practices of communicative writing
CO 2	Apply emotional intelligence in real life scenarios
CO 3	Recognize the attributes needed to function and grow in a corporate environment
CO 4	Identify the best practices to manage stress
CO 5	Identify the best practices of public speaking

CO-PO Mapping

Cos	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	1	-	-	-	-	-	1	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	1	-	-	-	-	-	-	-	-	3	2
CO5	3	2	1	1	1	-	-	-	-	1	-	-	3	2
CO	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**

1: Slight (Low)   **2: Moderate (Medium)**   **3: Substantial (High)**

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UNIT I	COMMUNICATIVE WRITING	9
Writing: Principles of Communicative Writing – Formal and Business letters – Writing Proposals – Use of Charts and graphs in Communicative Writing – Intelligence: Understand what emotional intelligence – Importance of Public Speaking – To apply public speaking in real life scenarios. Activity: identify topics related to the key words – Introduce the concept of Diversity in corporate environments through an activity Ask students to write a business Proposals in group – Ask students to note down the names of at least two movies in their Satori slam book, in which the characters display Emotional Intelligence.		
UNIT II	**CORPORATE SOCIAL RESPONSIBILITY (CSR)**	**9**
Corporate Social Responsibility (CSR): Recognize the importance of corporate social responsibility – Hear CSR stories – Tell a CSR story – Attributes required for work and life – Recognize the attributes needed to function and grow in a corporate environment – Activity: Activity – Groups will research in class, prepare and present CSR activity of Tata Steel, Microsoft, Google, TCS, Starbucks, Titan, Tata Chemicals and TOMS Shoes.		
UNIT III	**EMOTIONAL INTELLIGENCE**	**9**
Concepts: Concepts of Emotional Intelligence – Its importance in human life and professional life – difference between emotional quotients and intelligent quotients – Corporate Etiquette activity – Any two Abubhaav activities – 10 ways to build emotional intelligence by Daniel Golonem – Mock Interview.		
UNIT IV	**CONFLICT MANAGEMENT**	**9**
Concepts conflicts – Corporate and work place conflicts – Reason and impact of conflicts – guidelines for conflicts Teams – Role of team players – Stress – Stress Management – Importance of Feedbacks – Time Management – Activity – Creating Posters with Stress Management Tips – Open House Discussions on Challenges of Time Management – Tracking Time Activity.		
UNIT V	**DESIGN THINKING AND PUBLIC SPEAKING**	**9**
Concepts: Design Thinking – Importance of Startups – Proof of Concepts for Startups – Best Practices – Act of Public Speaking Activity: Pitch in Startup Idea – Listening Videos of Public Speaking – Finding Similarities among World famous speeches – Listening Swami Vivekananda's Speech – Martin Luther King's My Dream Speech – Dr. Abdul Kalam's Speech.		
	Total Periods	**45**

LIST OF EXPERIMENTS		**15**
1.	Introduce the concept of Diversity in corporate environments through an activity	
2.	Ask students to write a business Proposals in group	
3	Ask students to note down the names of at least two movies in their Satori slam book, in which the characters display Emotional Intelligence.	
4	Groups will research in class, prepare and present CSR activity of Tata Steel, Microsoft, Google, TCS, Starbucks, Titan, Tata Chemicals and TOMS Shoes.	
5	Creating Posters with Stress Management Tips	
6	Open House Discussions on Challenges of Time Management	
7	Tracking Time Activity.	
8	Watching Videos of Public Speaking	
9	Finding Similarities among World famous speeches	
10	Watching Swami Vivekananda's Speech – Martin Luther King's My Dream Speech – Dr. AbdulKalam's Speech	

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Reference (s)	
1	Emotional Intelligence: Why it Can Matter More Than IQ by Daniel Goleman,1995
2	Putting Emotional Intelligence To Work by Ryback David,1998
3	How to Develop Self Confidence and Improve Public Speaking – Time – Tested Methods of Persuasion by Dale Carnegie,2018
4	TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations,2016
Web References:	
1	https://www.tata.com/about-us/tata-group-our-heritage
2	https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms
Online Resources:	
1	https://youtu.be/reu8rzD6ZAE
2	https://youtu.be/Wx9v_J34Fvo
3	https://youtu.be/F2hc2FLOdhl
4	https://youtu.be/wHGqp8lz36c
5	https://youtu.be/hxS5He3KVEM
6	https://youtu.be/nMPqsjuXDmE

Regulation 2018		Semester VI	Total Hours			15
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
C	18CBC307L	COMPUTER NETWORKS LABORATORY	0	0	2	1

Prerequisite courses

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Gain knowledge in the concepts of data communications and functions of different layers of ISO/OSI reference architecture.
2	Understand the error detection and correction methods and types of LAN.
3	Examine the concepts of sub netting and routing mechanisms.
4	Empathize with the different types of protocols and network components.
5	Study and configure Switches and Routers

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO 1	Understand the fundamentals of data communications and functions of layered architecture.
CO 2	Practice the error detection and correction methods and understand the different network technologies in Data link layer and MAC.
CO 3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies.
CO 4	Configure Routers and Switches for efficient Data Transfer.
CO 5	Understand the application layer protocols and also the use of cryptography and network security.

CO-PO Mapping

Cos	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-	1	-	1	-	3	2
CO2	-	-	-	-		-	1	-	-	-	-	-	3	3
CO3	1	-	1	-	-	-	-	-	-	-	-	-	3	2
CO4	1		-	-	-	1	-	-	-	-	-	-	2	2
CO5	-	-	-	1	-	-	-	-	1	-	1	-	2	1
CO	1	1	1	1	-	1	1	-	1	-	1	-	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

	LIST OF EXPERIMENTS	15
1	Study of system administration and network administration	
2	Implementation of Sliding window protocol and stop and wait protocol	
3	Write a code simulating PING and TRACEROUTE commands	
4	Applications using TCP Sockets like ○ File transfer ○ Remote command execution ○ Chat ○ Concurrent services	
5	Create a socket for HTTP for webpage upload and download	
6	Implementation of Sub netting Applications a. DNS b. SNMP	
7	Study of PUTTY (NETWORK FILE TRANSFER APPLICATION	
8	Perform a case study about ETTERCAP (NETWORK SECURITY TOOL).	

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Regulation 2018		Semester VI	Total Hours			30
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
M	18MBM302L	EMPLOYABILITY SKILLS AND PRACTICES	0	0	2	1

Prerequisite courses

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Learn the application of mathematical or statistical models to different real-world contexts
2	Focus on writing & speaking skills through vigorous practices.
3	Enhance soft skills and analytical ability of students
4	Defeat the fear while communicating in group and to master the effective communication

Course Outcome (s) (Cos):

At the end of this course, learners will be able to:

CO 1	Solve both analytical and logical problems in a productive manner
CO 2	Launch their ability of comprising and delivering the information
CO 3	Upgrade their communication quality in near future

UNIT I	**Module – 1**	**6**
Aptitude: Time and Distance (Speed, Streams) – Problems on Trains – Arrangements and Blood Relations. **Communication:** Job Application – Cover letter, Bio-data, Resume & CV building.		
UNIT II	**Module – 2**	**6**
Aptitude: Time and Work – Pipes & Cisterns – Situation Reaction Test & Data Interpretations. **Communication:** Writing practices on circulars, notices, memos, Agenda preparation and Minutes of meeting.		
UNIT III	**Module – 3**	**6**
Aptitude: Ages – Averages – Probability – Profit and Loss. **Communication:** Email Etiquette –Essay writing		
UNIT IV	**Module – 4**	**6**
Aptitude: Mensuration - SI & CI - Cause and Effect Analysis - Statement, Assumptions & Conclusions. **Communication:** Group Discussion and guidelines.		
UNIT V	**Module - 5**	**6**
Aptitude: Permutation and Combinations - Partnership - Alligations or Mixtures. **Communication:** Interview skills - General instructions, Review of interview questions, Mock Interviews.		
	Total Periods	**30**

Reference(s)

1	Employability Skills by y Arihant Experts,2017
2	An Introduction to Employability Skills' published by Macmillan,2018
3	https://bharatskills.gov.in/pdf/EmployabilitNew.pdf
4	https://iti.directory/books/iti-employability-skills-books-i-year

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Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
Elective	18CBE001J	CONVERSATIONAL SYSTEMS	3	0	2	4

Prerequisite course

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Learn the basic knowledge about conversational systems.
2	Understand the different techniques of natural language processing
3	Explore the working knowledge of a chat bot and the prerequisite knowledge
4	Study the fundamental role of machine learning in building conversational systems
5	Explicate the various applications of conversational systems and its future developments

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Understand the basic technologies required for building a conversational system.
CO 2	Confer the NLTK tool kit and the pre-processing techniques of natural language processing.
CO 3	Expound basic concepts and architecture of chat bots and build a chat bot for any application and deploy it.
CO 4	Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behavior.
CO 5	Develop a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	1	-	-	1	2
CO2	1	2	2	2	1	-	-	-	2	1	1	1	3	2
CO3	1	2	2	2	1	-	-	-	2	1	2	2	3	2
CO4	1	2	2	2	1	-	-	-	2	1	1	1	2	2
CO5	1	1	2	2	1	-	-	-	2	1	1	1	2	2
CO	2	2	2	2	1	-	-	-	2	1	1	2	3	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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<table>
<tr><td><b>UNIT I</b></td><td><b>FUNDAMENTALS OF CONVERSATIONAL SYSTEMS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Introduction: Overview, Case studies, Explanation about different modes of engagement for a human being, History and impact of AI. Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, NLG, Speech-To-Text, Text-To-Speech, Computer Vision etc. Introduction to Top players in Market – Google, MS, Amazon &Market trends. Messaging Platforms (Facebook, WhatsApp) and Smart speakers – Alexa, Google Home and other new channels. Ethical and Legal Considerations in AI Overview.</td></tr>
<tr><td><b>UNIT II</b></td><td><b>NATURAL LANGUAGE PROCESSING</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chatbots etc. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfilment Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis, NLP using Python - libraries like NLTK, spaCy, Stanford NLP, Affective NLG.</td></tr>
<tr><td><b>UNIT III</b></td><td><b>BUILDING A CHATBOT/CONVERSATIONAL AI SYSTEMS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Fundamentals of Conversational Systems (NLU, DM and NLG), Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation UX design, APIs and SDKs, Usage of Conversational Design Tools. Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps. Overview of CE Testing techniques, A/B Testing, Introduction to Testing Frameworks - Botium /Mocha ,Chai. Security &Compliance – Data Management, Storage, GDPR, PCI</td></tr>
<tr><td><b>UNIT IV</b></td><td><b>ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Understanding on how Conversational Systems uses ML technologies in ASR, NLP, Advanced Dialog management, Language Translation, Emotion/Sentiment Analysis, Information extraction, etc. to effectively converse.</td></tr>
<tr><td><b>UNIT V</b></td><td><b>CONVERSATIONAL ANALYTICS AND THE FUTURE OF CONVERSATIONAL SYSTEMS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Contact Centers: Introduction to Contact centers – Impact &Terminologies, Case studies & Trends, How does a Virtual Agent/Assistant fit in here? Overview on Conversational Analytics: Conversation Analytics: The need of It, Introduction to Conversational Metrics. Future – Where are we headed? Summary, Robots and Sensory Applications overview .XR Technologies in Conversational Systems, XR-Commerce, What to expect next? – Future technologies and market innovations overview.</td></tr>
<tr><td colspan="2" align="right"><b>Total periods</b></td><td><b>45</b></td></tr>
<tr><td><b>LAB</b></td><td><b>LIST OF EXPERIMENTS</b></td><td><b>15</b></td></tr>
<tr><td colspan="3">Develop the code for the following:</td></tr>
<tr><td colspan="3">1. To identify morphological features of a word by analyzing it.</td></tr>
<tr><td colspan="3">2. To generate word forms from root and suffix information.</td></tr>
<tr><td colspan="3">3. To perform morphological analysis of a word by the use of Add-Delete table.</td></tr>
<tr><td colspan="3">4. To do sentiment analysis for the given dataset and to classify sentences based on their categories.</td></tr>
<tr><td colspan="3">5. To detect the entities from the dataset and tag them based on their categories.</td></tr>
</table>

6.	To find Parts – Of - Speech tags of words in a sentence.
7.	To detect the entities from the dataset and tag them based on their categories.
8.	To build a chatbot for an application that proves its importance from a social perspective

Text Book (s)	
1	McTear, Michael. "Conversational AI: dialogue systems, conversational agents, and chatbots." Synthesis Lectures on Human Language Technologies 13, no. 3 (2020): 1-251.
2	Hands-On Chatbots and Conversational UI Development: Build chatbots and voice user interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills Paperback – 1 January 2017 by Srini Janarthanam

Reference (s)	
1	Pearl, Cathy. Designing voice user interfaces: Principles of conversational experiences. "O'Reilly Media, Inc.", 2016.
2	https://www.tcs.com/content/dam/tcs/pdf/discover-tcs/research- book/ Conversational% 20Systems% 20in% 20Enterprises% 20dps.pdf
3	https://www.morganclaypoolpublishers.com/catalog_Orig/samples/9781636390321_sample.pdf
4	https://www.mdpi.com/2073-8994/13/7/1187/pdf

Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			
			L	T	P	C
Elective	18CBE002J	CLOUD MICROSERVICE AND APPLICATION	3	0	2	4

Prerequisite Course(s)

Operating Systems, Object Oriented Programming

Course Objective (s):

The purpose of learning this course is to:

1	Make the students to understand the fundamentals of developing application on Cloud, specifically public clouds such as AWS, AZURE and Google.
2	To help students to design applications for Cloud.
3	Enable students to develop applications using various cloud services.
4	Understand students to deploy applications on Cloud by using cloud native services.
5	Develops students to implement fundamentals tools and applications.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Understand the fundamentals of cloud service applications.
CO 2	Know about the different public cloud applications
CO 3	Design and develop the application for providing cloud services
CO 4	Deploy the cloud micro services using native cloud tools
CO 5	Evaluate and Implement python and Develop stools and applications

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	2	1	1	1	1	-	2	1	2	1
CO2	2	2	1	-	2	1	2	-	-	-	2	2	1	1
CO3	3	3	1	-	3	-	1	-	-	-	3	1	2	3
CO4	2	3	-	-	2	1	1	1	-	-	2	2	2	2
CO5	2	2	2	2	3	-	1	2	-	-	3	3	3	3
CO	3	3	2	2	3	1	2	2	-	-	3	3	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

<table>
<tr><td><b>UNIT I</b></td><td><b>CLOUD FUNDAMENTALS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Cloud Service Components, Cloud service/Deployment Models. Cloud Components Guiding Principle with respect utilization / Security/ Pricing and the applications of Cloud. Public Cloud Platforms overview and their usage.</td></tr>
<tr><td><b>UNIT II</b></td><td><b>APPLICATION ARCHITECTURE</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Application architectures-Monolithic & Distributed ,Micro service fundamental and design approach, Cloud Native applications, 12 Factors App, Application integration Process / APIFICATION Process , API Fundamental.</td></tr>
<tr><td><b>UNIT III</b></td><td><b>MICRO SERVICE</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Micro service / API management, Spring boot Fundamental and design of micro service, API Tools, Developer Portal. Applications of Micro service and APIFICATION.</td></tr>
<tr><td><b>UNIT IV</b></td><td><b>DEVELOPMENT FUNDAMENTALS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Tools and Applications Containerization Process and application.</td></tr>
<tr><td><b>UNIT V</b></td><td><b>PYTHON</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Introduction - Programming Concepts - Beyond the Basics - Use cases .Cloud Application development/Deployment/ Execution steps, Cloud Security and Monitoring Tools.</td></tr>
<tr><td colspan="2" align="right"><b>Total Periods</b></td><td><b>45</b></td></tr>
<tr><td><b>LAB</b></td><td><b>LIST OF EXPERIMENTS</b></td><td><b>15</b></td></tr>
<tr><td colspan="3">Students can select the project work/ thesis in any one of the Cloud application development / deployment use cases.</td></tr>
</table>

Text Book (s)

1	Hwang, Kai, Jack-Dongarra, and Geoffrey C. Fox. Distributed and cloud computing: from parallel processing to the internet of things. Morgan kaufmann, 2013.
2	Reese, George. Cloud application architectures: building applications and infrastructure in the cloud. "O'Reilly Media, Inc.", 2009.

Reference (s)

1	Raj Kumar Buyya ,Christian Vecchio la , S. ThamaraiSelvi," MasteringinCloud",MHI,2013
2	John W. Ritting house and James F. Ran some, "Cloud Computing :Implementation, Management, and Security", CRC Press, 2010
3	Barrie So sin sky ,"Cloud Computing Bible",Wiley,2011
4	Michael Huttermann, "DevOps for Developers", Apress, 2012.

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Regulation 2018		Semester V	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
Elective	18CBE003J	MACHINE LEARNING	3	0	2	4

Prerequisite Course(s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1.	Understand the fundamental concepts of Machine Learning
2	Help students to understand the concepts and algorithms of Classification
3	Make students to understand the theoretical and practical aspects of Probabilistic Graphical Models
4	Empathize with the concepts of regression analysis
5	Appreciate the concepts Clustering.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Understand the different types of Supervised and Unsupervised Learning.
CO 2	Analyze the different types of classification algorithms for real time applications.
CO 3	Analyze Probabilistic Discriminative and Generative algorithms for an application and Compare the results.
CO 4	Identify regression analysis techniques for Supervised Learning.
CO 5	Implement typical Clustering algorithms for different types of applications

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	2
CO2	3	2	2	2	-	-	-	-	2	2	-	2	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	1	3	2
CO4	3	2	2	1	2	-	2	-	2	2	-	2	3	2
CO5	3	2	1	1	-	2	-	-	-	1	-	1	3	2
CO	3	2	2	2	2	2	2	-	2	2	-	2	3	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION AND CLASSIFICATION	9
Introduction to Machine Learning (ML); Relationship between ML and human learning; Aick survey of major models of how machines learn ;Example applications of ML classification : Supervised Learning; problem of classification ;Feature engineering ;Training and testing classifier models Cross – validation ; Model evaluation (precision, recall, F1- measure, accuracy, area under curve) ; Statistical decision theory including discriminant functions and decision surfaces;		
UNIT II	CLASSIFICATION ALGORITHM	9
Naive Bayes classification; Bayesian networks; Decision Tree and Random Forests; k- Nearest neighbor classification ; Support Vector Machines ; Artificial neural networks including back propagation ; Applications of classifications ; Ensembles of classifiers including bagging and boosting.		
UNIT III	PROBABLITISTIC GRAPHICAL MODELS	9
Hidden Markov Models (HMM) with forward-backward and Viterbi algorithms; Sequence classification using HMM Conditional random fields; Applications of sequence classification such as part-of-speech tagging.		
UNIT IV	REGRESSION	9
Regression :Multi-variable regression ; Model evaluation ; Least squares regression ; Regularization ; LASSO : Applications of regression . Association rule mining algorithms Including apriori .Expectation-Maximization(EM) algorithm forum supervised learning		
UNIT V	CLUSTERING	9
Clustering :average linkage ;Ward's algorithm; Minimum spanning tree clustering; K nearest Neighbors clustering; BIRCH;CURE; DBSCAN .Anomaly and outlier detection methods.		
	Total Periods	45
LAB	LIST OF EXPERIMENTS	15
1.	Introduction to WEKA and R	
2.	Classification of some public domain datasets in UCI ML repository	
3.	Implement Decision Tree learning & Logistic Regression.	
4.	Implement association rule mining using apriori	
5.	Implement Expectation Maximization (EM) algorithm	
6.	Implement K-means Clustering to Find Natural Patterns in Data.	
7.	Implement Hierarchical clustering	
8.	Implement anomaly detection using one class SVM.	

Text Book(s)

1	E.Alpaydin, Introduction toMachineLearning,3/e,Prentice-Hall,2014.
2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (First Edition),2019

Reference (s)

1	C.Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
2	R. O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001.
3	A.Rostamizadeh, A.Talwalkar, M.Mohri, Foundations of Machine Learning, MIT Press,2012
4	A.Webb, Statistical Pattern Recognition,3/e,Wiley,2011.

BOARD OF COMPUTER SCIENCE & BUSINESS

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
Elective	18CBE004J	ROBOTICS AND EMBEDDED SYSTEM	3	0	2	4

Prerequisite course

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Acquire knowledge about modern day robotics and their industrial applications.
2	Learn about the technologies essential for Cognitive Robotics.
3	Understand computer vision and their applications in Robotics.
4	Get an insight about AI, Data Science and Cloud Computing in the context.
5	Understand the Robotic Operating system and to apply the programming languages in building the applications related to Robotics.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO 1	Learn about Robotics and its evolution in the industry along with the required technologies for Cognitive Robotics.
CO 2	Know about computer vision and the application of vision system in Robotics
CO 3	Understand modern day robotics and their industrial applications.
CO 4	Apply the concept of AI, Data Science and Cloud-Computing in the context of Cognitive Robotics.
CO 5	Analyze the suitable Operating system and programming languages that are applicable in the context of Robotics

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	2	1	1	1	1	-	2	1	2	1
CO2	2	2	1	-	2	1	2	-	-	-	2	2	1	1
CO3	3	3	1	-	3	-	1	-	-	-	3	1	2	3
CO4	2	3	-	-	2	1	1	1	-	-	2	2	2	2
CO5	2	2	2	2	3	-	1	2	-	-	3	3	3	3
CO	3	3	2	2	3	1	2	2	1	-	3	3	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	INTRODUCTION	9

Introduction to Modern Day Robotics and their industrial applications: Introduction to the industrial revolution, advancements in technologies, evolution of Robotics and advancements in Robotics, Types of Robots.

UNIT 2	TECHNOLOGIES	9

Technologies essential for Cognitive Robotics: Computer systems and Technologies relevant to modern day robotics. Introduction to computer vision and application of Vision Systems in Robotics: Concepts of computer vision and the how vision systems are becoming essential part of Robotics. Examples of applications of vision systems.

UNIT 3	ARTIFICIAL INTELLIGENCE AND DATA SCIENCE PLATFORM	9

AI in the context of Cognitive Robotics and Role of AI in Robotics: Artificial Intelligence making the Robots behaves like human beings. Applications of AI in Robotics. Data Science and Big Data in the context of Cognitive Robotics: Role of Data Science and Big Data in maximizing the availability of Robots in application; Leveraging Data Science in predicting the potential failure of the Robots.

UNIT 4	CLOUD COMPUTING AND OPERATING SYSTEM PLATFORM	9

Concepts of Cloud computing, cloud platforms and it applications in Robotics: Introduction to Cloud computing and commercially available cloud platforms; How the concept of cloud computing is making the need for complex and extremely high computing requirements in robotic systems. Basics of Robotic operating System: Concepts of Robotic Operating Systems and how it is enabling standardization and communication between different robotic systems and IT systems.

UNIT 5	PYTHON AND R PROGRAMMING IN ROBOTICS	9

Introduction to Python and R Programming in the context of Robotics: Basics of Python and R Programming and the application of Python and R Programming in Robotics.

	Total periods	45
LAB	LIST OF EXPERIMENTS	15

1. Program a Robot in a Code Free Environment with Machine Logic DIY projects.
2. Sloth Arduino DIY DOF Humanoid Robot Learning Kit with Programming.
3. DIY Raspberry Pi robot: Making of remote control/autonomous wandering 4W.D robot.

Text Book (s)

1	Embedded Systems and Robotics with Open Source Tools by Nilanjan Dey, Amartya Mukherjee,2016
2	Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems,2008

Reference (s)

1	Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University press, 2013
2	Nilanjan Dey, Amartya Mukherjee, Embedded Systems and Robotics with Open Source Tools
3	Mordechai Ben-Ari, Francesco Mondada, Elements of Robotics, Springer open, 2018
4	Thomas Braunl, Embedded Robotics-Mobile Robot Design and Applications with Embedded Systems, Third Edition, Springer, 2008.

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
Elective	18CBE005J	FULL STACK WEB DEVELOPMENT	3	0	2	4

Prerequisite course

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Enable students to develop modern web application by leveraging latest technologies.
2	Build strong foundation in students making them job ready as per industry requirements.
3	Enable them to learn new technologies by applying foundation paradigms
4	Build strong expertise to develop end to end application - web frontend and backend development
5	Perform database manipulation using MySQL and authenticate data.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Construct a basic website using HTML and Cascading Style Sheets.
CO 2	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO 3	Create simple web pages in PHP and to represent data in XML format.
CO 4	Design and implement server side programs using PHP.
CO 5	Perform database manipulation using MySQL and authenticate data.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	1	-	-	1	-	1	2	2	2
CO2	2	1	2	1	1	3	-	-	-	-	1	2	2	2
CO3	2	1	2	1	1	-	-	2	2	-	2	2	2	2
CO4	2	1	2	1	1	-	-	-	2	2	2	2	2	2
CO5	2	2	2	1	1	3	2	2	-	-	2	2	2	2
CO	2	2	2	1	1	3	2	2	2	2	2	2	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT 1	**INTRODUCTION**	**9**
Concept of website, its need and purpose, Types of websites: Static and dynamic website, Introduction to HTML, XML, JSON, Web Browsers, –Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Tiered Architecture: Client Server Model, Three Tier Model, Service Oriented Architectures, REST services.		
UNIT 2	**HYPERTEXT MARKUP LANGUAGE (HTML)**	**9**
Languages used for website development, HTML5: basic tags, formatting tags, Adding images, Lists, Embedding multimedia in Web pages, Inserting tables, Internal and External Linking, Frames, Forms.		
UNIT 3	**CASCADING STYLE SHEETS (CSS)**	**9**
Basics of Cascading Style sheets, Advantages of CSS, External Style sheet, Internal style sheet, Inline style sheet, CSS Syntax, color, background, Font, images.		
UNIT 4	**JAVA SCRIPT**	**9**
Features of Java Script, extension of JavaScript, Syntax of Java Script: data types, operators, variables, tag, Document Object Model (DOM) with JavaScript, Selection Statement using if and Switch, Iterative statement: for, for/in, while, do while, break and continue.		
UNIT 5	**FRONT END FRAMEWORK AND BACK END TECHNOLOGIES**	**9**
Front End Framework: Introduction to jQuery - Syntax, Selectors, Events, Traversing, AJAX ; Introduction to Bootstrap – Basics, Grids, Themes ; Angular JS – Expressions, Modules, Data Binding, Scopes, Directives & Events, Controllers, Filters, Services, Validation. Back End Technologies: Introduction to RESTful services, Resources, Messages (Request, Response), Addressing, Methods – (GET, POST, PUT, DELETE).		
	Total Periods	**45**
LAB	**LIST OF EXPERIMENTS**	**15**
Students can be given a single web application development exercise covering all the units. This exercise can be also done in group of 2-3 students. Student can define the suitable web application example to implement as per their choice. It should cover followings: • Application should cover Create, Read, Update, Delete scenarios of data. • Frontendtobedevelopedcoveringallthetechnologies(HTML5,CSS3,jQuery,AngularJS) • Back end connectivity to be established through RESTful services and must have database connectivity. Student can choose any backend technologies and database for developing REST services required for the application development. RESTful services should be developed using technologies already familiar. E.g. Java OR C# OR Python etc.		

Text Book (s)

1	Deitel P. J., Deitel H. M. and Deitel A., “Internet and World Wide Web: How to Program”, Fifth Edition, Pearson Prentice Hall, 2012.
2	Jon Duckett, “HTML & CSS: Design and Build Websites”, First Edition, John Wiley & Sons, 2011.
3	Naramore E., Gerner J., Scouarnec Y.L., et al., “Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer”, John Wiley & Sons Inc., 2005.

Reference (s)

1	Sebesta R. W.,” Programming the World Wide Web”, Eight Edition, Pearson, 2014.
2	Pressman R. and Lowe D.,” Web Engineering: a practitioner's approach”, First Edition, Mc Graw Hill, 2008.
3	Kappel G., et al.,” Web Engineering: The Discipline of systematic Development of Web Applications”, First Edition, John Wiley & Sons, 2006.
4	Ullman L.” PHP for the Web: Visual Quick Start Guide”, Fifth Edition, Peach pit Press, 2016.

Regulation 2018		Semester VI	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
Elective	18CBE006J	DATA MINING AND ANALYTICS	3	0	2	4

Prerequisite course

Nil

Course Objective (s):
The purpose of learning this course is to:

1	Familiarize the fundamental concepts of data mining and data representation.
2	Learn the data pre-processing task and attribute oriented analysis.
3	Understand the association rules, classification and prediction algorithms.
4	Apply the linear and non-linear models of data analysis.
5	Acquire knowledge about the time series analysis and aspects of prescriptive analysis.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Understand the basic concepts and techniques of Data Mining and representation.
CO 2	Perform pre-processing task for the Dataset.
CO 3	Apply association rules and predictive methods for data mining.
CO 4	Develop data models using linear and non-linear regression techniques.
CO 5	Perform time series analysis and prescriptive analysis.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	2	1	1	1	1	-	2	1	2	1
CO2	2	2	1	-	2	1	2	-	-	-	2	2	1	1
CO3	3	3	1	-	3	-	1	-	-	-	3	1	2	3
CO4	2	3	-	-	2	1	1	1	-	-	2	2	2	2
CO5	2	2	2	2	3	-	1	2	-	-	3	3	3	3
CO	3	3	2	2	3	1	1	2	1	-	3	3	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

BOARD OF COMPUTER SCIENCE
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UNIT 1	INTRODUCTION TO DATA MINING	9
Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications.		
UNIT 2	DATA PREPROCESSING	9
Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. Data mining knowledge representation: Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques. Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures.		
UNIT 3	ASSOCIATION AND CLASSIFICATION ALGORITHMS	9
Association rules: Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules. Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models.		
UNIT 4	REGRESSION ANALYSIS	9
Descriptive Analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis. Forecasting models: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation. Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regressions, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models. Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma. Non Linear Regression (NLS): Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods. Introduction to semi parametric regression models, additive regression models. Introduction to nonparametric regression methods.		
UNIT 5	TIME SERIES ANALYSIS	9
Time Series Analysis: Auto-Covariance, Auto- correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing. Linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARMA models such as Yule- Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes, Forecasting using ARIMA models. Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modeling, Decision and Risk analysis, Decision trees.		
	Total periods	45
LAB	LIST OF EXPERIMENTS	15
1.	Installing Weka and exploring a dataset.	
2.	Loading a dataset and visualizing the Data	
3.	Preprocessing a dataset from a real domain(Medical/Retail/Banking)	
4.	Building a classifier- Run Decision Tree, Naïve Bayesian Classifier, NN classifier and SVM	

5.	Mining Association Rules- Run Apriori Algorithm.
6.	Building a statistical model using a sample dataset – preprocessing, hypothesis building, model fitting, model validation and interpretation of results.
7.	Implementation of linear regression technique for statistical model building.
8.	Implementation of Non-linear regression technique for statistical model building.
Text Book (s)	
1	Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2	LiorRokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010
3	Box, G.E.P and Jenkins G.M. Time Series Analysis, Forecasting and Control, Holden-Day,1970
Reference (s)	
1	Draper, N. R. and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third Edition. Hosmer, D. W. and Lemeshow, S. (1989). Applied Logistic Regression (Wiley).
2	Hosmer, D. W. and Lemeshow, S., "Applied Logistic Regression", Third Edition, Wiley, 2003.
3	Daniel T.Larose, "Data Mining Methods and Models", Wiley-Inter Science, 2006.
4	Jason Brownlee "Machine Learning Mastery with Weka",2020.
5	http://garfield.library.upenn.edu/classics1989/A1989AV48500001.pdf

Regulation 2018		Semester VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC401J	USABILITY DESIGN OF SOFTWARE APPLICATIONS	2	0	2	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To create a learning system through which management students can enhance their innovation and creative thinking skills
2	To acquaint themselves with the special challenges of starting new ventures
3	To use IPR as an effective tool to protect their innovations and intangible assets from Exploitation.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand the user-cantered design process to evaluate the different Assignments.
CO2	Apply heuristic evaluation techniques to evaluate the website and application
CO3	Implement ideas for developing and testing innovation through an assignment presentation
CO4	Design UX research techniques for analysing the application
CO5	Analyse the personal technique for different projects

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	2	-	-	-	-	-	-	-	-	2
CO2	3	2	2	1	1	-	-	-	-	-	-	-	-	3
CO3	2	3	3	3	3	-	-	-	-	-	-	-	2	3
CO4	2	1	2	3	2	-	-	-	-	-	-	-	1	2
CO5	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO (Avg)	3	3	3	3	3	-	-	-	-	-	-	-	2	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	INTRODUCTION TO USER CENTRED DESIGN	7
Basics of User Centered design- Aspects of User Centered Design - Product Appreciation Assignment -Evaluating the product from user centered design aspects such as functionality, ease of use, ergonomics, aesthetics.		
UNIT II	**HEURISTIC EVALUATION**	**6**
Heuristic Evaluation-10 Heuristic Principles-Examples-Heuristic Evaluation-Group Assignment initiation -Website and App- Evaluation for key tasks of the app or website for heuristic principles severity – recommendations.		
UNIT III	**PROJECT DESIGN LIFE CYCLE**	**4**
Redesign project through the design lifecycle- Discovery -Define-Design-Implement (Design Prototype) -Usability Testing.		
UNIT IV	**UX RESEARCH**	**5**
Understanding users, their goals, context of use and environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX.		
UNIT V	**PRODUCT DEVELOPMENT**	**8**
Presentation of Personas for the group project-Design Thinking Technique-Discovery and brainstorming-Concept Development-Task flow detailing for the Project-Prototyping Techniques Paper-Electronic -Prototyping Tools.		
	Total Periods	**30**
	Lab Experiments	**15**

1	Product Appreciation Assignment – Evaluating the product from User Centred Design aspects such as functionality, ease of use, ergonomics, and aesthetics.
2	Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.
3	Identify a website or an App to redesign, with justification
4	Analysis of the mobile app or the website through the design life cycle
5	Identifying Personas and Scenarios for the App or the website
6	Concept development and task flow detailing
7	Prototype development with Iterations and justification
8	Usability testing and demonstration

Text Book (s)

1	Jenny Preece, Helen Sharp and Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, , 2015, Wiley publications.
2	Jonny Schneider , “Understanding Design Thinking, Lean, and Agile”, 1 st Edition, 2020.

Reference (s)

1	Alan Cooper and Robert Reimann, “About Face”, John Wiley, 4th Edition, Wiley publications
2	Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, “Observing the User Experience: A Practitioner's Guide to User Research”, 2nd Edition, 2012.
3	Jesse James Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond, 2 nd Edition, 2021
4	Jonny Schneider,Understanding Design Thinking, Lean, and Agile, 2017

Regulation 2018		Semester VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	18CBC402J	IT WORKSHOP SKYLAB/ MAT LAB	2	0	2	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Introduce the students with the basic features of MATLAB for problem solving.
2	Introduce the students about the Mathematical functions like matrix generation
3	Multiple data sets, line styles and colors
4	Introduce the students about the Array operations and solving Linear equations in MATLAB.
5	Introduce the students about the control flow and operators using if-end structures and loops.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Formulate the basic principles of MATLAB operations.
CO2	Design the working session and multiple statements per line in MATLAB.
CO3	Design the application based on the concepts of sub matrix and its operation.
CO4	Apply the language of graphs and trees to the real world problems.
CO5	Apply formalized arguments based on conditional looping statements.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	1	-	1	-	-	-	1	2	-	1	-	-
CO2	2	2	1	-	2	-	-	-	1	2	-	1	-	-
CO3	2	1	1	-	1	-	-	-	2	2	2	1	1	1
CO4	2	1	1	-	1	-	-	-	1	2	-	1	-	-
CO5	2	1	1	-	1	-	-	-	2	2	2	1	-	-
CO (Avg)	2	2	1	-	2	-	-	-	2	2	2	[illegible]	1	1

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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26 MAY 2023

UNIT I	INTRODUCTION TO MATLAB	6
History, basic features, strengths and weaknesses, good programming practices and plan your code. Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands		
UNIT II	MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS	6
Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.		
UNIT III	BASIC PLOTTING	6
Overview, creating simple plots, adding titles, axis labels and annotations, multiple data sets in one plot, specifying line styles and colours.		
UNIT IV	**INTRODUCTION TO PROGRAMMING**	**6**
Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands. Control flow and Operators "if ... end structure", relational and logical operators, "for ... end" loop, "while ... end" loop, other flow structures, operator precedence, saving output to a file.		
UNIT V	**DEBUGGING M-FILES**	**6**
Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file.		
	Total Periods	**30**
	Lab Experiments	**15**
1	Programs using mathematical, relational expressions and the operators.	
2	Vectors and Matrices: Programs using array operations and matrix operations (such as matrix multiplication).	
3	Programs on input and output of values.	
4	Selection Statements: Experiments on if statements, with else and elseif clauses and switch statements.	
5	Loop Statements and Vectorising Code: Programs based on the concepts of counted (for) and conditional (while) loops.	
6	Programs based on scripts and user-defined functions.	
7	Programs on Built-in text manipulation functions and conversion between string and number types.	
8	Programs based on Advanced Plotting Techniques.	

Text Book (s)	
1	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
2	Stormy Attaway, Butterworth-Heinemann, "MATLAB: A Practical Introduction to Programming and Problem Solving", 5th Edition, 2018.
Reference (s)	
1	https://www.mathworks.com/content/dam/mathworks/mathworks-dot com/moler/exm/book.pdf
2	https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf
3	Digital Image Processing using MATLAB. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Pearson Education, Inc., 2004.
4	MATLAB: A Practical Introduction to Programming and Problem Solving. Stormy Attaway, Butterworth-Heinemann, 2017.

Regulation 2018		Semester VII	Total Hours			30
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
S	18MBS401T	MARKETING RESEARCH & MARKETING MANAGEMENT	2	0	0	2

Prerequisite Course (s)
NIL

Course Objective (s):
The purpose of learning this course is to:

1	To outline key marketing concepts and its application to different markets
2	To identify factors and processes essential for designing marketing strategy
3	To analyse and examine the implementation of marketing concepts and strategy to firms
4	Communicate and defend your recommendations and critically examine and build upon the recommendations of your classmates both quantitatively and qualitatively.
5	To provide you with opportunities to analyze marketing activities within the firm;

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Relate the functioning of elasticity of demand in micro economics.
CO2	Design the dynamics of marketing and analyse how its various components interact with each other in the real world
CO3	Apply marketing concepts for effective decision making
CO4	Apply the basic concepts , principles, statistical tools of marketing research
CO5	Analyze various strategies of Internet Marketing

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	1	-	1	-	-	-	2	-	2
CO2	1	-	1	-	2	2	-	1	-	-	-	2	-	3
CO3	2	-	-	-	1	-	1	-	2	-	-	1	-	1
CO4	1	-	2	-	2	2	1	-	1	-	-	-	-	2
CO5	1	-	1	-	1	-	2	-	2	-	-	2	1	2
CO (Avg)	2	-	2	-	2	2	2	1	2	[illegible]	[illegible]	2	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**MARKETING CONCEPTS AND APPLICATIONS**	**6**
Introduction to marketing & Core concept, Marketing of Services, importance of marketing in service sector -Marketing planning and Environment ; Elements of marketing mix; analysing the needs and trends in Environment- Macro, Economic, Political, Technical and Social-Understanding the Consumers -- Determinants of consumer behaviour and factors influencing consumer behaviour - Market Segmentation – Meaning and concept; Basis of segmentation, selection of segments, Segmentation strategies, Target marketing, Product Positioning.		
UNIT II	**PRODUCT MANAGEMENT**	**6**
Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging.		
UNIT III	**PRICING, PROMOTION AND DISTRIBUTION STRATEGY**	**6**
Policies & Practices -- Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising		
UNIT IV	**MARKETING RESEARCH**	**6**
Introduction, Type of Market Research, Scope, Objectives & Limitations - Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research. Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis.		
UNIT V	**INTERNET MARKETING**	**6**
Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing. Business to Business Marketing: Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy		
	Total Periods	**30**

Text Book (s)	
1	Philip Kotler and Kevin Lane Keller, "Marketing Management", PHI 14th Edition, 2012.
2	Donald R. Cooper, Pamela S. Schindler and J K Sharma, "Business Research Methods", 11th Edition, Tata
Reference (s)	
1	Paul Baines, Chris Fill and Kelly Page, "Marketing", Oxford University Press, 2nd Edition, 2011.
2	Uma Sekaran and Roger Bougie, "Research methods for Business", 5th Edition, Wiley India, New Delhi, 2012.
3	Rajan Saxena , Marketing Management, McGraw Hill Education,6th edition, 2019
4	William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari,Mitch Griffin, "Business Research methods, A South Asian Perspective", 8th Edition, Cengage Learning, New Delhi, 2012.

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Regulation 2018		Semester VII	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MBS402T	HUMAN RESOURCE MANAGEMENT	2	0	0	2

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To familiarize the students with Policies, Procedures and Practices, techniques of HRM
2	To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
3	To help the students focus on and analyse the issues and strategies required to select and develop manpower resources
4	To develop relevant skills necessary for application in HR related issues
5	To Enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Recognize the basic principles of Human Resource Management.
CO2	Relate the system design of Human Resource Management.
CO3	Apply the concepts, roles, functional areas and activities of HR.
CO4	Assess organization's employee, their interest, motivation, satisfaction belief of fair treatment.
CO5	Analyze actual impact on the firm's current performance and sustainability in the long run.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	2	1	1	2	1	-	-	2	-	2
CO2	1	-	2	-	1	1	2	-	-	-	-	-	-	1
CO3	2	1	2	-	2	-	1	-	3	-	-	2	-	2
CO4	2	-	1	-	1	2	1	-	3	[illegible]	[illegible]	[illegible]	[illegible]	2
CO5	1	2	-	-	1	1	2	-	1	[illegible]	1	[illegible]	[illegible]	1
CO (Avg)	2	2	2	-	2	2	2	2	3	-	[illegible]	2	-	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	HUMAN RESOURCE MANAGEMENT	6
Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.		
UNIT II	**HUMAN RESOURCE SYSTEM DESIGN**	**6**
HR Profession, and HR Department, Line Management Responsibility in HRM, Measuring HR, Human resources accounting and audit; Human resource Information System.		
UNIT III	**FUNCTIONAL AREAS OF HRM**	**6**
Recruitment and Staffing, Benefits, Compensation, Employee Relations, HR compliance, Organizational design, Training and Development, Human Resource Information Systems (H.R.I.S.) and Payroll.		
UNIT IV	**HUMAN RESOURCE PLANNING**	**6**
Demand Forecasting, Action Plans – Retention, Training, Redeployment & Staffing, Succession Planning.		
UNIT V	**STRATEGIC MANAGEMENT OF HUMAN RESOURCES**	**6**
SHRM, Relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace.		
	Total Periods	**30**

Text Book (s)

1	Prof. Gary Dessler, Human Resources Management, Pearson, 16th Edition, 2020.
2	Prof.John M.Ivancevich, "Human Resource Management", Tata McGraw Hill Publication, 12th Edition, 2003.

Reference (s)

1	Dr.C.B.Gupta, "Human Resource Management ", Sultan Chand & Sons, New Delhi, 1st Edition, 2018.
2	Prof.S.S.Khanka, "Human Resource Management", Chand & Company, New Delhi, 2019.
3	Dr.S.Seetharaman et al., "Human Resource Management", SciTech Publications Pvt Ltd. Chennai,2012.
4	Prof.Aswathappa, "Human Resource Management and Personnel Management", 3rd Edition, Tata McGraw Hill,

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Regulation 2018		Semester VII	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
P	18CBP401L	PROJECT EVALUATION I	0	0	4	2

Prerequisite course

NIL

Course Objective (s):
The purpose of learning this course is to:

1	Develop their own innovative prototype of ideas.
2	Train the students in preparing project reports and examination.

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO 1	Identify and review research literature to apply the knowledge of different engineering specialization to the solution of complex engineering problems
CO 2	Provide sustainable solution to solve complex engineering problem with consideration for public health, safety, cultural and societal needs.
CO 3	Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge of different disciplines
CO 4	Function effectively as an individual member or leader in a team and make clear presentation on multidisciplinary settings
CO 5	Apply management principles to function effectively in multidisciplinary environment for project execution
CO 6	Write effective reports and make clear presentation to the engineering community and society

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO3	3	-	3	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO (Avg)	3	3	3	-	-	3	3	-	3	3	3	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MBS403J	SERVICES SCIENCES & SERVICE OPERATIONS MANAGEMENT	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Understand the services and service operations management concepts.
2	Comprehend the techniques of service operations.
3	Understand the service quality and service design aspects.
4	Understand the service innovation aspects.
5	To analyse how services are different from products by its characteristics.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand the concept of service operation system.
CO2	Design of service development and delivery system
CO3	Design the service design and quality
CO4	Apply the forecasting demand of services
CO5	Analyse the strategies for managing service supply relationship

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	2	1	3	1	2	1	1	2	1	2	2
CO4	1	2	1	1	1	1	1	1	1	1	3	2	1	1
CO5	1	1	1	1	1	1	1	1	1	1	3	[illegible]	1	1
CO (Avg)	1	2	1	2	1	3	1	2	1	1	3	2	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	9
Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters. Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value co-creation.		
UNIT II	**SERVICE STRATEGY AND COMPETITIVENES**	**9**
Development of Strategic Service Vision (SSV), Data Envelopment Analysis-New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system - Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design - Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools.		
UNIT III	**SERVICE GUARANTEE & SERVICE RECOVERY**	**9**
Service quality GAP analysis, Service guarantee-recover from service failure		
UNIT IV	**FORECASTING DEMAND FOR SERVICES**	**9**
Types of demand forecasting methods for Managing Capacity and Demand: Strategies for matching capacity and demand, managing waiting line in services. Managing Facilitating Goods: inventory models, Role of inventory in services - Managing service supply relationship: Understanding the supply chain / hub of services, Strategies for managing suppliers of service - Vehicle Routing Problem: Managing after sales service-understanding services that involve transportation of people and vehicle. Techniques for optimizing vehicle routes		
UNIT V	**SERVICE INNOVATION**	**9**
Services Productivity, Need for Services Innovation, service innovation in different service sector – educational, health and hospitality sectors.		
	Total Periods	**45**
	Lab Experiments	**15**
1	Option 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.	
2	Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.	
Text Book (s)		
1	Fitzsimmons & Fitzsimmons, “Service Management: Operations, Strategy, Information Technology”, McGraw Hill publications, 7th Edition, 2017.	
2	Christopher H.Lovelock and JochenWirtz, “Services Marketing”, Pearson Education, New Delhi, 7th Edition, 2011.	
Reference (s)		
1	Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D., “ Services marketing: Integrating customer focus across the firm”, McGraw Hill, 2012	
2	Lovelock, C,Services, “ Marketing”, Pearson Education India, 7 th Edition ,2011	

3	Robert Johnson, Graham clark, "Service Operations Management", Pearson Education, 2nd Edition, 2005
4	Reason, Ben, and Lovlie, Lavrans, "Service Design for Business: A Practical Guide to Optimizing the Customer Experience", Pan Macmillan India, 2016.

Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
S	18MBS404J	IT PROJECT MANAGEMENT	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Gain knowledge on fundamental concepts of project and project scheduling.
2	Understand Project Cost Control, Scheduling and Management Features
3	Obtain knowledge on Agile Project Management.
4	Know about the Scrum framework in detail.
5	Obtain knowledge on DevOps and its related concepts.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Relate the concept of project management.
CO2	Apply the concept of project management scheduling
CO3	Analyse the features of project management with respect to AGILE model.
CO4	Design the services of SCRUM
CO5	Analyze the concept of Devops in project management.

CO-PO Mapping

COs	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	-	-	-	-	3	2	-	-	1	2
CO2	1	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	3	2	-	-	1	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	1	-	-	-	-	3	2	[illegible]	[illegible]	1	2
CO (Avg)	2	2	2	2	2	2	2	2	3	[illegible]	2	2	2	[illegible]

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	PROJECT OVERVIEW AND PROJECT SCHEDULING	9
Project Overview and Feasibility Studies: Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal. Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.		
UNIT II	COST CONTROL, SCHEDULING AND MANAGEMENT FEATURES	9
Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling. Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination.		
UNIT III	AGILE PROJECT MANAGEMENT	9
Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal.		
UNIT IV	SCRUM	9
Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study.		
UNIT V	DEVOPS	9
DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study.		
	Total Periods	**45**
LIST OF EXPERIMENTS		**15**

1	Estimation of project cost and control activity using open-source tools.
2	Scheduling of project with PERT and CPM techniques to estimate the completion time.
3	Assessment of IT Project Risk Analysis using open-source tools.
4	Perform IT Project Audit and generate a report using open-source tools.
5	Study of Agile project management tools
6	Application of Scrum practices in the project.
7	Design and perform automated testing.

Text Book (s)

1	Mike Cohn, "Succeeding with Agile: Software Development Using Scrum", Addison-Wesley Professional Publisher, 1st Edition, 2009.
2	Burke, R 2017, Fundamentals of project management, 2nd edn, Burke Publishing.

Reference (s)

1	Roman Pichler, "Agile Product Management with Scrum", Addison-Wesley publisher, 1st Edition, 2010.
2	Ken Schwaber, "Agile Project Management with Scrum (Microsoft Professional)", Microsoft Press US publisher, 1st Edition, 2004.
3	Argyris, Chris. Overcoming Organizational Defenses: Facilitating Organizational Learning. Boston: Allyn and Bacon, 1990.

4	Adams, S 2019, Dilbert Collections, Andrews McMeel Publishing.

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Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
P	18CBP402L	PROJECT EVALUATION II	0	0	8	4

Prerequisite course	
NIL	
Course Objective (s): The purpose of learning this course is to:	
1	Develop their own innovative prototype of ideas.
2	Train the students in preparing project reports and examination.
Course Outcome (s) (COs): At the end of this course, learners will be able to:	
CO 1	Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge
CO 2	Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion.
CO 3	Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice
CO 4	Test and Evaluate the performance of the developed solution using appropriate techniques and tools
CO 5	Apply management principles to function effectively in the project team for project execution
CO6	Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs.
CO7	Write effective reports and make clear presentation to the engineering community and society

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	-	-	3	-	-	-	-	-	-	-
CO2	-	3	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3			3	-	-	-	-	-	-
CO4	-	3	-	-	3	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO6	-	-	-	-	-	3	3	-	-	-	-	3	-	-
CO7	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO (Avg)	3	3	3	3	3	3	3	3	3	3	3	3		-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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Regulation 2018		Semester VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE007T	COGNITIVE SCIENCE & ANALYTICS	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Introduction to cognitive science, psychology, nervous system and brain
2	Understand brain and sensory motor information, representation of sensory information.
3	Learn Data Theory and Taxonomy of Data.
4	Perform Multivariate Data Analytics & Cognitive Analytics
5	Learn fundamentals of Artificial Intelligence and Machine Learning .

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Recognize the basic concepts in Neural network model.
CO2	Apply the machine learning models and analyze the relationship between ML and Cognitive Science
CO3	Design the information processing models using brain imaging.
CO4	Apply the weka tool for information processing
CO5	Analyze the usage of various mathematical models in neuroscience

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	0	2	-	-	-	1	-	2	1	2	1
CO2	2	2	1	0	2	-	-	-	-	-	2	2	1	1
CO3	3	2	1	0	2	-	-	-	-	-	2	1	2	2
CO4	2	2	0	0	2	-	-	-	-	-	2	2	2	2
CO5	2	2	2	2	2	-	-	-	-	-	2	2	2	2
CO (Avg)	3	3	1	1	2	-	-	-	1	-	[illegible]	[illegible]	[illegible]	[illegible]

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION TO THE STUDY OF COGNITIVE SCIENCES	9
Introduction to the study of cognitive sciences - A brief history of cognitive science - Methodological concerns in philosophy - Artificial intelligence and psychology - Structure and constituents of the brain - Brief history of neuroscience - Mathematical models - Looking at brain signals - Processing of sensory information in the brain.		
UNIT II	**COGNITIVE MODELS**	**9**
Brain Imaging - FMRI, MEG - PET, EEG - Multisensory integration in cortex - Information fusion - From sensation to cognition – Cybernetics - From physics to meaning, Analog vs. Digital: Code duality.		
UNIT III	**LINGUISTIC KNOWLEDGE**	**9**
Linguistic knowledge: Syntax, semantics, (and pragmatics) - Generative linguistic - Brain and language - Language disorders – Lateralization - The great past tense debate - Cognitivist and emergent stand points - A robotic perspective.		
UNIT IV	**AFFORDANCES**	**9**
Direct perception - Ecological Psychology - Affordance learning in robotics - Child and robotic development - Attention and related concepts - Human visual attention - Computational models of attention - Applications of computational models of attention.		
UNIT V	**CATEGORIES AND CONCEPTS**	**9**
Logic; Machine learning - Constructing memories - Explicit vs. implicit memory - Information processing (three-boxes) model of memory - Sensory memory; Short term memory – Long term memory; Rationality - Bounded rationality; Prospect theory; Heuristics and biases - Reasoning in computers - Key points in social cognition - Context and social judgment; Schemas; Social signals.		
	Total Periods	**45**

Text Book (s)

1	Pradeep Kumar Mallick, Samarjeet Borah," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.
2	Cryptography, Theory and Practice. D. R. Stinson, CRC Press, 2018.

Reference (s)

1	Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2020.
2	Handbook of Applied Cryptography. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, CRC Press, 2014.
3	Basic Vision: An Introduction to Visual Perception" by Robert Snowden and Peter Thompson
4	"An Introduction to Cognitive Behaviour Therapy: Skills and Applications" by Joan Kirk and Helen Kennerley.

Regulation 2018		Semester VII	Total Hours			45
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
E	18CBE008T	INTRODUCTION TO IOT	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To understand about the fundamentals of Internet of Things and its building blocks along with their characteristics
2	To gain knowledge about IoT Architecture.
3	To understand and learn about Sensors and industrial systems.
4	To understand the other associated technologies like networking and communication in the domain of IoT.
5	To understand the data processing and standards designed for IoT and the current research on it.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Identify the fundamental building blocks and use cases of IoT.
CO2	Recognize the Reference Architecture in IoT
CO3	Design and develop IoT based sensor systems
CO4	Design the networking and communication protocols used in IoT
CO5	Analyze the data processing and storage in IoT

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	3	1	2	2	2	-	2	2	2
CO2	3	2	3	2	-	3	2	2	3	2	-	3	2	2
CO3	3	2	3	2	-	3	2	2	2	2	-	2	2	2
CO4	3	2	3	2	-	2	2	2	2	3	-	3	2	2
CO5	2	2	2	2	-	3	2	2	3	3	-	3	2	2
CO (Avg)	3	2	3	2		3	2	2	3	3		3	2	

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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<table>
<tr><td><b>UNIT I</b></td><td><b>INTRODUCTION TO IOT AND USE CASES</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.</td></tr>
<tr><td><b>UNIT II</b></td><td><b>ARCHITECTURE</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing.</td></tr>
<tr><td><b>UNIT III</b></td><td><b>SENSORS AND INDUSTRIAL SYSTEMS</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.</td></tr>
<tr><td><b>UNIT IV</b></td><td><b>NETWORKING AND COMMUNICATION FOR IOT</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications - web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers).</td></tr>
<tr><td><b>UNIT V</b></td><td><b>IOT DATA PROCESSING AND STORAGE</b></td><td><b>9</b></td></tr>
<tr><td colspan="3">Time series data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.</td></tr>
<tr><td colspan="2" align="right"><b>Total Periods</b></td><td><b>45</b></td></tr>
</table>

<table>
<tr><td colspan="2"><b>Text Book (s)</b></td></tr>
<tr><td>1</td><td>Samuel Greengard, “The Internet of Things-Essential Knowledge Series”, MIT Press, 1 st Edition, 2015.</td></tr>
<tr><td>2</td><td>Ben Fry, “Visualizing Data-Exploring and Explaining Data with the Processing Environment”, O'Reilly Media, 2007.</td></tr>
<tr><td colspan="2"><b>Reference (s)</b></td></tr>
<tr><td>1</td><td>Ben Fry, “Visualizing Data-Exploring and Explaining Data with the Processing Environment”, O'Reilly Media, 2007.</td></tr>
<tr><td>2</td><td>Andrew K Dennis, “Raspberry Pi Computer Architecture Essentials”, 2016.</td></tr>
<tr><td>3</td><td>M. Banzi, “Getting Started with Arduino”, O Reilly Media.</td></tr>
<tr><td>4</td><td>World Economic Forum Report on Industrial Internet of Things.
https:\\www.weforum.org/reports/industrialinternet-things</td></tr>
</table>

Regulation 2018		Semester VII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE009T	CRYPTOLOGY	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To understand the Basics of Number Theory
2	To be able to secure a message over an insecure channel by various means.
3	To use a variety of public key cryptosystems and authentication methods.
4	To gain a better understanding of the different security applications
5	To acquire a deeper insight of quantum computing on cryptography and security.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Recognize the elementary cryptosystem mechanisms
CO2	Apply the working principles of basic security services
CO3	Implement the types of symmetric and public ciphers in security services.
CO4	Analyze the privacy issues and use the appropriate security measures.
CO5	Analyze the implications of quantum computing on cryptography and security.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2		-	-	-	-	1	1	2	-
CO2	2	2	2	2	2	-	-	-	1	-	1	1	2	1
CO3	2	2	2	2	2	-	-	-	1	-	1	1	2	2
CO4	2	2	2	2	2	-	-	-	1	-	1	1	2	2
CO5	2	2	2	2	2	-	-	-	-	-	1	1	2	-
CO (Avg)	3	2	2	2	2	-	-	-	1	-	1	1	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	INTRODUCTION	9
Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems. Basic security services: confidentiality, integrity, availability, non-repudiation, privacy		
UNIT II	**SYMMETRIC KEY CRYPTOSYSTEMS**	**9**
Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC; Block Ciphers: DES, AES and Modes of Operation.		
UNIT III	**PUBLIC KEY CRYPTOSYSTEM & AUTHENTICATION**	**9**
Public Key Cryptosystems : RSA, ECC; Digital signatures; Hash Functions; Authentication		
UNIT IV	**SECURITY APPLICATIONS**	**9**
Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications.		
UNIT V	**QUANTUM CRYPTANALYSIS & POST-QUANTUM CRYPTOGRAPHY**	**9**
Quantum cryptography, quantum encryption, Issues related to Quantum Cryptanalysis. Post-Quantum Cryptography: Lattice-based cryptography : NTRU, Hash-based cryptography :SPHINCS, Multivariate cryptography: Rainbow.Time series data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.		
	Total Periods	**45**

Text Book (s)

1	Samuel Greengard, "The Internet of Things-Essential Knowledge Series", MIT Press, 1 st Edition, 2015.
2	A. Menezes, P. Van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC Press, 5th printing,2001.

Reference (s)

1	Stallings William, "Cryptography and Network Security - Principles and Practice", Pearson, Seventh Edition, 2017.
2	Neal Koblitz, "A course in number theory and cryptography", GTM, Springer
3	Ross Anderson, "Security Engineering", Wiley, 3rd Edition, 2020.
4	http://theory.caltech.edu/~preskill/ph229/

Regulation 2018		Semester VII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE010T	QUANTUM COMPUTATION AND QUANTUM INFORMATION	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To learn about Quantum information.
2	To gain knowledge about Quantum algorithms.
3	To understand and learn about Quantum random number generators.
4	To understand and learn about Quantum key distribution.
5	To study the basis of Post-Quantum cryptography.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Apply quantum gates and circuits using quantum information.
CO2	Apply quantum algorithms in cryptosystems
CO3	Relate the importance of Quantum random number generator.
CO4	Understand the importance of Quantum key distribution.
CO5	Apply the concept of post-quantum cryptography

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	2	2	3	3
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	3
CO3	3	3	2	2	2	1	-	-	-	-	1	1	3	3
CO4	3	3	2	3	2	1	-	-	-	-	1	1	3	3
CO5	3	3	2	2	2	1	-	-	-	-	1	1	3	3
CO (Avg)	3	3	2	3	2	1	-	-	-	-	1	1	3	3

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	**INTRODUCTION TO QUANTUM INFORMATION**	**12**
States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits		
UNIT II	**QUANTUM ALGORITHMS**	**12**
Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems. Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems		
UNIT III	**QUANTUM TRUE RANDOM NUMBER GENERATORS (QTRNG)**	**12**
Detailed design and issues of quantum ness, Commercial products and applications		
UNIT IV	**QUANTUM KEY DISTRIBUTION (QKD)**	**12**
BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products		
UNIT V	**INTRODUCTORY TOPICS IN POST-QUANTUM CRYPTOGRAPHY**	**12**
Refer to https://csrc.nist.gov/projects/post-quantum-cryptography. May discuss any two ciphers from this list Time series data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.		
	Total Periods	**60**

Text Book (s)

1	Quantum Computation and Quantum Information. M. A. Nielsen and I. L. Chuang, Cambridge University Press.
2	Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/

Reference (s)

1	An Introduction to Quantum Computing. P. Kaye, R. Laflamme, and M. Mosca, Oxford University Press, New York.
2	Quantum Computer Science. N. David Mermin:, Cambridge University Press.
3	Quantum Cryptography. D. Unruh:, Available online: https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/.
4	NIST Post Quantum Cryptography, Available online : https://csrc.nist.gov/projects/postquantum-cryptography/round-2-submissions

Regulation 2018		Semester VII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE011J	ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):
The purpose of learning this course is to:

1	To learn the fundamentals of text mining analysis.
2	To be able to use various tools for text mining and carry out pattern discovery, predictive modelling
3	Explore the use of social network analysis to understand the growing connectivity and complexity
4	Perform social network analysis to identify important network properties in social media sites.
5	Analysing interactions between people, and determine structural patterns in such interactions in real time application

Course Outcome (s) (COs):
At the end of this course, learners will be able to:

CO1	Recognize the trends in recent years on online social networks.
CO2	Apply the graphical relation between the community.
CO3	Design various social network algorithms related to predictive modelling and pattern Discovery.
CO4	Analyze the relation between the participants of various social media.
CO5	Apply Social Network Mining Tools and apply in real time problems

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	2	2	-	-	-	-	1	3	2
CO2	2	2	3	2	2	2	2	2	-	-	-	1	3	2
CO3	3	3	3	2	2	2	2	-	-	-	2	1	3	2
CO4	2	2	3	2	2	2	2	2	-	-	[illegible]	1	3	2
CO5	3	3	3	2	2	2	2	-	-	[illegible]	[illegible]	[illegible]	3	2
CO (Avg)	3	3	3	2	2	2	2	2	-	[illegible]	2	1	3	

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

26 MAY 2023

UNIT I	**INTRODUCTION TO TEXT MINING**	**9**
Introduction- Defining text mining, general architecture of text mining systems. Core text mining operations- Using background knowledge for text mining, Text mining query languages. Pre-processing techniques-Task oriented approaches. Categorization-Applications of text categorizations. Definition of the problem. Document representations. Knowledge engineering approach to TC. Machine learning approach to TC, Using unlabeled evaluation of text classifiers.		
UNIT II	**INFORMATION EXTRACTION**	**9**
Information extraction –Introduction, Historical evolution, Examples, Architecture of IE systems, Anaphora Resolution, Inductive algorithms, Structural IE. Probabilistic models for information extraction- Hidden Markov Models, Stochastic Context Free Grammars, Maximal entropy modeling, Maximal entropy Markov Models, Conditional Random Fields. Text mining applications.		
UNIT III	**CLUSTERING,TEXT MINING METHODS & APPROACHES**	**9**
Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling; Sentiment Analysis; Sentiment Prediction.		
UNIT IV	**WEB ANALYTICS**	**9**
Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models		
UNIT V	**SOCIAL MEDIA ANALYTICS**	**9**
Social network and web data and methods. Graphs and Matrices-Why Graphs? Graphs, Directed Graphs, Signed Graphs, Valued Graphs, Multigraphs, Hypergraphs, Relations, Matrices. Basic measures for individuals and networks. Information visualization: Architectural considerations, common visualization approaches for text mining, visualization technique in link analysis; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis.		
	Total Periods	45
	LIST OF EXPERIMENTS	**15**
1.	Installation of NLTK and perform simple tokenize on any web page.	
2.	Find the frequency distribution of words for the given web page.	
3.	Perform word stemming using NLTK.	
4.	Perform an experiment for text summarization applying Deep Learning.	
5.	Collect the Tweets of a particular Movie and interpret the influence of the Movie providing the Positive/Negative Comments.	
6.	Analyze emoticons feedbacks of consumable product and conclude whether to buy a product or not from e-newspaper.	
7.	Based upon the counts of share, like, comments for a post in Facebook, analyze and comment the Post.	
8.	Consider the role of a marketing manager for an apparel software company and develop a campaign for LinkedIn target audience.	
9.	Use Tableau to derive decision for knowledge worker from available previous data sets.	
10.	Create an ontology for news article in English contents that are good/bad to the country.	

Text Book (s)	
1	Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability", Edition 1, 2009.
2	Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, Edition 1, 2006.
Reference (s)	
1	Wasserman, S. & Faust, K.. "Social Network Analysis: Methods and Applications", New York: Cambridge University Press, 1994.
2	Monge, P. R. & Contractor, N. S., "Theories of Communication Networks", New York: Oxford University Press, 2003.
3	http://nosh.northwestern.edu/vita.html
4	Hansen, Derek, Ben Sheiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights from a Connected World", Morgan Kaufmann, 2011.

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Regulation 2018		Semester VII	Total Hours			60
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
E	**18CBE012J**	**MOBILE COMPUTING**	**3**	**0**	**2**	**4**

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To learn about the mobile infrastructure, radio resource management, overview of generation 1G to 5G.
2	To illustrate the location management involved in GSM, Mobile IP.
3	To illustrate the transmission, transaction technology involved in mobile.
4	To explore the wireless network in mobile.
5	To discover the cognitive radio networks in mobile

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Relate and apply the various concepts of Basics of Number Theory
CO2	Implement a message over an insecure channel by numerous symmetric key cryptosystem
CO3	Apply diverse Public Key Cryptosystem & Authentication
CO4	Implement varied Security Applications
CO5	Summarize the implications of quantum computing on cryptography and security

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	3	-	1	3	3	2
CO2	2	3	3	3	3	-	-	-	-	-	1	1	3	2
CO3	-	2	3	3	3	-	2	2	2	-	2	2	2	3
CO4	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO5	2	3	3	3	3	3	-	2	-	-	3	3	3	3
CO (Avg)	3	3	3	3	3	3	3	2	3	2	3	[illegible]	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**INTRODUCTION**	**9**
Overview of wireless and mobile infrastructure, Preliminary concepts on cellular architecture, and path loss models, Channel interference and frequency reuse, Cell splitting, Channel assignment strategies, Overview of generations:- 1G to 5G.		
UNIT II	**LOCATION AND HANDOFF MANAGEMENT**	**9**
Introduction to location management (HLR and VLR), Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based), Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model), Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based), Terminal Paging (Simultaneous paging, Sequential paging), Location management and Mobile IP, Overview of handoff process, Factors affecting handoffs and performance evaluation metrics, Handoff strategies, Different types of handoffs (soft, hard, horizontal, vertical).		
UNIT III	**WIRELESS TRANSMISSION FUNDAMENTALS**	**9**
Introduction to narrow and wideband systems, Spread spectrum, Frequency hopping, Introduction to MIMO, MIMO Channel Capacity and diversity gain, Introduction to OFDM, MIMO-OFDM system, Multiple access control (FDMA, TDMA, CDMA, SDMA), Wireless local area network, Wireless personal area network (Bluetooth and zigbee).		
UNIT IV	**WIRELESS NETWORKS**	**9**
Mobile Ad-hoc networks - Characteristics and applications; Coverage and connectivity problems, Routing in MANETs, Wireless sensor networks - Concepts, basic architecture, design objectives and applications; Sensing and communication range, Coverage and connectivity, Sensor placement, Data relaying and aggregation, Energy consumption, Clustering of sensors, Energy efficient Routing (LEACH).		
UNIT V	**COGNITIVE RADIO NETWORKS**	**9**
Fixed and dynamic spectrum access, Direct and indirect spectrum sensing, Spectrum sharing, Interoperability and co-existence issues, Applications of cognitive radio networks, Introduction to D2D communications-High level requirements for 5G architecture, Introduction to the radio resource management, power control and mode selection problems, Millimeter wave Communication in 5G.		
	Total Periods	**45**
	LIST OF EXPERIMENTS	**15**

	Design and Development of different wireless network protocols using network simulators such as NS-3/ OMNET++
1.	MAC Protocol
2.	Routing Protocol
3.	Transport Protocol
4.	Congestion Control Protocol
5.	Application Protocol
6.	Security Protocol

Text Book (s)

1	Jochen Schiller, "Mobile Communications", Second Edition, Pearson, 2004.
2	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005

Reference (s)	
1	Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, "Principles of Mobile Communication", Springer, 2017.
2	Theodore Rappaport, "Wireless Communications: Principles and Practice", Pearson Education, 2014.
3	Travis Keshav, Location Management in Wireless Cellular Networks. 2006. https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf.
4	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, 2003.

Regulation 2018		Semester VIII	Total Hours			45
Category	**Course Code**	**Course Name**	**Hours / Week**			**C**
			L	**T**	**P**	
E	18CBE013T	BEHAVIORAL ECONOMICS	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Understand the concept and theory of economics
2	Acquire knowledge on the choices and behavior of firms, households and other economics entities.
3	Learn the behavioral science perspective in economics.
4	Know the current ideas and concepts regarding decision making in economics.
5	Study the inter temporal choice in economics.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Interpret and apply various concepts in traditional and modern Microeconomics.
CO2	Analyze decision making, and develop a holistic understanding of these concepts and their interconnections.
CO3	Apply knowledge on behavioral science perspective in Economics
CO4	Analyze current ideas and concepts regarding decision making in Economics.
CO5	Relate the inter temporal choice in Economics.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	3	1	-	-	2	2	2	1	1	1
CO2	2	1	1	2	2	1	-	-	1	1	2	1	-	1
CO3	1	-	1	2	2	2	-	-	-	1	1	1	-	1
CO4	1	1	0	3	3	2	-	-	-	1	1	1	-	1
CO5	1	2	0	3	3	3	-	-	-	1	1	1	[illegible]	1
CO (Avg)	2	2	1	3	3	3	-	-	2	2	2	[illegible]	1	[illegible]

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

<table>
<tr><td><b>UNIT I</b></td><td><b>INTRODUCTION</b></td><td>9</td></tr>
<tr><td colspan="3">The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications – gains and losses, money illusion, charitable donation.</td></tr>
<tr><td><b>UNIT II</b></td><td><b>BASICS OF CHOICE THEORY</b></td><td>9</td></tr>
<tr><td colspan="3">Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis – consumption and addiction, environmental protection, retail therapy; applications – pricing, valuation, public goods, choice anomalies.</td></tr>
<tr><td><b>UNIT III</b></td><td><b>BELIEFS, HEURISTICS AND BIASES</b></td><td>9</td></tr>
<tr><td colspan="3">Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self projection; inconsistent and biased beliefs; probability estimation; trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia, policy analysis – norms and markets, labor markets, market clearing, public goods; applications – logic and knowledge, voluntary contribution, compensation design.</td></tr>
<tr><td><b>UNIT IV</b></td><td><b>CHOICE UNDER UNCERTAINTY</b></td><td>9</td></tr>
<tr><td colspan="3">Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications – ownership and trade, income and consumption, performance in sports. Strategic choice-Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signalling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry.</td></tr>
<tr><td><b>UNIT V</b></td><td><b>INTERTEMPORAL CHOICE</b></td><td>9</td></tr>
<tr><td colspan="3">Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts – future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis – mobile calls, credit cards, organization of government; applications – consumption and savings, clubs and membership, consumption planning. Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion.</td></tr>
<tr><td colspan="2" align="right"><b>Total Periods</b></td><td>45</td></tr>
<tr><td colspan="3"><b>Text Book (s)</b></td></tr>
<tr><td>1</td><td colspan="2">N. Wilkinson and M. Klaes, “An Introduction to Behavioral Economics”, 2017.</td></tr>
<tr><td>2</td><td colspan="2">Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, “Economics”, 19th edition, Tata McGraw Hill, 2010.</td></tr>
<tr><td colspan="3"><b>Reference (s)</b></td></tr>
<tr><td>1</td><td colspan="2">William Boyes and Michael Melvin, “Textbook of Economics”, DTECH, 6th Edition, 2004.</td></tr>
<tr><td>2</td><td colspan="2">N. Gregory Mankiw, “Principles of Economics”, Thomson learning, 3rd Edition, 2003.</td></tr>
</table>

3	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, 2003.
4	Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, "Principles of Mobile Communication", Springer, 2017.

Regulation 2018		Semester VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE014T	COMPUTATIONAL FINANCE AND MODELLING	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To understand existing financial models in a quantitative and mathematical way.
2	To obtain the knowledge of quantitative tools to solve complex problems in the areas of Portfolio management, risk management and financial engineering.
3	To clarify the approaches required to calculate the price of options and identify the methodsrequired to analyze information from financial data and trading systems.
4	To acquire the Option products appropriately and construct portfolios of options.
5	To examine the financial data using for statistical techniques.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Construct financial models in a quantitative and mathematical way.
CO2	Apply quantitative tools in Financial Engineering.
CO3	Analyze appropriate products from financial markets to hedge the risk.
CO4	Identify the option products appropriately and construct portfolios of options.
CO5	Recognize statistical analysis of financial returns.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	0	2	2	-	-	2	-	1	1
CO2	3	2	3	2	3	1	2	3	-	-	2	-	2	2
CO3	2	2	2	3	2	2	1	3	-	-	2	-	2	2
CO4	3	3	2	2	3	2	2	3	-	-	3	-	2	2
CO5	1	3	1	2	2	3	2	3	-	-	3	-	3	2
CO (Avg)	3	3	3	3	3	3	2	3	[illegible]	-	2	[illegible]	2	2

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

UNIT I	**NUMERICAL METHODS FOR FINANCE**	**9**
Numerical methods relevant to integration-differentiation and solving the partial differential equations of mathematical finance-examples of exact solutions including Black Scholes and its relatives-finite difference methods including algorithms and question of stability and convergence-treatment of near and far boundary conditions-the connection with binomial models-interest rate models-early exercise and the corresponding free boundary problems-and a brief introduction to numerical methods for solving multi-factor models		
UNIT II	**BLACK SCHOLES FRAMEWORK**	**9**
Black-Scholes framework: Black-Scholes PDE: simple European calls and puts - put call parity - The PDE for pricing commodity and currency options - Discontinuous payoffs - Binary and Digital options The Greeks: theta - delta - gamma - vega& rho and their role in hedging - The mathematics of early exercise - American options: perpetual calls and puts - optimal exercise strategy and the smoothpasting condition - Volatility considerations - actual - historical - and implied volatility - local vol and volatility surfaces.		
UNIT III	**FINANCIAL PRODUCTS AND MARKETS**	**9**
Financial Products and Markets: Introduction to the financial markets and the products: Equities - indices - foreign exchange and commodities - Options contracts and strategies for speculation and Hedging		
UNIT IV	**APPLICATION AREAS**	**9**
The pricing of American options - pricing interest rate dependent claims and credit risk - The use of importance sampling for Monte Carlo simulation of VaR for portfolios of options - Copulas - hedging in incomplete markets - American Options - Exotic options - Electronic trading, Jump Diffusion Processes - High-dimensional covariance matrices - Extreme value theory, Statistical Arbitrage.		
UNIT V	**STATISTICAL ANALYSIS**	**9**
Statistical Analysis of Financial Returns: Fat - tailed and skewed distributions - outliers - stylized facts of volatility - implied volatility surface and volatility estimation using high frequency data		
	Total Periods	**45**
Text Book (s)		
1	R. Seydel,Tools for Computational Finance, 2nd edition, Springer-Verlag, New York, 2019	
2	P. Glasserman, Monte Carlo Methods in Financial Engineering, Springer-Verlag, New York,2003	
Reference (s)		
1	A. Lewis,Option Valuation under Stochastic Volatility, Finance Press, Newport Beach,California, 2016	
2	A. Pelsser,Efficient Methods for Valuing Interest Rate Derivatives, Springer-Verlag, New York,2000	

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3	Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, “Principles of Mobile Communication”, Springer, 2017.
4	Travis Keshav, Location Management in Wireless Cellular Networks. 2006. https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf

Regulation 2018		Semester VIII	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE015T	PSYCHOLOGY	3	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Students will demonstrate familiarity with the major concepts, theoretical perspectives, empirical findings, and historical trends in psychology.
2	Students will understand basic methodological approaches used in psychology, including research design, analysis, and interpretation
3	To make students familiar with employee performance
4	To familiarize the students with employee motivation and satisfaction
5	Students will understand and be able to apply psychological principles to individual, interpersonal, group, leadership and societal issue

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand the major content areas of Industrial Psychology.
CO2	Identify comfort with statistical concepts in the context of making personnel decisions.
CO3	Apply practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being.
CO4	Analyze your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions.
CO5	Relate other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	2	1	-	1	1	-	2	-	3
CO2	1	1	2	-	-	2		1	3	1	-	1	-	2
CO3	2	-	3	-	-	3	1	1	-	2	-	1	-	2
CO4	2	1	-	-	-	-	2	3	-	1	-	2	-	1
CO5	2	2	2	-	-	3	1	1	1	1	[illegible]	2	[illegible]	1
CO (Avg)	2	2	2	-	-	3	1	3	3	2	[illegible]	2	-	

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	**INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY**	**9**
Industrial/Organizational Psychology: Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modeling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment.		
UNIT II	**TEST VALIDATION**	**9**
Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods.		
UNIT III	**PERFORMANCE EVALUATION**	**9**
Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.		
UNIT IV	**MOTIVATION AND COMMITMENT**	**9**
Employee Motivation, Satisfaction and Commitment, Fairness and Diversity.		
UNIT V	**LEADERSHIP AND TEAMS**	**9**
Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behaviour, Stress Management: Demands of Life and Work.		
	Total Periods	**45**

Text Book (s)	
1	Elmes, D., Kantowitz, B., & Roediger, H, "Research methods in psychology", Cengage Learning, 9th Edition, 2011.
2	Landy, F. J. and Conte, J. M, "Work in the 21st Century", Oxford: Blackwell Publishing, 4th Edition, 2013.

Reference (s)	
1	Breakwell, G.M., Smith, J.A., &Wright, D.B, "Research methods in psychology", Sage, 4th Edition, 2012.
2	TV.Rao, "Performance Management towards Organizational Excellence", Sage, 2nd Edition, 2016.
3	Stephen Robbins, Tim Judge, Neharika Vohra, "Organizational Behaviour", Pearson, 18th Edition, 2019.
4	Pratibha Goyal , Alok Chakrawal , "Stress Management", Studera Press, 1st Edition, 2016.

Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE016J	ENTERPRISE SYSTEMS	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	Understand the concept of Simple Web Applications using MVC.
2	Be exposed to different models in SOA and ERP.
3	Be exposed to CRM models.
4	Be exposed to interactive networks and applications.
5	Be familiar with configuration of networking.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Design and deploy Simple Web Applications using MVC.
CO2	Analyze SOA and ERP models.
CO3	Design of CRM models.
CO4	Design interactive network and application.
CO5	Manage, Maintain and configuration of Networking.

CO-PO Mapping

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	1	-	-	-	1	2	2	1	2	2
CO2	1	1	1	-	1	-	-	-	-	1	1	-	1	1
CO3	1	1	-	-	1	-	-	-	1	-	-	1	1	2
CO4	1	1	-	-	1	-	-	-	1	-	-	1	2	2
CO5	2	2	2	1	1	-	-	-	1	1	[illegible]	[illegible]	2	2
CO (Avg)	1	1	1	1	1	-	-	-	1	[illegible]	2	[illegible]	2	[illegible]

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

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UNIT I	WEB APPLICATIONS USING MVC	8
Overview of Database Management Systems; Overview of Model - View - Control (MVC); Control (MVC) method of software development in a 3 tier environment - Tools and Technologies; Brief overview of the following : Java server pages; Related Java Technologies; Microsoft .NET framework; PHP; Ruby on Rails; JavaScript; Ajax; Angular/React JS		
UNIT II	**SOA AND ERP MODELS**	**8**
Service Oriented Architecture (SOA); Principles of loose coupling, encapsulation; Inter-operability; Web Services as the implementation vehicle protocols, usage; Enterprise Resource Planning (ERP); systems and their architecture; Overview of SAP and Oracle Applications; Generic ERP Modules: Finance; HR; Materials Management; Investment, etc.; Examples of Domain Specific Modules.		
UNIT III	**CRM MODELS**	**9**
Electronic Data Exchange; Customer Relationship Management (CRM); Customer Relationship Management (CRM); Supplier Relationship Management (SRM) ; Security Issues - Authentication, Authorisation, Access control ; Roles; single-sign-on ; Directory servers, Audit trails; Digital signatures; Encryption: review of IPSec, SSL and other technologies; Simple Applications Demo; Case study.		
UNIT IV	**INTERACTIVE NETWORK AND APPLICATION**	**12**
Overview of : MPLS ; Virtual Private Networks (VPN) ; Firewalls ; Network monitoring and enforcement of policies ; Software Acquisition Process ; Tendering; conditions of contract ; Commercial off the shelf software (COTS) versus Bespoke Implementations; Total cost of ownership; Issues on using Open source software or free software; Licensed software; Case study.		
UNIT V	**CONFIGURATION OF NETWORKING**	**8**
Hardware Architectures for Enterprise Systems; Servers; Clustering; Storage area networks; Storage units; Back-up strategies; Local Area Network (LAN) technologies and products; Data Centres; Disaster recovery site design and implementation issues; Hardware Acquisition Issues; Case study.		
	Total Periods	**45**
	LIST OF EXPERIMENTS	**15**
1	Create a Movie Database Application using MVC.	
2	Creating an ASP.NET MVC Web Application Project	
3	Explore the client/server architecture of SAP. Learn how to use the user interface	
4	Create customer, material master data. Execute the sales process in SAP.	
5	Create vendor, material master data for purchasing. Execute the Purchasing process in SAP.	
6	A model of customer relationship management and business intelligence systems for catalogue and online retailers.	
7	A model of customer relationship management and business intelligence systems for catalogue and online retailers with access control.	
8	Configure firewall settings for an interactive network	
9	Configure and Implement a COTS	
10	Mini project	
Text Book (s)		
1	Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 3rd Edition, 2017.	

2	Alexis Leon, "Enterprise Resource Planning – Diversified",TMH, 2 nd Edition.
Reference (s)	
1	Ravi Shankar & S. Jaiswal, Galgotia, "Enterprise Resource Planning", 1 st Edition, 1999.
2	Dr. Ravi Kalakota, "E-Business Network Resource planning using SAP R/3 Baan and Peoples soft: A Practical Roadmap For Success", Pearson, 2nd Edition, 2001.
3	Enterprise Resource Planning-RaviShankar and S.Jaiswal, Galgotia, 1st Ed, 1999.
4	Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill, 2008.

Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE017T	ADVANCE FINANCE	3	1	0	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To review and understand the six sequential steps in financial statement analysis.
2	To effectively analyze, interpret, and use financial statements.
3	To employ financial analysis tools, methods, and techniques to analyze a company's profitability.
4	To utilize financial analysis tools, methods, and techniques to analyze a company's risk, includingunexpected changes in commodity prices, exchange rates, and interest rates.
5	To examine the quality of income statement and balance sheet information.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Recognize the sources of funds including regulatory framework.
CO2	Understand the Corporate Restructuring.
CO3	Develop skills for the interpretation of business information and application of financial theory in corporate investment decisions.
CO4	Predict the working capital requirements of a concern.
CO5	Summarize Basics of Derivatives.

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	2	-	-	-	2	-
CO2	3	2	1	-	-	-	2	-	-	-	1	-	1	-
CO3	1	1	3	-	-	-	-	2	1	-	2	-	-	1
CO4	1	2	1	-	2	-	-	-	1	-	-	-	2	-
CO5	-	-	-	-	-	-	2	1	1	[illegible]	1	-	-	-
CO (Avg)	3	2	3	-	2	-	2	2	2	[illegible]	2	-	[illegible]	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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UNIT I	**SOURCES OF FUNDS**	**12**
Sources of Funds (including regulatory framework) Types of securities- Issuing the capital in market-Pricing of issue -Valuation of Stocks and bonds. Dividend Decisions: Traditional Approach, Dividend Relevance Model, Miller and Modigliani Model, Stability of Dividends, Forms of Dividends, Issue of bonus shares, Stock Split.		
UNIT II	**CORPORATE RESTRUCTURING**	**12**
Corporate Restructuring: Mergers and Acquisitions- Types of Mergers, Evaluation of Merger Proposal-Take-over-Amalgamation-Leverage buy-out-Management buy-out-Corporate Failure and Liquidation. Evaluation of Lease Contracts.		
UNIT III	**FINANCIAL RESTRUCTURING**	**12**
Share Split – Consolidation -Cancellation of Paid-up Capital -Other Mechanisms.		
UNIT IV	**WORKING CAPITAL MANAGEMENT**	**12**
Working Capital Planning- Monitoring and Control of Working Capital-Working Capital Financing - Managing the Components of Working Capital- Cash Management- Receivable Management - Inventory Management.		
UNIT V	**INTRODUCTION TO DERIVATIVES**	**12**
Basics of Futures, Forwards, Options, Swaps -Interest rate Payoff Diagrams, Pricing of Futures, Put Call Parity, Option Pricing using Binomial Model and Black Scholes Model -Use of Derivatives for Risk Return Management- Credit Default Swaps.		
	Total Periods	**60**

Text Book (s)

1	John.C.Hull, Options, "Futures and other Derivative Securities", PHI Learning, 9th Edition, 2012.
2	Fred Weston, Kwang S Chung, Susan E Hoag Mergers, "Restructuring And Corporate Control", Pearson Education, 4th Edition.

Reference (s)

1	Stulz, "Risk Management and Derivatives", Cengage Learning, 2nd Edition, 2011.
2	Rajinder S. Aurora, Kavita Shetty and Sharad R. Kale, "Mergers and Acquisitions", Oxford University Press, 2011.
3	M.Y.Khan and P.K.Jain, "Financial Management, Text, Problems and Cases", Tata McGrawHill,5th edition, 2008.
4	John.C.Hull, Options, "Futures and other Derivative Securities", PHI Learning, 9th Edition, 2012.

Regulation 2018		Semester VIII	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	18CBE018J	IMAGE PROCESSING AND PATTERN RECOGNITION	3	0	2	4

Prerequisite Course (s)

NIL

Course Objective (s):

The purpose of learning this course is to:

1	To study the fundamentals of image formation and formats
2	To recognize the intensity transformations and filtering techniques
3	To obtain knowledge on image segmentation operations
4	To discover the feature extraction and image registration process
5	To understand the components of colour image processing

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Recognize the fundamentals of image formation and formats
CO2	Implement image transformation functions and filtering operations
CO3	Apply the segmentation techniques on the images
CO4	Extract the features of an image and perform image registration
CO5	Apply colour image processing and conversion operations

CO-PO Mapping

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	-	-	-	1	2	-
CO2	3	3	3	3	3	1	1	1	-	-	-	1	3	-
CO3	3	3	3	3	3	1	1	1	-	-	-	1	3	-
CO4	3	3	3	3	3	1	1	1	-	-	-	1	3	-
CO5	3	3	3	3	3	1	1	1	-	[illegible]	[illegible]	1	3	-
CO (Avg)	3	3	3	3	3	1	1	1	[illegible]	[illegible]	[illegible]	1	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I	INTRODUCTION AND IMAGE FORMATION	9
Introduction - Image processing systems and its applications - Basic image file formats. Image formation: Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics		
UNIT II	INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING	9
Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG- Morphological Filtering Basics - Dilation and Erosion Operators, Top Hat Filters.		
UNIT III	IMAGE SEGMENTATION	9
Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform.		
UNIT IV	FEATURE EXTRACTION AND IMAGE REGISTRATION	9
Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties. Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.		
UNIT V	COLOUR IMAGE PROCESSING	9
Fundamentals of different Colour models - RGB, CMY, HSI, YCbCr, Lab; False Colour; Pseudo Colour; Enhancement.		
	Total Periods	**45**
	LIST OF EXPERIMENTS	**15**

1	Implementation of Histogram Mapping and Equalization.
2	Implementation of Image Smoothening and Sharpening.
3	Implementation of Morphological Operations on Binary Images.
4	Implementation of Edge Detection using Sobel, Prewitt and Roberts Operators
5	Implementation of Canny Edge Detector.
6	Implement the calculation of the GLCM of the given image
7	Implementation of image registration of the given images.
8	Implementation of colour model conversion.
9	Implementation of pseudo-colour operation on the given image.
10	Implementation of Image Intensity slicing technique for image enhancement
11	Analyze the given set of camera captured images and identify the nature of the image.
12	Write a program to detect the face from the given set of images and determine the type of animal.

Text Book (s)

1	R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson, 4th Edition, 2018.
2	Maria Petrou and Panagiota Bosdogianni, "Image Processing: The Fundamentals", John Wiley & Sons, Ltd, 2 nd Edition, 2010.

Reference (s)	
1	A. Blake and A. Zisserman, “Visual Reconstruction”, MIT Press, Cambridge. https://doi.org/10.7551/mitpress/7132.001.0001
2	A. N. Netravali and B. G. Haskell, “Digital Pictures”, Plenum Press, 2nd Edition, 1995
3	A. B. Watson, “Digital Images and Human Vision”, MIT Press, Cambridge, 1993.
4	K. R. Castleman, “Digital Image Processing”, Prentice Hall, Englewood Cliffs, 1 st Edition, 1995.