

B.Tech (CSBS)

Curriculum and Syllabus for B.Tech(CSBS) under

AEC Autonomy

Computer Science and Business System

(Effective from 2024-25 Admission Batch)

L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

1ST Year 1st Semester: 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	M(BS)101	Discrete Mathematics	3	0	0	3	3
2	Basic Science course	M(BS)102	Introductory Topics in Statistics, Probability and Calculus	3	0	0	3	3
3	Engineering Science Courses	CB101	Fundamentals of Computer Science	3	0	0	3	3
4	Engineering Science Courses	EE(BS)101	Principles of Electrical Engineering	2	0	0	2	2
5	Basic Science course	PH(BS)101	Physics for Computing Science	2	0	0	2	2
6	Humanities and Social Sciences	HU(BS)101	Business Communication and Value Science-I	2	0	0	2	2
B. PRACTICAL								
7	Engineering Science Courses	CB191	Fundamentals of Computer Science Lab	0	0	3	3	1.5
8	Engineering Science Courses	EE(BS)191	Principles of Electrical Engineering Lab	0	0	2	2	1
9	Basic Science course	PH(BS)191	Physics for Computing Science Lab	0	0	2	2	1
TOTAL CREDIT								18.5

1 ST Year 2 nd Semester: 2nd Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	
A. THEORY				L	T	P	Total	
1	Basic Science courses	M(BS)201	Linear Algebra	3	0	0	3	3
2	Basic Science courses	M(BS)202	Statistical Methods	3	0	0	3	3
3	Engineering Science Courses	CB201	Data Structures and Algorithms	3	1	0	4	4
4	Engineering Science Courses	EC(BS)201	Principles of Electronics	2	0	0	2	2
5	Basic Science courses	BS201	Fundamentals of Economics	2	0	0	2	2
6	Humanities and Social Sciences	HU(BS)201	Business Communication and Value Science - II	2	0	0	2	2
7	Basic Science courses	MC(BS)201	Environmental Sciences (Non-Credit)	3	0	0	3	-
B. PRACTICAL								
8	Basic Science course	M(BS)292	Statistical Methods Lab	0	0	2	2	1
9	Engineering Science Courses	CB291	Data Structures and Algorithms Lab	0	0	3	3	1.5
10	Engineering Science Courses	EC(BS)291	Principles of Electronics Lab	0	0	2	2	1
TOTAL CREDIT							19.5	

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

2nd Year 1st Semester: 3rd Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	CB301	Formal Language and Automata Theory	3	0	0	3	3
2	Engineering Science Courses	CB302	Computer Organization and Architecture	3	0	0	3	3
3	Engineering Science Courses	CB303	Object Oriented Programming	3	0	0	3	3
4	Program Core Course	CB304	Computational Statistics	3	0	0	3	3
5	Program Core Course	CB305	Software Engineering	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	MC(BS)301	Indian Constitution (Non-Credit)					
B. PRACTICAL								
7	Engineering Science Courses	CB391	Computer Organization and Architecture Lab	0	0	3	3	1.5
8	Engineering Science Courses	CB393	Object Oriented Programming Lab	0	0	3	3	1.5
9	Program Core Course	CB394	Computational Statistics Lab	0	0	2	2	1
10	Program Core Course	CB395	Software Engineering Lab	0	0	2	2	1
TOTAL CREDIT								20

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2nd Year 2 nd Semester: 4 th Semester								
Sl · N	Category	Course Code	Course Title	Hours per week				Cre dits
				L	T	P	To tal	
A. THEORY								
1	Program Core Course	CB401	Operating Systems (Unix)	3	0	0	3	3
2	Program Core Course	CB402	Database Management Systems	3	0	0	3	3
3	Program Core Course	CB403	Software Design with UML	3	0	0	3	3
4	Program Core Course	BS401	Introduction to Innovation, IP Management and Entrepreneurship	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	BS402	Business Communication and Value Science-III	2	0	0	2	2
6	Basic Science course	M(BS)401	Operations Research	2	0	0	2	2
7	Humanities and Social Sciences including Management courses	MC(BS)40 1	Essen Essence of Indian Traditional Knowledge (Non- Credit)					
B. PRACTICAL								
8	Program Core Course	CB491	Operating Systems Lab (Unix)	0	0	2	2	1
9	Program Core Course	CB492	Database Management Systems Lab	0	0	2	2	1
10	Program Core Course	CB493	Software Design with UML Lab	0	0	2	2	1
11	Engineering Science Courses	M(BS)491	Operations Research Lab	0	0	2	2	1
TOTAL CREDIT								20

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3 rd Year 1 st Semester: 5 th Semester								
Sl. No	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Program Core Course	CB501	Design and Analysis of Algorithms	3	0	0	3	3
2	Program Core Course	CB502	Compiler Design (LEX & YACC)	3	0	0	3	3
3	Program Core Course	BS501	Fundamentals of Management	2	0	0	2	2
4	Program Core Course	BS502	Business Strategy	2	0	0	2	2
5	Program Core Course	BS503	Design Thinking	2	1	0	3	3
6	Professional Elective courses	PE-CB503A	Conversational Systems	2	0	0	2	2
		PE-CB503B	Cloud, Microservices and Application					
		PE-CB503C	Machine Learning					
B. PRACTICAL								
7	Program Core Course	CB591	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
8	Program Core Course	CB592	Compiler Design Lab (LEX & YACC)	0	0	3	3	1.5
9	Program Core Course	BS593	Design Thinking Lab	0	0	2	2	1
10	Professional Elective courses	PE-CB593A	Conversational Systems Lab	0	0	2	2	1
		PE-CB593B	Cloud, Microservices and Application Lab					
		PE-CB593C	Machine Learning Lab					
11	PROJECT	PR(BS)591	Minor Project I	0	0	2	2	1
TOTAL CREDIT								21

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** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

3 rd Year 2 nd Semester: 6 th Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Program Core Course	CB601	Computer Networks	3	0	0	2	3
2	Program Core Course	CB602	Information Security	3	0	0	3	3
3	Program Core Course	CB601	Artificial Intelligence	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	BS601	Financial and Cost Accounting	2	0	0	3	3
5	Humanities and Social Sciences including Management courses	HU(BS)601	Business Communication and Value Science-IV	2	0	0	2	2
6	Professional Elective courses	PE-CB603A	Robotics and Embedded Systems	2	0	0	2	2
		PE-CB603B	Modern Web Applications					
		PE-CB603C	Data Mining and Analytics					
B. PRACTICAL								
7	Program Core Course	CB691	Computer Networks Lab	0	0	3	3	1.5
8	Program Core Course	CB692	Information Security Lab	0	0	2	2	1
9	Program Core Course	CB691	Artificial Intelligence Lab	0	0	3	3	1.5
10	Professional Elective courses	PE-CB693A	Robotics and Embedded Systems Lab	0	0	0	2	1
		PE-CB693B	Modern Web Applications Lab					
		PE-CB693B	Data Mining and Analytics Lab					
TOTAL CREDIT								21

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4th Year 1st Semester: 7th Semester

Sl No	Course Code	Paper Code	Theory	Contact /Week			Hours		Credit Points
				L	T	P	Total		
A. THEORY									
1	Professional Elective courses	CB701	Usability Design of Software Applications	2	0	0	2	2	
2	Professional Elective courses	CB702	IT Workshop Skylab / Matlab	2	0	0	2	2	
3	Professional Elective courses	BS701	Financial Management	3	0	0	3	3	
4	Humanities and Social Sciences	BS702	Human Resource Management	2	0	0	2	2	
5	Professional Elective courses	PE-CB703A	Cognitive Science and Analytics	2	1	0	3	3	
		PE-CB703B	Introduction to IoT						
		PE-CB703C	Cryptology						
6	Professional Elective courses	PE-CB704A	Quantum Computation and Quantum Information	2	1	0	3	3	
		PE-CB704B	Advanced Social, Text and Media Analytics						
		PE-CB704C	Mobile Computing						
B. PRACTICAL									
7	Professional Elective courses	CB791	Usability Design of Software Applications Lab	0	0	2	2	1	
8	Professional Elective courses	CB792	IT Workshop Skylab / Matlab Lab	0	0	2	2	1	
9	Professional Elective courses	PE-CB793A	Cognitive Science and Analytics Lab	0	0	2	2	1	
		PE-CB793B	Introduction to IoT Lab						
		PE-CB793C	Cryptology Lab						
10	Professional Elective courses	PE-CB794A	Quantum Computation and Quantum Information Lab	0	0	2	2	1	
		PE-CB794B	Advanced Social, Text and Media Analytics Lab						
		PE-CB794C	Mobile Computing Lab						
11	PROJECT	CB781	Project Evaluation I	0	0	4	4	2	
TOTAL CREDIT									21

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4 th Year 2 nd Semester: 8 th Semester									
Sl No	Course Code	Paper Code	Theory	Contact Hours				Credit Points	
				L	T	P	Total		
A. THEORY									
1	Professional Elective courses	BS801	Services Science and Service Operational Management	3	0	0	3	3	
2	Professional Elective courses	BS802	IT Project Management	2	0	0	2	2	
3	Professional Elective courses	BS803	Marketing Research and Marketing Management	2	0	0	2	2	
4	Open Elective courses	PE-CBS804A	Behavioral Economics	3	0	0	3	3	
		PE-CBS804B	Computational Finance and Modeling						
		PE-CBS804C	Psychology						
		PE-CBS804D	Enterprise Systems						
5	Open Elective courses	PE-BS805A	Advance Finance	3	0	0	3	3	
		PE-BS805B	Image Processing and Pattern Recognition						
B. PRACTICAL									
6	Professional Elective courses	BS891	Services Science and Service Operational Management Lab	0	0	0	2	1	
7	Professional Elective courses	BS892	IT Project Management Lab	0	0	0	2	1	
8	Open Elective courses	PE-BS894A	Behavioral Economics Lab	0	0	2	2	1	
		PE-BS894B	Computational Finance and Modeling Lab						
		PE-BS894C	Psychology Lab						
		PE-BS894D	Enterprise Systems Lab						
9	Open Elective courses	PE-CS895A	Advance Finance Lab	0	0	2	2	1	
		PE-CS895B	Image Processing and Pattern Recognition Lab						
10	Project	BS881	Project Evaluation II	0	0	12	2	6	
TOTAL CREDIT								23	

Department of Computer Science & Engineering

Curriculum Structure & Syllabus

1st Semester to 8th Semester

(Effective from 2024-25 Admission Batch)

Curriculum for B.Tech under Autonomy
Computer Science & Business Systems

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A. THEORY								
1	Basic Science course	M(BS)101	Discrete Mathematics	3	0	0	3	3
2	Basic Science course	M(BS)102	Introductory Topics in Statistics, Probability and Calculus	3	0	0	3	3
3	Engineering Science Courses	CB101	Fundamentals of Computer Science	3	0	0	3	3
4	Engineering Science Courses	EE(BS)101	Principles of Electrical Engineering	2	0	0	2	2
5	Basic Science course	PH(BS)101	Physics for Computing Science	2	0	0	2	2
6	Humanities and Social Sciences	HU(BS)101	Business Communication and Value Science-I	1	0	0	2	2
B. PRACTICAL								
7	Engineering Science Courses	CB191	Fundamentals of Computer Science Lab	0	0	3	3	1.5
8	Engineering Science Courses	EE(BS)191	Principles of Electrical Engineering Lab	0	0	2	2	1
9	Basic Science course	PH(BS)191	Physics for Computing Science Lab	0	0	2	2	1
TOTAL CREDIT								18.5

Course Name: Fundamentals of Computer Science

Course Code: CB101

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

General problem Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops. Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C)

- Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation.
- Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming.
- Functions and Program Structure with discussion on standard library: Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialization, Recursion, Pre-processor, Standard Library Functions and return types.
- Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialization of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.
- Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral structures, Table look up, typedef, unions, Bit-fields
- Input and Output: Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.
- 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, make file utility.

Course Outcome(CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	3	1	-	-	2	2	2	-	1	-
CO2	3	2	3	1	-	-	1	1	2	-	1	-
CO3	3	2	3	1	-	-	1	1	2	-	1	-
CO4	3	2	3	1	-	-	1	1	2	-	1	-

B. PRACTICAL

Course Name: Fundamentals of Computer Science Lab

Course Code: CB191

Credits: 1.5

Laboratory

1. Algorithm and flowcharts of small problems like GCD
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

Text Books:

1. The C Programming Language, (Second Edition) B. W. Kernighan and D. M. Ritchi, PHI.
2. Programming in C, (Second Edition)B. Gottfried, Schaum Outline Series.

Reference Books:

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

Course Name: Principles of Electrical Engineering Lab

Course Code: EE(BS)191

Credits: 1

Laboratory

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
4. Transfer theorem)
5. Simulation of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$
6. Simulation of Time response of RC circuit
7. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
8. Demonstration of measurement of electrical quantities in DC and AC systems.

Text Books:

1. Electric Machinery,(Sixth Edition) A.E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology,(vol. I),B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press.
T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. Engineering Circuit Analysis, William H. Hayt& Jack E. Kemmerly, McGraw-Hill Book Company Inc.
4. Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

Course Name: Physics for Computing Science Lab

Course Code: PH(BS)101

Credits: 1

Laboratory

- 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.

Text Books:

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

Reference Books:

1. Optics, (Fifth Edition) Ajoy Ghatak, Tata McGraw Hill.
2. Sears & Zemansky University Physics, Addison-Wesley.
3. Fundamentals of Optics, (Third Edition) Jenkins and White, McGraw-Hill.

Business Communication & Value Science - I

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Lectures: 3 Hr./Week	Semester Examination: 50 marks	4
Tutorials: 0 Hr. / Week	Continuous Assessment: Yes	
Lab: 2-4 Hrs. / Week	Term Work: 50 marks	

Course ID:

1.6 (Year 1 Semester 1)

	Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral	
Pre requisites	Basic Knowledge of high school English	
Course Objectives:		
1	Understand what life skills are and their importance in leading a happy and well-adjusted life	
2	Motivate students to look within and create a better version of self	
3	Introduce them to key concepts of values, life skills and business communication	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C1.6.1	Recognize the need for life skills and values	[U]
C1.6.2	Recognize own strengths and opportunities	[U]
C1.6.3	Apply the life skills to different situations	[AP]
C1.6.4	Understand the basic tenets of communication	[U]
C1.6.5	Apply the basic communication practices in different types of communication	[AP]
Course Contents:		
<ul style="list-style-type: none"> • Overview of the course with immersion activity • Overview of biz communication • Self-awareness, confidence and communication • Essentials of Business communication • Application of communication skills • Application of Life Skills • Assignment 		
Total Hours:		65
Text Books:		
	There are no prescribed texts for Semester 1 – there will be handouts and reference links shared.	
Reference Books:		
1	English vocabulary in use – Alan Mc’Carthy and O’dell	
2	APAART: Speak Well 1 (English language and communication)	

3	APAART: Speak Well 2 (Soft Skills)		
4	Business Communication – Dr. Saroj Hiremath		
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=bBsT9omTeh0		
Online Resources:			
1	https://www.coursera.org/learn/learning-how-to-learn		
2	https://www.coursera.org/specializations/effective-business-communication		
Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1	Understand	Immersion (interview)	5
C1.6.2	Understand	Create Resume	4
C1.6.3	Apply	Group Assignment – community service	5
C1.6.4	Understand	Group activities	3
C1.6.5	Apply	Record a conversation	3
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand	Paper		50
Apply	Trek followed by project		
Analyse			

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Recognize the need for life skills and values	Understand	Overview of LOL (include activity on introducing self)	Lecture & reflection	1 hour
			Class activity – presentation on favorite cricket captain in IPL and the skills and values they demonstrate	Activity	1 hour
			Self-work with immersion – interview a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them	Immersion activity	2 hours
			Overview of business communication	Lecture with videos	1 hour
			Activity: Write a newspaper report on an IPL match	Class activity with 3 iterations - Formative Evaluation	1 hour

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			Activity: Record a conversation between a celebrity and an interviewer	Class activity with 3 iterations - Formative Evaluation	1 hour
			Quiz Time	Summative Evaluation for Unit	30 mins
	Recognize own strengths and opportunities	Understand	Self-awareness – identity, body awareness, stress management	Anubhaab Activities (Please conduct at least one activity per week and include the Meditation session in it)	4 hours
2	Understand the basic tenets of communication Unit name: Be At Ease (BAE) (in Millennial lingo it means Before Anyone Else)	Understand	Essential Grammar – I: Refresher on Parts of Speech – Listen to an audio clip and note down the different parts of speech followed by discussion Tenses: Applications of tenses in Functional Grammar – Take a quiz and then discuss	Lecture with audio and video	1 hour
			Sentence formation (general & Technical), Common errors, Voices. Show sequence from film where a character uses wrong sentence structure (e.g.Zindagi Na MilegiDobara where the characters use 'the' before every word)	Lecture with video/audio	1 hour
			Communication Skills: Overview of Communication Skills Barriers of communication, Effective communication		1 hour
			Types of communication- verbal and non – verbal – Role-play based learning Importance of Questioning	Activity based learning	1 hour
			Listening Skills: Law of nature-Importance of listening skills, Difference between listening and hearing, Types of listening.	Activity based learning	1 hour
	Recognize own	Understand	Expressing self, connecting with	Anubhaab	4 hours

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	strengths and opportunities		emotions, visualizing and experiencing purpose	Activities (Please conduct at least one activity per week and include the Meditation session in it)	
	Apply the basic communication practices in different types of communication	Apply	Activity: Skit based on communication skills	Formative Evaluation	4 hours
			Evaluation on Listening skills – listen to recording and answer questions based on them	Formative Evaluation	30 mins
3	Understand the basic tenets of communication Talk Mail Write (TMW) - In Millennial it means That Moment When	Understand	Email writing: Formal and informal emails, activity	Activity based learning	1 hour
			Verbal communication: Pronunciation, clarity of speech	Audio and video based learning	30 minutes
			Vocabulary Enrichment: 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 – Read Economic Times, Reader's Digest, National Geographic and take part in a GD, using the words you learnt/liked from the articles. Group discussion using words learnt	Activity based learning (Group Discussion) Flipped classroom where students will study words before coming to class	1 hour
			Practice: Toastmaster style Table Topics speech with evaluation	Activity based learning	2 hours over 2/3 days
			Written Communication: Summary writing, story writing	Activity based learning	1 hour
			Build your CV – start writing your comprehensive CV including every achievement in your life, no format, no page limit	Formative Evaluation	30 minutes
			Apply the basic communication practices in different types of communication	Apply	Project: Create a podcast on a topic that will interest college students
Recognize own strengths and opportunities	Understand	Life skill: Stress management, working with rhythm and balance, colours, and teamwork	Anubhaab Activities (Please	4 hours	

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
				conduct at least one activity per week and include the Meditation session in it)	
	Apply the basic communication practices in different types of communication	Apply	Project: Create a musical using the learnings from unit	Formative Evaluation	2 hours
4	Unit 4 Recognize the need for life skills and values Unit name: Realities of Facing Life (ROFL)	Understand	Understanding Life Skills: Movie based learning – Pursuit of Happiness. What are the skills and values you can identify, what can you relate to?	Interactive learning	3 hours
			Introduction to life skills What are the critical life skills	Activity and Video	1 hour
			Multiple Intelligences Embracing diversity – Activity on appreciation of diversity	Video and activity based	1 hour
	Apply the life skills to different situations	Apply	Life skill: Community service – work with an NGO and make a presentation	Field work: Formative Evaluation	10 hours
			Life skill:Join a trek – Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation	Field work: Formative Evaluation	12 hours
TOTAL					65 hours
	Summative Evaluation	Bloom's Level	Type of Assessment	Marks	Total
		Understand	Knowledge Test	20 marks	50 marks
		Apply	Project (to be evaluated by TCS)	20 marks	
		Apply	Group discussion (to be evaluated by TCS)	10 marks	

1 ST Year 2 nd Semester: 2nd Semester							
Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
	A. THEORY			L	T	P	Total
1	Basic Science courses	M201	Linear Algebra	3	0	0	3
2	Basic Science courses	M202	Statistical Methods	3	0	0	3
3	Engineering Science Courses	CB201	Data Structures and Algorithms	3	1	0	4
4	Engineering Science Courses	EC201	Principles of Electronics	2	0	0	2
5	Basic Science courses	BS201	Fundamentals of Economics	2	0	0	2
6	Humanities and Social Sciences	HU201	Business Communication and Value Science - II	2	0	0	2
7	Basic Science courses	MC201	Environmental Sciences (Non-Credit)	3	0	0	3
	B. PRACTICAL						
8	Basic Science course	M292	Statistical Methods Lab	0	0	2	2
9	Engineering Science Courses	CB291	Data Structures and Algorithms Lab	0	0	3	3
10	Engineering Science Courses	EC291	Principles of Electronics Lab	0	0	2	2
	TOTAL CREDIT						19.5

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Statistical Methods

Course Code: M(BS)202

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Sampling Techniques: 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.

Linear Statistical Models: Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Multiple regression & multiple correlation, Analysis of variance (one way, two way with as well as without interaction).

Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.

Sufficient Statistic: Concept & examples, complete sufficiency, their application in estimation.

Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing.

Non-parametric Inference: 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.

Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

Text Books:

1. Probability and Statistics for Engineers (Fourth Edition), I.R. Miller, J.E. Freund and R. Johnson, Prentice Hall India Learning Private Limited.
2. Fundamentals of Statistics (vol. I & vol. II), A. Goon, M. Gupta and B. Dasgupta, World Press.
3. The Analysis of Time Series: An Introduction, Chris Chatfield, Chapman & Hall/CRC.

Reference Books:

1. Introduction to Linear Regression Analysis, D.C. Montgomery and E. Peck, Wiley-Interscience.
2. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill and D.C. Boes, McGraw Hill.
3. Applied Regression Analysis, N. Draper and H. Smith, Wiley-Interscience.
4. Hands-on Programming with R, Garrett Golemund, O'Reilly.
5. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander, Addison-Wesley Professional.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	1	-	-	-	-	-	-	-
CO3	3	3	2	1	1	-	-	-	-	-	-	-
CO4	3	3	2	-	1	-	-	-	-	-	-	-
CO5	3	3	2	-	1	-	-	-	-	-	-	-

Course Name: Principles of Electronics
Course Code: EC201
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

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.

Bipolar Junction Transistors: Formation of PNP / NPN junctions, energy band diagram; 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 and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

Field Effect Transistors: 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; CMOS: Basic Principles

Feed Back Amplifier, Oscillators and Operational Amplifiers: 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; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

Digital Electronics Fundamentals: Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Text Books:

1. Microelectronics Circuits, Adel S. Sedra and Kenneth Carless Smith, Oxford University Press.
2. Millman's Integrated Electronics, Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education.
3. Digital Logic & Computer Design, M. Morris Mano, Pearson

Reference Books:

1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky.
2. Solid State Electronic Devices, 6th Edition, Ben Streetman, Sanjay Banerjee
3. Electronic Principle, Albert Paul Malvino.
4. Electronics Circuits: Discrete & Integrated, D Schilling C Belove T Apelewicz R Saccardi.
5. Microelectronics, Jacob Millman, Arvin Gabel.
6. Electronics Devices & Circuits, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj
7. Electronic Devices & Circuit Theory, 11th Edition, Robert L. Boylestad, Louis Nashelsky.

Course Name: Fundamentals of Economics
 Course Code: BS 201
 Contact: 2:0:0
 Total Contact Hours: 24
 Credits: 2

Microeconomics: 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; Consumer Behaviour- 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; 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

Macroeconomics: 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; 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 Books:

1. Microeconomics, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. Macroeconomics, Dornbusch, Fischer and Startz.
3. Economics, Paul Anthony Samuelson, William D. Nordhaus.

Reference Books:

1. Intermediate Microeconomics: A Modern Approach, Hal R, Varian.
2. Principles of Macroeconomics, N. Gregory Mankiw.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	3	2	-	-	2	2	1	1	-	-	1
CO2	-	2	1	-	-	1	1	1	1	-	-	1
CO3	-	3	2	-	-	2	2	1	1	-	-	1
CO4	-	1	1	-	-	1	1	1	1	-	-	1
CO5	-	2	1	-	-	1	1	1	1	-	-	1

Course Name: Business Communication & Value Science – II
 Course Code: HU 201
 Contact: 2:0:0
 Total Contact Hours: 24
 Credits: 2

Course ID:

1.6 (Year 1 Semester 2)

	Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral	
Pre requisites	Basic Knowledge of English (verbal and written) Completion of all units from Semester 1	
Course Objectives:		
1	Develop effective writing, reading, presentation and group discussion skills.	
2	Help students identify personality traits and evolve as a better team player.	
3	Introduce them to key concepts of a) Morality b) Behavior and beliefs c) Diversity & Inclusion	
Course Outcomes: Upon completion of the course, students shall have ability to:		
C2.6.1	Understand tools of structured written communication	[U]
C2.6.2	Use tools of structured written communication	[AP]
C2.6.3	Use electronic/social media to share concepts and ideas	[AP]
C2.6.4	Develop materials to create an identity for an organization dedicated to a social cause	[C]
C2.6.5	Understand the basics of presentation	[U]
C2.6.6	Apply effective techniques to make presentations.	[AP]
C2.6.7	Assess presentations based on given criteria	[E]
C2.6.8	Understand tools for quick reading.	[U]
C2.6.9	Apply the basic concept of speed reading, skimming and scanning.	[AP]
C2.6.10	Identify individual personality types and role in a team.	[U]
C2.6.11	Recognize the concepts of outward behavior and internal behavior	[AP]
C2.6.12	Understand the basic concepts of Morality and Diversity	[U]
C2.6.13	Create communication material to share concepts and ideas	[C]
C2.6.14	Argue on a topic based on morality and diversity	[E]
C2.6.15	Articulate opinions on a topic with the objective of influencing others	[C]
C2.6.16	Organize an event to generate awareness and get support for a cause	[C]

Course Contents:

<ul style="list-style-type: none"> • Identification of common errors in written communication and ways of rectification • Understanding speed reading techniques – Skimming and Scanning • Application of reading and writing skills • Analyzing personality traits and team player style • Understanding the concepts of Morality, Diversity and Inclusion • Application of these concepts • Creation of communication material • Experiencing diversity and organizing events to support inclusion • Assignment – Assimilation of concepts and present them effectively 	
Total Hours:	61
Text Books:	
	There are no prescribed texts for Semester 2 – there will be handouts and reference links shared.
Reference Books:	
1	Guiding Souls : Dialogues on the purpose of life; Dr. A.P.J Abdul Kalam ;Publishing Year-2005; Co-author--Arun Tiwari
2	The Family and the Nation; Dr. A.P.J Abdul Kalam; Publishing year: 2015; Co-author: Acharya Mahapragya
3	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
4	Forge Your Future: Candid, Forthright, Inspiring ;Dr. A.P.J Abdul Kalam; Publishing year: 2014
5	Abundance: The Future is Better Than You Think; Peter H. Diamandis and Steven Kotler; Published: 21 Feb, 2012; Publisher: Free Press
6	Start With Why: How Great Leaders Inspire Everyone to Take Action; Simon Sinek; Published: 6 October 2011; Publisher: Penguin
7	Advertising & IMC: Principles and Practice; Sandra Moriarty, Nancy D. Mitchell, William D. Wells; Published: 15 June 2016; Publisher: Pearson Education India
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 Resources:	
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
Assessment Methods & Levels (based on Bloom's Taxonomy)	

Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1	Understand	Immersion (interview)	5
C1.6.2	Understand	Create CV	4
C1.6.3	Apply	Group Assignment- Form an NGO	5
C1.6.4	Understand	Group activities	3
C1.6.5	Create	Create and present a street play to articulate and amplify the social cause.	3
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand	Written Assessment, project and group discussion		50
Apply			
Analyze			

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1			Icebreaker. 1) Participate in 'Join Hands Movement'. Individual identification of social issues.2) Each Individual chooses one particular social issue which they would like to address. 3) Class to be divided in teams for the entire semester. All activities to be done in teams and the grades, credit points will be captured in the leader board in the class room.4) Theory to introduce the participant Slam book to be used for capturing individual learning points and observations.	Group discussion, Practical	60 Minutes
1	Understand tools of structured written communication	Understand	Research on the social cause each group will work for.	Practical (practical)	90 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Use tools of structured written communication	Understand	Class discussion- Good and Bad Writing. Common errors, punctuation rules, use of words.	PPT, Theory and Practical	90 Minutes
1			Group Practical – As a group, they will work on the social issue identified by them. Research, read and generate a report based on the findings.(Apply the learning and recap from the session)	Formative evaluation	70 Minutes
1	Create communication material to share concepts and ideas	Create	Practical: Plan and design an E Magazine. Apply and assimilate the knowledge gathered from Sem-1 till date. Share objective & guideline. All members to contribute an article to the magazine, trainer to evaluate the content.	Practical (Practical)	120 Minutes
1	Understand tools for Lucid writing	Understand	Lucid Writing: Encourage the students to go through the links given about Catherine Morris and Joanie McMahon's writing techniques.	Theory and Discussion	30 mins
1	Create communication material to share concepts and ideas	Create	Create the magazine	Practical (Lab)	90 Minutes
1		Understand	SATORI – Participants share the personal take away acquired from GD, writing and reading skills activities captured in their handbook. Share the most important learning points from the activities done so far and how that learning has brought a change.	Theory/Discussion	60 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Use electronic/social media to share concepts and ideas	Apply	Launching an E Magazine.	Practical (Lab)	120 Minutes
1			Quiz Time	Summative Evaluation for Unit	60 Minutes
Unit 2					
2	Develop materials to create an identity for an organization dedicated to a social cause	Create	Each group will form an NGO. Create Vision, Mission, Value statement, tagline and Design a logo.	Practical and Practical	90 Minutes
2	Understand the basics of presentation	Understand	Introduction to basic presentation skills & ORAI app	Theory and video	60 Minutes
2	Apply effective techniques to make presentations.	Apply	Groups to present their NGOs. Apply the learning gathered from session 2. Presentation to be recorded by the groups. feedback from the audience/ Professor	Formative evaluation	60 Minutes
2	Assess presentation based on given criteria	Evaluate	Group to come back and share their findings from the recording. Post work-individual write up to be written and evaluated for the E- magazine	Sharing of learning, written Practical and formative evaluation	60 Minutes & 60 Minutes
2	Create communication material to share concepts and ideas Use electronic/social media to share concepts and ideas	Create Apply	Prepare and publish the Second episode of the E Magazine.	Practical (Lab)	120 minutes
2	Understand the tools for speed reading. Apply the basic concepts of speed reading, skimming and	Understand Apply	Speed Reading session: Introduction to skimming and scanning; practice the same.	Theory and Practical	30 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	scanning.				
2		Understand	SATORI – Join the dots- Participants to connect their learning gathered from AIP Unit-2 with their existing curriculum	Share the most important learning points	60 Minutes
2			Quiz Time	Summative Evaluation for Unit	60 Minutes
Unit 3					
3	Develop materials to create an identity for an organization dedicated to a social cause	Create	Ad campaign- Brain storming session- Students to discuss and explore the means of articulating and amplifying the social issue their NGOs are working for.	Discussion	60 Minutes
3	Create communication material to share concepts and ideas.	Create	Design a skit- a) write the script articulating the message of their respective NGOs. Read out the script. (Skit time-5 minutes). Feedback of Theory.	Practical based learning. Formative evaluation by Theory	a) 30 Minutes b) 60 Minutes
3	Use electronic/social media to share concepts and ideas	Apply Apply	Promote the play through a social media and gather your audience. Enact the play. Capture the numbers of likes and reviews. Theory to assign grades to individual team.	Practical based learning Formative Evaluation	Lab Time: 90 Minutes Class Time:60Minutes
3	Identify individual personality types and role in a team.	Understand	(1) Theory to find out from the participants their views, observations and experiences of working in a team(2) Intro of Dr. Meredith Belbin and his research on team work and how individuals contribute.	Discussion and Theory	60 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
3	Identify individual personality types and role in a team.	Understand	Cont. (3) Belbin's 8 Team Roles and Lindgren's Big 5 personality traits.(4) Belbin's 8 team player styles	Practical based learning followed by a presentation	40 Minutes
3	Identify individual personality types and role in a team.	Understand	(1) Team Falcon Practical to identify individual personality traits with Belbin's 8 team player styles	Practical based learning followed by a presentation.	(1 &2) 40 Minutes
3	Recognize the concepts of outward behavior and internal behavior	Understand	(2) Similar personality types to form groups (3) Groups present their traits.	Presentation	(3) 60 minutes
3	Create communication material to share concepts and ideas. Use the electronic/social media to share concepts and ideas	Create Apply	Prepare and publish the third episode of the E Magazine.	Practical	60 Minutes
3		Understand Understand	SATORI – (join the dots with participants personal life) Participants share the personal take away acquired from working in teams, GD, learning about presentations, presenting their NGOs	Share the most important learning points from the activities done so far. Participants talk about the changes they perceive in themselves	60 Minutes
3			Quiz Time	Summative Evaluation for Unit	60 Minutes
Unit 4					
4	Understand the basic conceptsof Morality and Diversity	Understand	Ten minutes of your time – a short film on diversity. Play the video (link to be attached in the FG)	Video & discussion	30Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
4	Understand the basic concepts of Morality and Diversity	Understand	Discuss key take away of the film. Theory to connect the key take away of the film to the concept of empathy.	Practical	30 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Touch the target (Blind man) - Debriefing of the Practical. Film: "The fish and I" by BabakHabibifar" (1.37mins)	Practical and discussion	60 Minutes
4	Create communication material to share concepts.	Create	Groups to create a story – 10 minutes of a person's life affected by the social issue groups are working on. Narrate the story in first person. Feedbacks to be shared by the other groups.	Practical, sharing and Practical	120 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Research on a book, incident or film based on the topic of your respective NGO	Research and written Practical	120 Minutes
4	Create communication material to share concepts.	Create	Write a review in a blog on the topics they are covering in their research. Theory will give grades to each team.	Written Practical and Formative Evaluation	60 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Session on Diversity & Inclusion- Different forms of Diversity in our society.	PPT, Theory, discussion	60 Minutes
4	Create communication material to share concepts.	Create	Teams to video record interviews of people from diverse groups (Ask 5 questions). Share the recordings in FB	Practical	120 Minutes
4	Argue on a topic based on morality and diversity	Evaluate	Debate on the topic of diversity with an angle of ethics, morality and respect for individual (In the presence of an external moderator). Groups will be graded by	Practical and formative evaluation	60 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			the professor.		
4	Articulate opinions on a topic with the objective of influencing others	Create	Prepared speech- Every student will narrate the challenges faced by a member of a diverse group in 4 minutes (speech in first person). Theory to give feedback to each student.	Practical and formative Evaluation	90 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Discussion on TCS values, Respect for Individual and Integrity.	PPT, Theory, Practical and discussion	60 Minutes
4	Create communication material to share concepts and ideas. Use the electronic/social media to share concepts and ideas	Create Apply	Prepare and publish the final episode of the E Magazine.	Practical	120 Minutes
4		Understand	SATORI –Participants share the personal take away acquired from working in teams, GD, learning about presentations and understanding diversity inclusion.	Discussion	60 Minutes
4	Use tools of structured written communication	Apply	Revisit your resume Include your recent achievements in your resume.	Submit it to the Professor	Lab time-30 Minutes
4			Quiz Time	Summative Evaluation for Unit	60 Minutes
4	Organize an event to generate awareness and get support for a cause	Create	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	Field work: Formative Evaluation	7 Hours

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>challenges they face.</p> <p>3) Render voluntary service to the group for one day</p> <p>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</p> <p>5) The groups to present their experience of a day with the NGO and inspire students to work for the cause.</p>		
TOTAL					61 hours
	Assessment	Understand	Written Assessment of 20 marks		
		Create	Project of 20 marks (E-Magazine 4 editions)		
		Analyze, Create	Focus Group Discussion 10 marks		

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	-	-	-	3	-	-	-	3	2	1	-
CO2	-	-	-	-	1	-	-	-	3	1	1	-
CO3	-	-	-	-	1	-	-	-	3	2	1	-
CO4	-	-	-	-	1	-	-	-	3	2	1	-
CO5	-	-	-	-	1	-	-	-	3	3	1	-

Course Name: ENVIRONMENTAL SCIENCES (Non-Credit)

Course Code: MC 201

Contact: 3:0:0

Total Contact Hours: 36

Credits: NIL

Module 1: General [11L]

Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy

Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography

Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)

Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems

Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act), Hazardous waste(management and Handling) Rules.

Module 2: Air pollution and control [10L]

Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant

Types of air pollutants: primary & secondary pollutant; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),

Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion

Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury)).

Module 3: Water Pollution [9L]

Classification of water (Ground & surface water) Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.

Surface water quality parameters: pH, DO, 5-day BOD test, BOD reaction rate constants, COD. Numerical related to BOD Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)

Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride Layout of waste water treatment plant (scheme only).

Module 4: Land Pollution [3L]

Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages). Waste management: waste classification, waste segregation, treatment & disposal

Module 5: Noise Pollution [3L]

Definition of noise, effect of noise pollution on human health, Average Noise level of some common noise sources Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18 hr Index). Noise pollution control.

Text Book: A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited

References Books:

1. Environmental Studies, Dr. J P Sharma, University Science Press
2. Environmental Engineering, J K Das Mohapatra, Vikas Publication

B. PRACTICAL

Course Name: Statistical Methods Laboratory

Course Code: M(BS)292

Credits: 1

R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

Data Source:

- www.rbi.org.in

Course Name: Data Structures and Algorithms

Course Code: CB 291

Credits: 1.5

Laboratory

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

Course Name: Principles of Electronics

Course Code: EC291

Credits: 1

Laboratory

1. Semiconductor Diodes and application,
2. Transistor circuits,
3. JFET, oscillators and amplifiers.

2nd Year 1st Semester: 3rd Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	CB301	Formal Language and Automata Theory	3	0	0	3	3
2	Engineering Science Courses	CB302	Computer Organization and Architecture	3	0	0	3	3
3	Engineering Science Courses	CB303	Object Oriented Programming	3	0	0	3	3
4	Program Core Course	CB304	Computational Statistics	3	0	0	3	3
5	Program Core Course	CB305	Software Engineering	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	MC301	Indian Constitution (Non-Credit)					
B. PRACTICAL								
7	Engineering Science Courses	CB391	Computer Organization and Architecture Lab	0	0	3	3	1.5
8	Engineering Science Courses	CB393	Object Oriented Programming Lab	0	0	3	3	1.5
9	Program Core Course	CB394	Computational Statistics Lab	0	0	2	2	1
10	Program Core Course	CB395	Software Engineering Lab	0	0	2	2	1
TOTAL CREDIT								20

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

A. THEORY

Course Name: Formal Language and Automata Theory

Course Code: CB301

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, 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.

Context-free languages and pushdown automata: 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.

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Turing machines: 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, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP-completeness, Cook's Theorem, other NP-Complete problems.

Text Books:

1. Introduction to Automata Theory, Languages, and Computation John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman.

Reference Books:

1. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou.
2. Automata and Computability, Dexter C. Kozen.
3. Introduction to the Theory of Computation, Michael Sipser.
4. Introduction to Languages and the Theory of Computation, John Martin.
5. Computers and Intractability: A Guide to the Theory of NP Completeness, M. R. Garey and D. S. Johnson.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
C01	1	2	2	3	2	-	-	-	-	-	-	1
C02	2	3	3	3	2	-	-	-	-	-	-	2
C03	2	3	3	3	2	2	-	-	-	-	-	3
C04	2	2	3	3	2	2	-	-	-	-	-	3
C05	2	2	2	3	3	2	-	-	-	-	-	3

Course Name: Computer Organization and Architecture
Course Code: CB302
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Revision of basics in Boolean logic and Combinational/Sequential Circuits.

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.

Computer arithmetic: 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.

Introduction to x86 architecture.

CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU.

Memory system design: Semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: 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

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Text Books:

1. Computer System Architecture M. M. Mano:, 3rd ed., Prentice Hall of India, New Delhi, 1993.
2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy.
3. Computer Organization and Embedded Systems, Carl Hamacher.

Reference Books:

1. Computer Architecture and Organization, John P. Hayes.
2. Computer Organization and Architecture: Designing for Performance, William Stallings.
3. Computer System Design and Architecture, Vincent P. Heuring and Harry F. Jordan.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	2	2	1	-	-	-	-	1	-	-	-
CO2	1	1	3	1	-	-	-	-	1	-	-	-
CO3	1	1	2	-	-	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	1	-	-	-	-	-
CO5	1	1	2	1	-	-	1	-	-	-	-	-

Course Name: Object Oriented Programming

Course Code: CB303

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Procedural programming, 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, #define constant vs const, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

The Fundamentals of Object Oriented Programming: 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)

Essentials of Object Oriented Programming: 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

Generic Programming: Template concept, class template, function template, template specialization

Input and Output: Streams, Files, Library functions, formatted output

Object Oriented Design and Modelling: UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design.

Text Books:

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

Reference Books:

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

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	2	2	2	-	-	-	2	-	-	-	-
CO2	-	2	2	2	-	-	-	2	-	2	-	-
CO3	-	2	3	3	2	-	-	2	-	3	2	-
CO4	-	2	3	3	2	-	-	2	-	3	2	-
CO5	-	1	2	1	1	-	-	1	-	2	2	-

Course Name: Computational Statistics
Course Code: CB304
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Multivariate Normal Distribution: Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.

Multiple Linear Regression Model: Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions.

Multivariate Regression: Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance

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, deciding on how many principal components to retain, H-plot.

Factor Analysis: Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.

Cluster Analysis: Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters.

Text Books:

1. An Introduction to Multivariate Statistical Analysis, T.W. Anderson.
2. Applied Multivariate Data Analysis, Vol I & II, J.D. Jobson.
3. Statistical Tests for Multivariate Analysis, H. Kris.
4. Programming Python, Mark Lutz.
5. Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.
6. Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005.

Reference Books:

1. Regression Diagnostics , Identifying Influential Data and Sources of Collinearity, D.A. Belsey, E. Kuh and R.E. Welsch
2. Applied Linear Regression Models, J. Neter, W. Wasserman and M.H. Kutner.
3. The Foundations of Factor Analysis, A.S. Mulaik.
4. Introduction to Linear Regression Analysis, D.C. Montgomery and E.A. Peck.
5. Cluster Analysis for Applications, M.R. Anderberg.
6. Multivariate Statistical Analysis, D.F. Morrison.
7. Python for Data Analysis, Wes Mc Kinney.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	2	1	-	-	2	2	-	-	-	-
CO2	3	2	2	1	-	-	2	2	-	-	-	-
CO3	3	2	2	1	-	-	2	3	-	-	-	-
CO4	2	2	3	1	-	-	3	3	2	2	-	-
CO5	2	2	3	1	-	-	3	3	2	2	-	-

Course Name: Software Engineering
Course Code: CB305
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Introduction: 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.

Software Project Management: 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.

Software Quality and Reliability: Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

Software Requirements Analysis, Design and Construction: Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modeling – 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.

Object Oriented Analysis, Design and Construction: 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.

Software Testing: 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.

Text Books:

1. Software Engineering, Ian Sommerville

Reference Books:

1. Fundamentals of Software Engineering, Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino
2. Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, Michael Jackson
3. The Unified Development Process, Ivar Jacobson, Grady Booch, James Rumbaugh
4. Design Patterns: Elements of Object-Oriented Reusable Software, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides
5. Software Metrics: A Rigorous and Practical Approach, Norman E Fenton, Shari Lawrence Pfleeger
6. Software Engineering: Theory and Practice, Shari Lawrence Pfleeger and Joanne M. Atlee

7. Object-Oriented Software Construction, Bertrand Meyer
 8. Object Oriented Software Engineering: A Use Case Driven Approach --Ivar Jacobson
 9. Touch of Class: Learning to Program Well with Objects and Contracts --Bertrand Meyer
- UML Distilled: A Brief Guide to the Standard Object Modeling Language --Martin Fowler

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	2	1	-	-	2	2	-	-	-	-
CO2	3	2	2	1	-	-	2	2	-	-	-	-
CO3	3	2	2	1	-	-	2	3	-	-	-	-
CO4	2	2	3	1	-	-	3	3	2	2	-	-
CO5	1	1	2	1	-	-	1	1	1	2	-	-

Course Name: Computational Statistics Lab

Course Code: CB394

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, 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

Multivariate data analysis: Multiple regression, multi variate regression, cluster analysis with various algorithms, factor analysis, PCA and linear discriminant analysis. Various datasets should be used for each topic

Course Name: Software Engineering Lab
Course Code: CB395
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Introduction to on Object Oriented Technologies and the UML Method.

- 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.

Requirements Analysis Using Case Modeling

- 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.

The Logical View Design Stage: The 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.

Dynamic Model: 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.

Deployment Model.

- Processors.
- Connections.
- Components.
- Tasks.
- Threads.
- Signals and Events.

Text Books:

1. Object-Oriented Software Engineering: using UML, Patterns, and Java. Bernd Bruegge and Allen H. Dutoit.

Reference Books:

1. Design Patterns: Elements of Reusable Object-Oriented Software. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides.

Course Name: Indian Constitution (Non-Credit)
Course Code: MC(BS)301
Contact: 0:0:0
Total Contact Hours: 0
Credits: 0

Pre Requisites: Nil

Course Objectives:

- 1 To familiarize with basic information about Indian constitution
- 2 To understand the fundamental rights and duties as citizens of India

Course Outcomes:

Upon completion of the course, students shall have ability to

- MC(BS)301.1 Explain the objectives of the Constitution of India and its formation
MC(BS)301.2 Recall state and central policies (Union and State Executive), fundamental Rights and their duties.
MC(BS)301.3 Make use of legal directions in developing solutions to societal issues
MC(BS)301.4 Utilized for competitive exams that requires knowledge of Indian Constitution
MC(BS)301.5 Use of various provisions available for citizens to use the government services

Course Contents:

Historical perspective: The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Federal structure: Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Amendments: Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

Text Books:

- 1 Dr.D.D.Basu, Introduction to the Constitution of India, LexisNexis, 22nd Edition, 2016.
- 2 Bare act, constitution of India, The universal Publications, LexisNexis 2020.

Reference Books:

- 1 Subhash.C. Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust, 5thEdition, 2019.
- 2 M. Laxmikanth, Constitution of India, Cengage Learning India, 1stEdition 2018.

Web References:

- 1 <https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ>
- 2 <https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	1	-	1	1	3	-	-	1	-	-	1
CO2	-	1	-	1	1	3	1	-	1	-	-	2
CO3	-	1	-	1	1	3	1	-	1	-	2	2
CO4	-	1	-	1	1	3	2	-	1	2	2	2
CO5	-	-	-	-	-	3	2	2	-	-	-	-

2nd Year 2ndSemester: 4thSemester

Sl. N	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Program Core Course	CB401	Operating Systems (Unix)	3	0	0	3	3
2	Program Core Course	CB402	Database Management Systems	3	0	0	3	3
3	Program Core Course	CB403	Software Design with UML	3	0	0	3	3
4	Program Core Course	BS401	Introduction to Innovation, IP Management and Entrepreneurship	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	BS402	Business Communication and Value Science-III	2	0	0	2	2
6	Basic Science course	M401	Operations Research	2	0	0	2	2
7	Humanities and Social Sciences including Management courses	MC401	Essen Essence of Indian Traditional Knowledge (Non-Credit)					
B. PRACTICAL								
8	Program Core Course	CB491	Operating Systems Lab (Unix)	0	0	2	2	1
9	Program Core Course	CB492	Database Management Systems Lab	0	0	2	2	1
10	Program Core Course	CB493	Software Design with UML Lab	0	0	2	2	1
11	Engineering Science Courses	M491	Operations Research Lab	0	0	2	2	1
TOTAL CREDIT								20

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Operating Systems (Unix)
Course Code: CB401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of 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.

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, 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.

Inter-process Communication: 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, Dining 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.

Concurrent Programming: 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 – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Notrecently used (NRU) and Least Recently used (LRU).

I/O Hardware: 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, programming with the standard I/O, UNIX system calls.

Text Books:

1. Operating System Concepts Essentials. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.

Reference Books:

1. Operating Systems: Internals and Design Principles. William Stallings.
2. Operating System: A Design-oriented Approach. Charles Patrick Crowley.
3. Operating Systems: A Modern Perspective. Gary J. Nutt.
4. Design of the Unix Operating Systems. Maurice J. Bach.
5. Understanding the Linux Kernel, Daniel Pierre Bovet, Marco Cesati.

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1	-	-	-	-	-	1	1	1	-
CO2	3	3	3	-	-	-	-	-	3	3	2	-
CO3	3	3	3	-	-	-	-	-	3	3	3	-
CO4	1	1	1	-	-	-	-	-	1	1	3	-
CO5	1	1	2	-	-	-	-	-	-	-	3	-

Course Name: Database Management Systems
Course Code: CB402
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Introduction: Introduction to Database. Hierarchical, Network and Relational Models.

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

Data models: 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, ORACLE, DB2, SQL server.

Relational database design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Storage strategies: 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.

Database Security: 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 Books:

1. Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.

Reference Books:

1. Principles of Database and Knowledge – Base Systems, Vol 1 by J. D. Ullman.
2. Fundamentals of Database Systems. R. Elmasri and S. Navathe.
3. Foundations of Databases. Serge Abiteboul, Richard Hull, Victor Vianu.

Course Outcome(CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	3	3	2	1	-	-	-	-	1	-
CO2	2	2	3	3	2	1	-	1	1	1	-	1
CO3	2	2	2	2	3	1	-	-	-	-	-	-
CO4	2	2	2	2	3	-	-	-	-	-	-	-
CO5	3	2	3	2	2	-	-	-	-	-	-	-

Course Name: Introduction to Innovation, IP Management and Entrepreneurship
Course Code: BS401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre Requisite(s):

Good knowledge of Fundamentals of Management (Covered in Year 2, Semester 1)

Course Outcome(s):

The major emphasis of the course will be on creating a learning system through which management students can enhance their innovation and creative thinking skills, acquaint themselves with the special challenges of starting new ventures and use IPR as an effective tool to protect their innovations and intangible assets from exploitation.

As a part of this course, students will:

- Learn to be familiar with creative and innovative thinking styles
- Learn to investigate, understand and internalize the process of founding a startup
- Learn to manage various types of IPR to protect competitive advantage

Topics to Be Covered:

UNIT – I

Innovation: What and Why?

Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations.

Class Discussion- Is innovation manageable or just a random gambling activity?

UNIT – II

Building an Innovative Organization

Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture

Class Discussion- Innovation: Co-operating across networks vs. 'go-it-alone' approach

UNIT – III

Entrepreneurship:

- Opportunity recognition and entry strategies
- Entrepreneurship as a Style of Management
- Maintaining Competitive Advantage- Use of IPR to protect Innovation

UNIT – IV

Entrepreneurship- Financial Planning:

- Financial Projections and Valuation
- Stages of financing

- Debt, Venture Capital and other forms of Financing

UNIT – V

Intellectual Property Rights (IPR)

- Introduction and the economics behind development of IPR: Business Perspective
- IPR in India – Genesis and Development
- International Context
- Concept of IP Management, Use in marketing

UNIT – VI

Types of Intellectual Property

- Patent- Procedure, Licensing and Assignment, Infringement and Penalty
- Trademark- Use in marketing, example of trademarks- Domain name
- Geographical Indications- What is GI, Why protect them?
- Copyright- What is copyright
- Industrial Designs- What is design? How to protect?

Class Discussion- Major Court battles regarding violation of patents between corporate companies

Home Assignment:

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be ready to discuss these topics (in groups) in class. Students are required to meet in groups before coming to class and prepare on the topic. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

Topic 1- Is innovation manageable or just a random gambling activity?

Topic 2- Innovation: Co-operating across networks vs. 'go-it-alone' approach

Topic 3- Major Court battles regarding violation of patents between corporate companies

Text Books:

1. Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change
2. Case Study Materials: To be distributed for class discussion

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	2	2	3	-	-	3	-	-	-	3	-
CO2	2	3	3	3	3	3	3	-	3	2	2	-
CO3	2	2	3	3	3	1	3	-	-	2	1	-
CO4	2	3	3	3	3	3	3	-	3	2	1	-
CO5	1	1	3	2	2	1	2	1	2	2	1	-

Course Name: Business Communication and Value Science-III
 Course Code: BS402
 Contact: 2:0:0
 Total Contact Hours: 24
 Credits: 2

Business Communication & Value Science 3

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 2.5 Hrs./Week	Semester Examination: 50 marks	
Practical: 1.5 Hrs. / Week	Continuous Assessment: Yes	
Lab: 2 Hrs. / Week	Term Work: 50 marks	

Course ID:

1.6 (Year 2 Semester 4)

	Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral	
Pre requisites	Basic Knowledge of English (verbal and written) Completion of all units from Semesters 1, 2 and 3	
Course Objectives:		
1	Develop technical writing skills	
2	Introduce students to Self-analysis techniques like SWOT & TOWS	
3	Introduce students to key concepts of: a) Pluralism & cultural spaces b) Cross-cultural communication c) Science of Nation building	
Course Outcomes: Upon completion of the course, students shall have ability to		
C2.6.1	Apply & analyze the basic principles of SWOT & life positions.	[U]

C2.6.2	Understand, analyze & leverage the power of motivation in real life	[AP]
C2.6.3	Identify & respect pluralism in cultural spaces	[AP]
C2.6.4	Understand and apply the concepts of Global, glocal and translocational	[C]
C2.6.5	Analyze cross cultural communication	[U]
C2.6.6	Apply the science of Nation building	[AP]
C2.6.7	Identify the common mistakes made in cross-cultural communication	[E]
C2.6.8	Understand, apply & analyze the tools of technical writing	[U]
C2.6.9	Recognize the roles and relations of different genders.	[AP]
C2.6.10	Understand Artificial intelligence & recognize its impact in daily life	[U]
C2.6.11	Identify the best practices of technical writing	[AP]
C2.6.12	Differentiate between the diverse culture of India	[E]

Course Contents:

Objectives for Semester 4

After completing this semester, learners will be able to:

- Summarize the basic principles of SWOT and Life Positions.
- Apply SWOT in real life scenarios.
- Recognize how motivation helps real life.
- Leverage motivation in real-life scenarios.
- Identify pluralism in cultural spaces.
- Respect pluralism in cultural spaces.
- Differentiate between the different cultures of India.
- Define the terms global, glocal and translocational.
- Differentiate between global, glocal and translocational culture.
- Recognize the implications of cross-cultural communication.
- Identify the common mistakes made in cross-cultural communication.
- Apply cross-cultural communication.
- Differentiate between the roles and relations of different genders.
- Summarize the role of science in nation building.
- Define AI (artificial intelligence).
- Recognize the importance of AI.
- Identify the best practices of technical writing.
- Apply technical writing in real-life scenarios.

Total Hours:	48 hours
Text Books:	
	There are no prescribed texts for Semester 4 – there will be handouts and reference links shared.
Reference Books:	
1	
2	
3	
4	
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 Resources:	
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		
Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1	Analyze	SWOT in real life	5
C1.6.2	Analyze	Motivation in real life	4
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand	Written Assessment, project and group discussion		50
Apply			
Analyze			

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			Guest lecture by a renowned personality to kick start this semester.	This will be outside the total hours for this Semester	90 mins
1			<p>REUNION</p> <p>Recap activity on the earlier learning after a 6 months break.</p> <p>If we can flash the projects they completed in the last semester.....</p> <p>End with a Quiz in multiple format rounds testing the objectives.</p>	Activity	60 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Summarize the basic principles of SWOT and Life Positions.	2	<p>SWOT and Life Positions</p> <p>Meet Dananjaya: Meet Dananjaya Hettiarachchi The World Champion of Public Speaking 2014 who made the winning speech which was rated amongst the “Most talked-about speeches of 2014”.</p> <p>https://www.youtube.com/watch?v=bbz2boNSeL0&t=24s</p> <p>Debrief on the video. How it relates to SWOT.</p> <p>Intro activity: Give story of an individual* and divide people into 4 groups S W O T and ask them to jot down the SWOT. Start with a different nomenclature (demystifying SWOT)</p>	Lecture and activity	60 Minutes
1	Apply SWOT in real life scenarios.	3	<p>Pat your back activity...strength will be written by others other points by you</p> <p>Create your SWOT</p>	Practical	60 Minutes
1	Apply SWOT in real life scenarios.	3	<p>SWOT Vs. TOWS The Balancing Act</p> <p>Ted talk on biomimicry: (Only first 8 mins): https://www.youtube.com/watch?v=RHR04t86phA</p> <p>Debrief on the Ted talk in which the facilitator gently guides the group towards the understanding that survival</p>	Lab	120 minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>happens only when we seek ideas from the external world to turn the threat into opportunity</p> <p>Research on TOWS and find out how you can turn your threat into opportunity. Two people mutually identifying opportunities from each other's threats.</p>		
1	Apply SWOT in real life scenarios.	3	<p>Presentation on what are the strengths they have identified to survive in the VUCA World.</p> <p>Group presentations of 10 mins each.</p>	Formative evaluation	90 mins
1	Recognize how motivation helps real life.	1	<p>Motivation</p> <p>Stories YouTube videos on Maslow's Theory</p>	Lecture and activity	90 mins
1	Leverage motivation in real-life scenarios.	3	Scenario based activity on identifying and leveraging motivation	Formative evaluation/Lab	60 mins
1	Recognize how motivation helps real life.	1	Present their findings and approaches as groups. They need to explain the idea of motivation with the help of examples.	Practical	60 mins
Unit 2					
2	Identify pluralism in cultural spaces.	1	<p>Rivers of India</p> <p>a. Divide participants into groups of 5. Each group should assign themselves a name from the Indian Rivers. These groups will continue throughout this Unit.</p> <p>b. Learn and Exchange</p>	Activity	90 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Group activity in which participants need to learn the following four greetings of a state (different from their own) and exchange it with another group:</p> <ul style="list-style-type: none"> • Good morning • Thank you • Sorry • Good night <p>Indicative only</p>		
2	<p>Identify pluralism in cultural spaces.</p> <p>Respect pluralism in cultural spaces.</p>	<p>2</p> <p>3</p>	<p>a. Awareness and respect for pluralism in cultural spaces</p> <p>b. Announce the Rhythms of India activity to be held in the next session. The rules of the activity will be detailed at this point. Teams to prepare for the performance beyond class hours.</p>	Theory/Discussion using Phir Miley Sur MeraTumhara	90 Minutes
2	Differentiate between the different cultures of India.	2	<p>Rhythms of India (Cultures in India)</p> <p>Group activity: Each group to perform a short dance piece (3 mins) from any of the Indian states (to be decided by lots).</p> <p>They have to present the background and unique features of the dance form (5 min).</p>	Practical/Discussion	120 Minutes
2	<ul style="list-style-type: none"> • Define the terms global, glocal and translocational. • Differentiate between global, glocal and translocational culture. 	1, 2	<p>a. Global, glocal, translocational</p> <p>Use Ted and YouTube videos to show examples</p> <p>b. Announce debate to be held in the next session. They have to come prepared for the debate/discussion.</p>	Lecture/Discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
2	Differentiate between global, glocal and translocational culture.	2	<p>Debate on Global, glocal, translocational impacts (topics to be decided by the faculty or suggested by the students).</p> <p>Debate to be held in the presence of an external moderator.</p> <p>Eight groups will get four topics to debate upon.</p>	Activity	60 mins
2	<ul style="list-style-type: none"> Recognize the implications of cross-cultural communication. Identify the common mistakes made in cross-cultural communication. 	1, 2	<p>Cross-cultural communication</p> <p>A. Verbal and non-verbal communication (approach is through videos). Point out the obvious mistakes. From our perspective...how anyone would feel if someone else made mistakes about our cultures.</p> <p>B. Let participants have a group discussion on the implications of cross cultural communication.</p>	Lecture/Discussion	60 mins
2	Apply cross cultural communication.	3	Suggested long-term activity: A VR game in which learners can visit different locations of the world and overcome challenges by using cross cultural skills.		
2	Identify the common mistakes made in cross-cultural communication	2	<p>Culture shock</p> <p>Group activity to perform skits based on situations provided by the lecturer.</p>	Practical	60 mins
2	Differentiate between the roles and relations of different genders.	2	<p>Gender awareness</p> <p>Participants will view relevant scenarios in the class and then participate in a reflection activity in group. The scenarios can be presented using an Augmented Reality</p>	Discussion	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			intervention.		
2	Differentiate between the roles and relations of different genders.	2	<p>Gender awareness campaign</p> <p>Groups to present the detailed plan of Gender awareness campaigns with four different themes.</p> <ul style="list-style-type: none"> • College • Workplace • Family • Friends 	Activity	60 mins
2			Quiz Time	Summative Evaluation for Unit	60 Minutes
Unit 3					
3	Summarize the role of science in nation building.	2	<p>Role of science in nation building</p> <p>Introduce the topic and discuss the role of scientists and mathematicians from ancient India.</p> <p>Break the students into groups and give them ten minutes to access internet and get information about ten eminent scientists and mathematicians of ancient India. Groups will be given five minutes to present on the next day. Groups will also frame two questions which they will ask after presenting.</p> <p>This can also be taught through Augmented Reality, where images of the scientists will be put up around the class and they will be able to gather the</p>	Theory and lab	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			information by using their phones and AR app.		
			Groups present their findings. Other groups note down their learning. At the end there will be a quiz to assess their learning.	Activity	90 mins
	Summarize the role of science in nation building.	2	Role of science post-independence Groups to present using multiple formats on any one of the four given topics. <ul style="list-style-type: none"> • Inventions • Inventors • Institutes • Information technology 	Lab and practical	120 mins
	Identify the best practices of technical writing.	1	Introduction to technical writing Basic rules of technical writing through examples.	Lecture (Guest over faculty, webinar)	60 mins
	Identify the best practices of technical writing.	1	Practice activity on technical writing.	Lab	60 mins
	Apply technical writing in real-life scenarios.	3	Assessment on technical writing on the following topic: Explain the following to a visually impaired person: <ul style="list-style-type: none"> • DNA • Rings of Saturn • Structure of an oxygen atom 	Summative evaluation	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<ul style="list-style-type: none"> Structure of heart 		
Unit 4					
4	Define AI (artificial intelligence).	1	<p>“Voice of the Future” Activity</p> <p>How will a voice assistant evolve in 25 years from now? Each group will present a skit.</p>	Activity	90 mins
	Recognize the importance of AI.	1	<p>AI in Everyday Life</p> <p>Discussion in groups on given topics and then cross sharing of discussion points amongst the groups.</p>	Lab and Activity	90 mins
	Recognize the importance of AI.	1	<p>Design your college in the year 2090</p> <p>Groups need to create the college of future with the future teachers, teaching methods, types of students, etc.</p> <p>We will end the session with the question: How will offices/workplaces change in future? Who do you think would be your colleagues?</p>	Lab and Practical	90 mins
	Recognize the importance of AI.	1	<p>Communicating with machines</p> <p>Theory and Ted talk videos</p>	Lecture	60 mins
	Recognize the importance of AI.	1	<p>Debate in the presence of an external moderator.</p> <p>Will machines control us in future?</p>	Discussion	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	Identify the best practices of technical writing.	1	Applying technical writing in profession Theory with YouTube and Dr Bimal Ray's videos. Dr Bimal Kumar Roy, a former Director of the Indian Statistical Institute, is a cryptologist from the Cryptology Research Group of the Applied Statistics Unit of ISI, Kolkata.	Lecture	90 mins
	Apply technical writing in real-life scenarios.	3	Scenario-based Assessment on technical writing Each group will make a presentation on the following: a) Sell Analytics and Insight to the local tea seller. b) Explain the concept of Cloud to your 87 year old grandmother. c) Introduce the concept of friendly robots to a class 3 kid. Explain IOT to your helping hand at home	Summative evaluation	60 mins
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.	Project	10 hours

Course Outcome(CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	-	-	-	-	2	2	3	3	3	3	3
CO2	-	-	-	-	-	2	-	2	3	2	2	3
CO3	-	-	-	-	-	2	1	2	3	2	2	2
CO4	-	-	-	-	-	-	-	2	-	3	-	2
CO5	-	-	-	-	-	2	-	-	2	2	-	2

Course Name: Operations Research

Course Code: M(BS)401

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Introduction to OR:

Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

Linear Programming:

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP.

Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.

Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & 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.

Transportation and Assignment problems:

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.

PERT – CPM:

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 order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

Queuing Theory:

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 behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.

Simulation Methodology:

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.

Text Books:

1. Operations Research: An Introduction. H.A. Taha.

Reference Books:

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.

Essence of Indian Traditional Knowledge (Non Credit)

(To be finalised by Respective Institute)

3rd Year 1st Semester: 5th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Program Core Course	CB501	Design and Analysis of Algorithms	3	0	0	3	3
2	Program Core Course	CB502	Compiler Design (LEX & YACC)	3	0	0	3	3
3	Program Core Course	BS501	Fundamentals of Management	2	0	0	2	2
4	Program Core Course	BS502	Business Strategy	2	0	0	2	2
5	Program Core Course	BS503	Design Thinking	2	1	0	3	3
6	Professional Elective courses	PE-CB503A	Conversational Systems	2	0	0	2	2
		PE-CB503B	Cloud, Microservices and Application					
		PE-CB503C	Machine Learning					
B. PRACTICAL								
7	Program Core Course	CB591	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
8	Program Core Course	CB592	Compiler Design Lab (LEX & YACC)	0	0	3	3	1.5
9	Program Core Course	BS593	Design Thinking Lab	0	0	2	2	1
10	Professional Elective courses	PE-CB593A	Conversational Systems Lab	0	0	2	2	1
		PE-CB593B	Cloud, Microservices and Application Lab					
		PE-CB593C	Machine Learning Lab					
11	PROJECT	PR 591	Minor Project I	0	0	2	2	1
TOTAL CREDIT								21

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Design and Analysis of Algorithms

Course Code: CB501

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

Fundamental Algorithmic Strategies: 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.

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

Books:

1. Fundamental of Computer Algorithms, E. Horowitz and S. Sahni.
2. The Design and Analysis of Computer Algorithms, A. Aho, J. Hopcroft and J. Ullman.

Reference Books:

1. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
2. Computer Algorithms: Introduction to Design and Analysis, S. Baase.
3. The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, .D. E. Knuth.

Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang.

Course Name: Design and Analysis of Algorithms Lab

Course Code: CB591

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Implementation of Different Algorithms based on various algorithmic strategies using C/C++

Course Name: Compiler Design (LEX and YACC)
Course Code: CB502
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

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).

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)

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

Symbol Table: Basic structure, symbol attributes and management. 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.

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) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Books:

1. Compilers: Principles, Techniques and Tools, V. Aho, R. Sethi and J. Ullman.
2. Lex & Yacc, Levine R. John, Tony Mason and Doug Brown

Reference Books:

The Design and Evolution of C++, Bjarne Stroustrup.

Course Name: Compiler Design (LEX and YACC) Lab
Course Code: CB592
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Assignments using Lex and Yaac

Course Name: Fundamentals of Management
Course Code: BS501
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Course Outcome(s):

This course will teach students the management theories, evolution of management over the years and few basic concepts without going into the details. After studying this course the students will develop an understanding about how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc. which will be taken up in future terms.

Topics to Be Covered:

UNIT – I

Management Theories: 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, Elton Mayo etc.

UNIT – II

Functions of Management- Planning, Organizing, Staffing, Directing, Controlling

UNIT – III

Organization Behavior: Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making, Problems in Decision Making, Decision Making, Organizational Culture, Managing Cultural Diversity

UNIT – IV

Organizational Design: Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)

UNIT – V

Managerial Ethics: 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 – VI

Leadership: Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid

Home Assignment:

The topic for class discussion will be mentioned beforehand and students should be ready to discuss these topics (in groups) in class. Students are required to meet in groups before coming to class and prepare on the topic. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

1. Topic: Corporate social responsibility (CSR) and HRM implications: What does it mean to be socially responsible within an increasingly financially driven market economy?
2. Topic: Leaders are Born, Not Made! The debate

Text Books:

1. Richard L. Daft, Understanding the Theory and Design of Organizations

Reference Books:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior

Course Name: Business Strategy
Course Code: BS502
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Course Outcome(s):

This course will help students,

- To learn the fundamental concepts of strategic management to analyze business situations and apply these concepts to solve business problems.
- To understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology
- To understand the inter-relationships of business to individuals, other organizations, government and society.
- To analyze complex, unstructured qualitative and quantitative problems, using appropriate tools.

Topics to Be Covered:

UNIT – I

Introduction to Strategic Management

- Importance of Strategic Management
- Vision and Objectives
- Schools of thought in Strategic Management
- Strategy Content, Process, and Practice
- Fit Concept and Configuration Perspective in Strategic Management

UNIT – II

Internal Environment of Firm- Recognizing a Firm's Intellectual Assets

- Core Competence as the Root of Competitive Advantage
- Sources of Sustained Competitive Advantage
- Business Processes and Capabilities-based Approach to Strategy

UNIT – III

External Environments of Firm- Competitive Strategy

- Five Forces of Industry Attractiveness that Shape Strategy
- The concept of Strategic Groups, and Industry Life Cycle
- Generic Strategies
- Generic Strategies and the Value Chain

UNIT – IV

Corporate Strategy, and Growth Strategies

- The Motive for Diversification

- Related and Unrelated Diversification
- Business Portfolio Analysis
- Expansion, Integration and Diversification
- Strategic Alliances, Joint Ventures, and Mergers & Acquisitions

UNIT – V

Strategy Implementation: Structure and Systems

- The 7S Framework
- Strategic Control and Corporate Governance

Home Assignment:

- Latest business events would be discussed in class and students should be ready to discuss these events (in groups). The topic will be mentioned beforehand. Students are required to meet in groups before coming to class and prepare on the topic.
- There will be periodic homework assignments relating to the course concepts or mini-cases. Specific instructions will be given separately.

Final Project:

Students (in groups) are required to work on a project and submit the project report and deliver presentation. The topic of the project will be given later.

Text Books:

1. Robert M. Grant (2012). Contemporary Strategic Management, Blackwell, 7th Edition.

Reference Books:

1. M.E. Porter, Competitive Strategy, 1980.M.E. Porter,
2. Competitive Advantage, 1985 Richard Rumelt (2011).
Good Strategy Bad Strategy: The Difference and Why It Matters.

Course Name: Design Thinking
 Course Code: BS502
 Contact: 3:0:0
 Total Contact Hours: 36
 Credits: 3

DESIGN THINKING

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 1 Hr./Week	Semester Examination: 50 marks	2
Practical: 1 Hr. / Week	Continuous Assessment: Yes	
Activity: 1 Hr. / Week	Term Work: 50 marks	

Course ID:

3.5 (3rdYear __Semester 5)

	Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral	
Pre requisites	Completion of all units from Semesters 1, 2, 3 and 4	
Course Terminal Objectives:		
1	Recognize the importance of DT	
2	Explain the phases in the DT process	
3	List the steps required to complete each phase in DT process	
4	Apply each phase in the DT process	
5	Use doodling and storytelling in presenting ideas and prototypes	
6	Create value proposition statements as part of their presentations	
7	Recognize how DT can help in functional work	
8	Recognize how Agile and DT complement each other to deliver customer satisfaction	

Course Enabling Objectives: Upon completion of the course, students shall have ability to		
1	Recognize the importance of Design Thinking	[U]
2	Identify the steps in the DT process	[C]
3	Recognize the steps in the empathize phase of DT	[C]
4	Identify the steps required to conduct an immersion activity	[C]
5	Conduct an immersion activity and fill up the DT question template	[AP]
6	Recognize the steps to create personas in the define phase of DT	[C]
7	Create personas in the define phase of DT	[AP]
8	Recognize the steps to create problem statements in the define phase of DT	[AP]
9	Define the problem statements in the define phase of DT	[E]
10	Recognize the steps in the ideate phase of DT	[C]
11	Apply the steps in the ideate phase of DT	[AP]
12	Recognize how doodling can help to express ideas	[U]
13	Recognize the importance storytelling in presenting ideas and prototypes	[U]
14	Recognize the importance of the prototype phase in DT	[C]
15	Create a prototype	[AP]
16	Recognize the importance of service value proposition	[C]
17	Create a value proposition statement	[AP]
18	Recognize the best practices of the testing phase in DT	[U]
19	Test a prototype created through a DT process	[AP]
20	Recognize how DT can help in functional work	[E]
21	Recognize how Agile and DT complement each other to deliver customer satisfaction	[C]

Course Contents:	
Total Hours:	45 hours
Textbooks:	
	There are no prescribed texts for Semester 5 – there will be handouts and reference links shared.
Reference Books:	
1	Hooked by NirEyal
2	The Art of Creative Thinking by Rod Judkins
3	Start Up nation by Dan Senor and Saul singer
4	Start with Why by Simon Sinek

Web References:			
1	What is Design Thinking? Interaction Design Foundation		
2	What are some of the good examples of design thinking? - Quora		
3	Design thinking 101: Principles, Tools & Examples to transform your creative process		
Online Resources:			
1	Understanding Design thinking WF NEN		
2	Design Thinking and Innovation at Apple Wei Li		
3	Stanford Webinar- Design Thinking = Method, Not Magic		
4	Stanford Design Thinking Virtual Crash Course		
5	So Many Uses- activity to spark creativity and design		
Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
	Apply	Defining problem statement	5
	Apply	Ideating solutions	5
	Apply	Creating a prototype	10
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand	Understand, Analyze, Apply		50
Apply			
Analyze	Conduct and apply DT in the project.		

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
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Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Recognize the importance of Design Thinking	2	<p>Why is Design Thinking important for business?</p> <p>Stories and examples will be used to introduce Design Thinking to the participants. We will use relevant stories and the following videos.</p> <ol style="list-style-type: none"> 1. YouTube video: The Design Thinking Process – Sprouts (3.57 mins) 2. Leverage TCS-provided DT content to show the evolution of DT and why is important in present business environment. Can be a video. (2 mins) <p>Lecturer to encourage the students to maintain their Satori slam book and capture their learning points in it.</p>	Introduction and discussion	60 mins
1	Recognize the importance of Design Thinking	2	<p>Why is Design Thinking important for you?</p> <p>Experiential activity</p> <p>Products that you loved and hated: In this activity, learners will have to share about a product they like of disliked based on their experience.</p> <p>What would they need in a bad product to make it good?</p>	Activity	90 mins
1	Identify the steps in the DT process	2	<p>What is DT?</p> <p>Introduce the 5-Step Stanford Model using YouTube videos:</p> <p>The video will give a brief idea</p>	Lecture and demo	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>about the five steps:</p> <ul style="list-style-type: none"> • Empathize (search for rich stories and find some love) • Define (user need and insights – their POV) • Ideate (ideas, ideas, ideas) • Prototype (build to learn) • Test (show, don't tell) <p>Start all over and iterate the flow as much as possible</p>		
1	Recognize the steps in the empathize phase of DT	2	<p>What is empathy?</p> <p>Touch the target activity (Recap from Sem 2 Unit 4)</p> <p>Discussions in class</p> <p>Reference: FHIL Stages of Design Thinking EMPATHY (2:29 mins)</p>	Activity	60 mins
1	Identify the steps required to conduct an immersion activity	1 and 2	<p>How to empathize?</p> <p>Moccasin Walk activity for 1 hour to allow learners experience stepping into the shoes of another person. This is an individual activity.</p> <p>Sharing observations with the group.</p> <p>Suggest that students try this even in their free time away from studies.</p>	Activity and lecture	90 mins
1	Identify the steps required to conduct an immersion activity	1 and 2	<p>Intro to Immersion Activity</p> <p>Introduction to immersion activity through flowcharts and handouts and examples (to be provided by TCS DT Team) (steps and the question template:</p> <ol style="list-style-type: none"> 1. We met; 2. We were amazed to realize that; 3. We wonder if this means 4. It would change the world 	Lecture	45 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			if)		
1	Conduct an immersion activity and fill up the DT question template	3	<p>Immersion activity</p> <p>Participants will be divided into four groups. Each group will need to visit any one of the following places to conduct an immersion activity. They need to interview people and fill up the DT question template (explained in the last class)</p> <ol style="list-style-type: none"> 1. College cafeteria 2. College library 3. College sports facility 4. Transport facility near college 	Practical	180 mins
2	<p>Recognize the steps to create personas in the define phase of DT</p> <p>Create personas in the define phase of DT</p>	<p>2</p> <p>3</p>	<p>Creating personas</p> <p>Start with YouTube videos explaining the process of persona creation:</p> <ol style="list-style-type: none"> 1. Personas – What is a persona and how do I create one? (2019) <p>https://www.youtube.com/watch?v=GnvLpfXCge8</p> <p>Each group will create at least one persona based on the immersion study they conducted in the empathize stage (refer to the four question templates). The group can use A4 pages, colours and other props to create and display their respective persona.</p> <p>Reference: https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them</p>	Lecture and practical	120 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			Lecturer to guide participants on getting the personas right (based on guidelines provided by TCS DT Team).		
2	Recognize the steps to create problem statements in the define phase of DT	2	<p>Problem statements</p> <p>Session will begin with YouTube videos on how to define problem statements in the Define phase.</p> <p>1. FHIL Stages of Design Thinking REFRAME (1:55 mins)</p> <p>Lecturer will provide examples of problem statements in class (based on handouts provided by TCS DT Team)</p>	Lecture and demo	60 mins
2	Define the problem statements in the define phase of DT	3	<p>Defining problem statements</p> <p>Group activity, in which each group will define the key problem statements (max three) for their lead personas.</p> <p>Each group will present while the remaining groups will do a peer review.</p> <p>Finally, lecturer will moderate/validate the problem statements (based on handouts provided by TCS DT Team)</p>	Formative assessment	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
3	Recognize the steps in the ideate phase of DT	1 and 2	<p>How to Ideate?</p> <p>The session will start with YouTube videos:</p> <ol style="list-style-type: none"> 1. FHIL Stages of Design Thinking IDEATE (1:54 secs) 2. What Is Six Thinking Hats? (Litmos Heroes) (1:58 secs) <p>Lecturer to briefly tell them about the guidelines of ideating (to be provided by TCS DT Team)</p>	Lecture and demo	60 mins
3	Apply the steps in the ideate phase of DT	3	<p>Ideation games</p> <p>Game 1: Six Thinking Hats</p> <p>Game 2: Million-dollar idea</p>	Activity	90 mins
3	Apply the steps in the ideate phase of DT	3	<p>Ideate to find solutions</p> <p>Participants will work in their assigned groups to ideate solutions for the problem statements they identified (as continuation of immersion activity) applying ideation methods discussed in the previous session. They will get scores based on how well they can apply the ideation methods.</p> <p>Lecturers will observe the groups separately and assign them scores based on specific rubric (provided by the TCS DT Team).</p>	Formative assessment	90 mins
3	Recognize how doodling can help to express ideas	1	<p>Let's doodle!</p> <p>Participants will first watch a video on doodling:</p> <p>Doodling – how it can help in presenting ideas during ideate and prototype phases</p> <p>After that, participants will complete an activity on doodling.</p>	Demo and activity	60 mins
3	Recognize the	1	What is Storytelling in DT?	Activity	120 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	importance storytelling in presenting ideas and prototypes		<p>Activity- Research to find out about people who have used DT in providing solutions. Present their findings in forms of stories. (Recap from Unit- Sem-)</p> <p>Suggested topics to be provided by the TCS DT team.</p>		
4	Recognize the importance of the prototype phase in DT	2	<p>Why is a Prototype important in Design Thinking?</p> <p>The session will start with an activity to drive home the importance of creating a prototype in the design thinking process.</p> <p>As part of debrief of the activity, lecturer will share relevant examples and prototyping guidelines (provided by the TCS DT Team).</p> <p>Finally, the participants will watch two YouTube videos:</p> <ol style="list-style-type: none"> 1. FHIL Stages of Design Thinking PROTOTYPE 2. Prototyping Phase - Design Thinking Coursera https://www.coursera.org/lecture/patient-safety-project-planning/prototyping-phase-jVuQn 	Activity and demo	60 mins
4	Create a prototype	3	<p>Prototype your idea</p> <p>This is a group activity in which the participants will work in groups (created at the beginning of the course, in which they did immersion, persona creation, defining problem statement and ideating) to create prototypes based on the solutions they had identified.</p>	Formative assessment	180 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			Lecturer to share feedback based on guidelines provided by the TCs DT team.		
4	Recognize the importance of service value proposition Create a value proposition statement	2 3	Value Proposition Statement You Tube: What is Value Proposition (by Venture Well) (3:51 mins)? Lecturer to discuss the guidelines for creating a value proposition statement (to be provided by the TCS DT Team) Each group now needs to create value proposition statement for the solution they have suggested.	Lecture	120 mins 1635 mins
4	Recognize the best practices of the testing phase in DT	1	Testing in Design Thinking Participants will first watch a YouTube video: FHIL Stages of Design Thinking TESTING After that lecturers will explain them the importance of Testing the prototype through stories (provided by the TCS DT Team). They will also explain how the loop works in DT between the Empathize and Testing phases.	Lecture	60 mins
	Test a prototype created through a DT process	3	Test the Prototype Each group needs to test their prototype created earlier and: <ol style="list-style-type: none"> 1. Document user feedback 2. Write down their inference from the feedback 3. Suggest next steps (the loop that happens in DT) 	Activity	120 mins
4	Recognize how DT can help in	1	Role of DT in your work	Discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	functional work		Lecturer conducts a group/open house discussion on: "How DT can help me to become a better coder?" Lecturer needs to capture the key learning points in these discussions.		
4	Recognize how Agile and DT complement each other to deliver customer satisfaction	1	Suggested session on: How Agile and DT complement each other to deliver customer satisfaction	Lecture	45 mins
4			Share your Satori Participants will be asked to share their Satori moments from the DT sessions	Reflection activity	60 mins
					33 hours
			Project Option 1: Each group needs to present a Prototype of how they can apply DT in their functional work or coding. Examples will be provided to explain what exactly they need to do. Option 2: Each group will apply DT to create a prototype to improve any existing product or service. For both options, groups need to complete all phases of the Stanford DT model and include the outputs of each phase in their presentation. Lecturers will evaluate the project based on the rubric provided by the TCS DT Team.		12 hours
				Total	45 hours

Course Name: Conversational Systems
Course Code: CB503A
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Pre requisites: Nil

Course Objectives:

1. Enable attendees to acquire knowledge on chatbots and its terminologies.
2. Work with machine learning concepts and different algorithms to build custom model.
3. Understand on conversational experiences and provide better customer experiences.

Course Outcomes:

Upon completion of the course, students shall have ability to

- BS503A.1 Understand the fundamentals of conversational systems and foundational blocks of programming.
- BS503A.2 Apply the natural language processing techniques in building conversational systems.
- BS503A.3 Design and build chatbots and conversational intelligent systems.
- BS503A.4 Analyse the significance of machine learning methods and artificial intelligence in conversational technologies.
- BS503A.5 Perform the analytics on conversational systems using performance metrics

Course Contents:

Fundamentals of Conversational Systems. 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. Foundational Blocks for Programming** - Basic Python programming concepts - Node Basics - Coding Best Practices- Evaluation Test (Hands On)–1 HR.

Natural Language Processing - 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, Fulfillment - 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 - Make use of any of the NLP libraries like NLTK, spaCy, StanfordNLP etc. (Practice session to use an NLP Tool -Hands on) - Affective NLG. **Building a chatbot/Conversational AI Systems** - 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 - Building a Voice/Chat Bot - Hands on

Role of ML/AI in Conversational Technologies: Brief 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.

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 – Whereare 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.

Project 1: Case Study to build a learning chatbot –

Project 2: Case Study to build a ML Model using LSTM/any RNN and integrate with chatbot.

Text Books:

1. Micheal McTear, Conversational AI: Dialogue Systems, Conversational Agents and chatbots, 1st Edition, Morgan and Claypool, 2020,
2. Luis Fernando D Haro, Zoraida Callejas, Satosh Nakamura, Conversational Dialogue Systems for the Next Decade, 2021, 1st Edition, Springer
3. Srinu Janarthanam, Chatbots and Conversational UI Development, 2017, 1st Edition, Packt Publishers.
4. Diana Perez-marin and Ismael Pascual-Nieto, Conversational Agents And Natural Language Interaction, 2011, 1st Edition, IGI Global publishers.

Web References:

1. <https://ocw.mit.edu/courses/media-arts-and-sciences/mas-632-conversational-computer-systems-fall-2008/index.htm>
2. <https://www.coursera.org/learn/contact-center-ai-conversational-design-fundamentals>
3. <https://www.kth.se/student/kurser/kurs/DT2151?l=en>
4. https://hao-fang.github.io/ee596_spr2018/

Online Resources:

1. <https://www.microsoft.com/en-us/research/group/conversational-systems-research-group/>

<https://www.youtube.com/watch?v=9P8CdYfh00I>

Course Name: Cloud, Microservices and Application

Course Code: CB503B

Contact: 2:0:0

Total Contact Hours: 24
Credits: 2

Pre requisites: Operating Systems, Database Management Systems

Course Objectives:

- 1 To 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 To enable students to develop applications using various cloud services.
- 4 To enable students to deploy applications on Cloud by using cloud native services.
- 5 To help students to implement Develops fundamentals tools and applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

- BS503B.1 Understand the fundamentals of cloud service applications
- BS503B.2 Understand the different public cloud applications
- BS503B.3 Design and develop the application for providing cloud services
- BS503B.4 Deploy the cloud micro services using native cloud tools
- BS503B.5 Evaluate and Implement python and Devops tools and applications

Course Contents:

Cloud Fundamentals: Cloud Service Components, Cloud service/Deployment Models. Cloud components Guiding Principle with respect to utilization/Security/Pricing and the applications of Cloud. Public Cloud Platforms overview and their usage.

Application architectures-Monolithic & Distributed, Micro service fundamental and design approach, Cloud Native applications-12 Factors App. Application integration process/APIFICATION Process, API Fundamental. Micro service /API management, Spring boot Fundamental and design of micro service, API tools. Developer Portal. Applications of Micro service and APIFICATION

Develops fundamentals: Tools and Applications Containerization Process and application. **Python-** Intrduction, Programming Concepts, Beyond the Basics, Use cases. Cloud Application development/Deployment/Execution steps. Cloud Security and Monitoring Tools.

Text Books:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
2. George Reese, Cloud Application Architectures: Building applications and infrastructure in the Cloud, O'Reilly Media, Inc, 2009

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, Mastering in Cloud, MHI, 2013.

2. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management, and Security, CRC Press, 2010.
3. Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.
4. Moshe Zadka, DevOps in Python, Apress, 2019.
5. Michael Huttermann, DevOps for Developers, Apress, 2012.
6. Brian Heinold, A Practical Introduction to Python Programming, Mount St. Mary's University, 2012.

Web Resources:

1. <https://azure.microsoft.com/en-us/overview/what-is-cloud-computing/>
2. <https://docs.microsoft.com/en-us/learn/modules/principles-cloud-computing/>
3. <https://aws.amazon.com/lambda/>
4. <https://docs.python.org/2/reference/index.html>
5. <https://cloud.google.com/security/infrastructure/design>

Online Resources:

1. <https://www.coursera.org/browse/information-technology/cloud-computing>
2. <https://www.coursera.org/learn/python>
3. <https://www.coursera.org/professional-certificates/sre-devops-engineer-google-cloud>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	2	2	1	1	1	2	2	2
CO4	1	1	2	1	2	2	2	2	2	2	2	2
CO5	1	2	2	1	2	2	2	2	2	2	2	2

Course Code: CB503C
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

1. Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML
2. Classification: Supervised Learning; The 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; 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
3. 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
4. Regression: Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression
5. Association rule mining algorithms including apriori
6. Expectation-Maximization (EM) algorithm for unsupervised learning
7. Clustering: average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbors clustering; BIRCH; CURE; DBSCAN
8. Anomaly and outlier detection methods

Course Name: Machine Learning Lab
Course Code: CB593C
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Lab Sessions:

- (1) Introduction to WEKA and R
- (2) Classification of some public domain datasets in UCI ML repository

Mini projects in the Lab:

- (1) Implementation of one clustering algorithm
- (3) Implementation of one association rule mining algorithm
- (4) Implementation of one anomaly detection algorithms
- (5) Implementation of EM algorithm for some specific problem

References:

- [1] R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001.
- [2] C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
- [3] E. Alpaydin, Introduction to Machine Learning, 3/e, Prentice-Hall, 2014.
- [4] A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
- [5] A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	2	-	-	-	-	-	-	3	2	2	2
CO2	3	3	3	-	2	-	-	-	-	-	-	3	3	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	3	3	3	3

3rd Year 2nd Semester: 6th Semester

Sl.No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Program Core Course	CB601	Computer Networks	3	0	0	2	3
2	Program Core Course	CB602	Information Security	3	0	0	3	3
3	Program Core Course	CB601	Artificial Intelligence	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	BS601	Financial and Cost Accounting	2	0	0	3	3
5	Humanities and Social Sciences including Management courses	HU601	Business Communication and Value Science-IV	2	0	0	2	2
6	Professional Elective courses	PE-CB603A	Robotics and Embedded Systems	2	0	0	2	2
		PE-CB603B	Modern Web Applications					
		PE-CB603C	Data Mining and Analytics					
B. PRACTICAL								
7	Program Core Course	CB691	Computer Networks Lab	0	0	3	3	1.5
8	Program Core Course	CB692	Information Security Lab	0	0	2	2	1
9	Program Core Course	CB691	Artificial Intelligence Lab	0	0	3	3	1.5
10	Professional Elective courses	PE-CB693A	Robotics and Embedded Systems Lab	0	0	0	2	1
		PE-CB693B	Modern Web Applications Lab					
		PE-CB693B	Data Mining and Analytics Lab					
TOTAL CREDIT								21

Course Name: Computer Networks
Course Code: CB601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

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.

LAN: Wired LAN, Wireless LAN, Virtual LAN.

Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

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 -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

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.

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.

Course Name: Computer Networks Lab
Course Code: CB691
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

1. Socket Programming using C/C++
2. Network System Administration: Understanding switches and routers

Books:

1. Computer Networks, A. Tannenbaum.
2. Data and Computer Communication, William Stallings.

Reference Books:

3. Network Security, Kaufman, R. Perlman and M. Speciner.
4. UNIX Network Programming, Vol. 1,2 & 3, W. Richard Stevens

Course Name: Information Security
Course Code: CB602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Overview of Security Parameters: Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.

Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.

Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interference and policy composition, international standards.

Systems Design: Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.

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.

Course Name: Information Security Lab
Course Code: CB692
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

1. Analysis of security in Unix/Linux.
2. Administration of users, password policies, privileges and roles

Books:

1. Security Engineering, Ross Anderson.
2. Computer Security: Art and Science, M. Bishop, Pearson Education.
3. Information Security: Principles and Practice, M. Stamp.

Reference Books:

1. Security in Computing, C.P. Pfleeger, S.L. Pfleeger, J. Margulies.
2. Secure Programming HOWTO, David Wheeler.
3. Browser Security Handbook, Michael Zalewski.
4. Handbook of Database Security, M. Gertz, S. Jajodia.

Course Name: Artificial Intelligence
Course Code: CB603
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Outcome(s):

This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence.

Topics to Be Covered:

UNIT – I

Introduction, Overview of Artificial intelligence: 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.

UNIT – II

Problem Solving, Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

UNIT – III

Search techniques: 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 – IV

Constraint satisfaction problems: 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 – V

Knowledge & reasoning: 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 – VI

Probabilistic reasoning: 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.

UNIT – VII

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Home Assignments:

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbours, decision trees, etc. can be included in home assignments.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

Reference Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS

Course Name: Financial and Cost Accounting
Course Code: BS601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Outcome(s):

This course will help students

- To create an awareness about the importance and usefulness of the accounting concepts and their managerial implications
- To develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements
- To create an awareness about cost accounting, different types of costing and cost management

Topics to Be Covered:

UNIT – I

Accounting Concept: Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements

UNIT – II

Accounting Process:

- Book Keeping and Record Maintenance
- Fundamental Principles and Double Entry
- Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts
- Cash Book and Subsidiary Books
- Rectification of Errors

UNIT – III

Financial Statements: Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards.

Class Discussion: Corporate Accounting Fraud- A Case Study of Satyam

UNIT – IV

Cash Flow and Fund Flow Techniques: Introduction, How to prepare, Difference between them

UNIT – V

Costing Systems:

- Elements 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

Class Discussion: Application of costing concepts in the Service Sector

UNIT – VI

Company Accounts and Annual Reports:

- Audit Reports and Statutory Requirements
- Directors Report
- Notes to Accounts
- Pitfalls

Home Assignment:

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be prepared to discuss these topics in class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

3. Topic: Corporate Accounting Fraud: A Case Study of Satyam
4. Topic: Application of costing concepts in the Service Sector

Text Books:

1. Robert N Anthony, David Hawkins, Kenneth Marchant, Accounting: Texts and Cases, McGraw-Hill
2. Case Study Materials: To be distributed for class discussion

Course Name: Business Communication and Value Science-IV

Course Code: HU(BS)601

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 5 Hrs./Week	Semester Examination: 50	4
Practical: 2 Hrs. / Week	Continuous Assessment: Yes	
Lab: 1 Hr / Week	Term Work: marks	

Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral
Pre requisites	Basic Knowledge of English (verbal and written) Completion of all units from Semesters 1, 2, 3, 4 and 5
Course Objectives:	
1	Recognize the importance of diversity in workplace
2	Recognize the best practices of communicative writing
3	Understand the importance of emotional intelligence in personal and professional lives
4	Apply emotional intelligence in real life scenarios
5	Use the best practices of public speaking in real life scenarios
6	Understand the importance of corporate social responsibility (CSR)
7	Understand the importance of corporate etiquettes
8	Practice corporate etiquettes in real life scenarios
9	Recognize the best practices to share and receive feedback

10	Use the basic guidelines required to manage conflicts	
11	Understand how stress impacts life and work	
12	Use the best practices to manage stress	
13	Practice the best time management practices	
Course Outcomes: Upon completion of the course, students shall have ability to		
	Understand the importance of diversity in workplace	[U]
	Apply emotional intelligence in real life scenarios	[AP]
	Recognize the best practices of communicative writing	[AP]
	Understand the importance of corporate social responsibility (CSR)	[C]
	Recognize the importance of time management	[U]
	Apply knowledge of multiple intelligences and learning styles in interpersonal interactions	[AP]
	Recognize the impact of stress in life and work	[E]
	Understand how stress impacts life and work	[U]
	Identify the best practices to manage stress	[AP]
	Recognize the attributes needed to function and grow in a corporate environment	[U]
	Recognize the best practices to share and receive feedback	[AP]
	Identify the best time management practices	[E]

Course Contents:
<p>Objectives for Semester 6</p> <ul style="list-style-type: none"> • Understand the importance of diversity in workplace • Identify the key aspects of communicative writing • Apply communicative writing in real life scenarios • Use charts and graphs in communicative writing • Understand what is emotional intelligence • Recognize the importance of emotional intelligence in personal and professional lives • Understand why you would need public speaking at your workplace

<ul style="list-style-type: none"> • Identify the best practices of public speaking • Apply public speaking in real life scenarios • Recognize the importance of corporate social responsibility (CSR) • Recognize the importance of corporate social responsibility (CSR) • Recognize the attributes needed to function and grow in a corporate environment • Recognize the best practices to share and receive feedback • Apply emotional intelligence in real life scenarios • Apply knowledge of multiple intelligences and learning styles in interpersonal interactions • Recognize the impact of conflicts • List the basic guidelines required to manage conflicts • Recognize the key features of corporate etiquette • Recognize the business idioms and corporate terms • Apply the business idioms and corporate terms • Recognize the impact of stress in life and work • Identify the best practices to manage stress • Recognize the importance of time management • Identify the best time management practices 	
Total Hours:	45 hours 40 hours of must know + 5 hours of nice to know learning
Text Books:	
	There are no prescribed texts for Semester 6 – there will be handouts and reference links shared.
Reference Books:	
1	Emotional Intelligence: Why it Can Matter More Than IQ by Daniel Goleman
2	Putting Emotional Intelligence To Work by Ryback David
3	How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion by Dale Carnegie
4	TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations
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_J34Fyo		
3	https://youtu.be/F2hc2FLOdhI		
4	https://youtu.be/wHGqp8lz36c		
5	https://youtu.be/hxS5He3KVEM		
6	https://youtu.be/nMPqsjuXDmE		
Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1			5
C1.6.2			4
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand			
Apply			
Analyze			

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	NA – Recapitulation activity	Recall information	Auld Lang Syne This will be a group activity in which lecturer will give some key words (from what they taught in the previous semesters). Each group will identify topics related to the key words and take 2 mins to share a summary of what they learnt in that topic. They can refer to their Satori books and finally note down these key learnings too.	Activity	45 mins
1	Understand the importance of diversity in workplace	2	Introduce the concept of Diversity in corporate environments through an activity.	Activity	45 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Understand the importance of diversity in workplace	2	Discussion, role plays and sharing reference materials.	Discussion and Practical	60 mins
1	Identify the key aspects of communicative writing	2	Communicative Writing <ul style="list-style-type: none"> Principles of Communicative Writing Formal and Business letters 	Lecture and practice	90 mins (30 mins lecture + 60 mins practice)
1	Apply communicative writing in real life scenarios	3	Writing proposals This will be taught through a group activity in which students will be asked to create a business proposal to get funding to begin a start-up of their choice. After they share their presentations, lecturer will share the best practices and templates for writing proposals (will be provided to the lecturer as part of the Faculty guide) and ask students to review their proposal and update it. Students should save this proposal for reference later in the sem. Students will have to continue in these groups for the rest of this sem.	Lecture and activity	90 mins
1	Use charts and graphs in communicative writing	3	How to tell a story with charts and graphs Session will begin with a couple of demo videos. This will be followed by an	Practical	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			activity on how to visually represent information to tell a complete story. Students will be required to use the proposal for the start-up that they created in the previous class for this.		
1	<p>Understand what is emotional intelligence</p> <p>Recognize the importance of emotional intelligence in personal and professional lives</p>	2	<p>Emotional Intelligence</p> <p>Begin with a short video/movie clip showing manifestations of EI.</p> <p>Introduce the concept of EI and give them the experience through a game/activity.</p> <p>Discuss the findings that students with higher EQ write better exam papers.</p> <p>Ref reading: 10 Ways to Build EI by Daniel Goleman</p> <p>Ask students to note down the names of at least two movies in their Satori slam book, in which the characters display EI.</p>	Lecture and activity	90 mins
1	Understand why you would need public speaking at your workplace	2	<p>Why do we need public speaking?</p> <p>Any two of the YouTube /IncTalks videos:</p> <ol style="list-style-type: none"> Swami Vivekananda's Chicago speech Steve Jobs' first iPhone launch Martin Luther King Jr (I have a dream...) J K Rowling commencement speech address 2008 APJ Abdul Kalam Any regional speakers <p>Professors to ask what is common in these videos and lead them to the concept of</p>	Lecture and discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>public speaking (directions will be provided in the Facilitator's Guide).</p> <p>Session for students to re-visit the group discussion and value proposition sessions that they participated in during the previous semesters. (This will be integrated in the semester 6 content)</p>		
1	Identify the best practices of public speaking		<p>Public speaking – best practices</p> <p>Ask each group (formed earlier) to research and come up with a list of best practices along with examples (in the class).</p> <p>After each group presents their list of best practices, students will discuss and create a consolidated list of best practices by considering all common or overlapping ones and map it against the guidelines provided by the TCS team.</p> <p>Additional: Possible guest lecture or webinar (Dr Giri)</p>	Activity	60 mins
1	Apply public speaking in real life scenarios	3	<p>Get, Set, Go – sell your start-up ideas</p> <p>Each group to pitch their start-up idea to a panel consisting of external professors.</p> <p>They will use the presentation they created earlier and the best practices of public speaking to tell their story leveraging the storytelling and doodling methods they learnt in the previous semester (Design Thinking). Their story should at least include:</p> <ul style="list-style-type: none"> • Name of their start-up • Who is the target 	Formative assessment	120 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>audience/end user?</p> <ul style="list-style-type: none"> • What problem will their start-up solve? • How do they plan to run start up? • How much money/budget would they need to begin their work? <p>Professors to share the results of this formative assessment with the TCS Team so that we can use it for reference in GD post sem.</p>		
1	NA		<p>Let's relax</p> <p>This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).</p>	Activity	45 mins
2	Recognize the importance of corporate social responsibility (CSR)	1	<p>Corporate Social Responsibility (CSR)</p> <p>Ubuntu story – A story to introduce the concept of social responsibility.</p> <p>The story will be played through an audio embedded in the PPT (similar to an audiobook).</p>	Lecture	45 mins
2	Recognize some of the stalwarts in CSR	1	<p>Hear CSR stories</p> <ul style="list-style-type: none"> • Meeting of JNT and Swami Vivekananda. • Societal connect of JNT. Stalwarts in CSR (Led by Tatas) • More Tata Group CSR stories --- from Titan and Tata Chemicals <p>Initially, Professors will share any two of the above CSR stories. Thereafter, they will discuss the stories in the class and ask the students to share</p>	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>their thoughts.</p> <p>Lecturer to ask students why they need to conduct CSR activities? (Answers will be given in handouts provided by the TATA Team)</p> <p>Why do corporates need to engage in CSR? Is it for compliance only? The answers to these questions (given in the content) will refer back to the topics on TCS values, life skills and empathy taught in the earlier semesters.</p> <p>Lecturer to explain to the students how CSR connects to their values and how CSR activities can add value to their resumes.</p>		
2	Recognize the importance of corporate social responsibility (CSR)	1	<p>Tell a CSR story</p> <p>Activity - Groups will research in class, prepare and present CSR activity of Tata Steel, Microsoft, Google, TCS, Starbucks, Titan, Tata Chemicals and TOMS Shoes.</p>	Practice activity	90 mins
2	Recognize the attributes needed to function and grow in a corporate environment	1	<p>Attributes required for work and life</p> <ul style="list-style-type: none"> • Qualities of a good team member: <ul style="list-style-type: none"> a) Resilience b) Flexibility c) Strategic thinking and planning d) Decision making e) Resolving conflicts <p>Professors to first show examples and non-examples and then the participants to identify the traits that set them</p>	Lecture and discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			apart.		
	NA		Let's relax This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).	Activity	45 mins
3	Recognize the attributes needed to function and grow in a corporate environment	1	Activity –Who am I? (Image Management. Building a perfect image) This is an individual activity in which each participant needs to reflect upon the following questions (in the order given below) and jot down the answers. They will be given a handout with the questions printed on it for this activity. 1. What do I wish to be seen as? (aspirational state) 2. How do I see myself now? (present state) 3. How others see me? (perceptions) 4. What is the gap between how others see me and how I see myself? 5. How do I fill the gap? Why is it important to fill the gap (connect to importance of personal branding to stay relevant). Professor to share examples of personal branding in the corporate world, as mentioned in the content.	Activity	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
3	Recognize the best practices to share and receive feedback	1	<p>Examination Result Activity - Locus of control (referring back to Emotional intelligence)</p> <p>One person from each group (to be decided through drawing lots) will be asked to step aside to act as teachers. The rest of the group members will participate as students. Each group will be given a scenario in which they will get mock grades in an examination. They will be asked to react to their result. Their reactions will be noted.</p> <ul style="list-style-type: none"> Examination Result Activity-Phase II –Role play on feedback. <p>Now the teachers will be asked to have a discussion with each one to two people from each group sharing their feedback on their reactions.</p> <p>After the activity, tips to receive and give feedback will be shared. Handouts will be shared with lecturers.</p>	Activity	90 mins
3	Apply emotional intelligence in real life scenarios	3	<p>Applying emotional intelligence</p> <p>Activity for applying</p>	Lab Activity	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Emotional Intelligence using scenarios within each start-up group. There will be separate scenarios for each group.</p> <p>Professors will judge the groups based on guidelines provided by the TCS team.</p>		
	NA		<p>Let's relax</p> <p>This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).</p>	Activity	45 mins
4	Apply knowledge of multiple intelligences and learning styles in interpersonal interactions	3	<p>Sensitivity to diversity - Quiz</p> <p>A scenario-based quiz on (handouts to refresh Sem-1 content on multiple intelligences and learning styles followed by scenario-based quiz) – awareness of multiple intelligences and learning styles in communication. The questions will be based on scenarios that the students might face later in their work environment.</p>	Formative assessment	60 mins
4	Recognize the impact of conflicts		<p>Understanding conflicts</p> <p>This will be a group activity. Each group will be given a scenario of typical conflicts that occurs in a corporate office. In each group roles will be assigned to the group members who would be expected to play it.</p>	Activity	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Each group will enact the situation while others watch and note down their observations on:</p> <ol style="list-style-type: none"> 1. What is the conflict? 2. What has caused the conflict? 3. What is the negative impact of the conflict? 4. What can be a positive impact of the conflict? <p>Each group will be requested to draw up a list of tips to manage conflicts at work and share in the next class and post on their Fb/Insta page. They can compare it with handout provided to lecturers.</p> <p>Student needs to reflect upon lessons in empathy and active listening (taught in the previous semesters) while managing conflicts.</p> <p>Each person will be requested to capture at least one Satori moment from these enactments of real-life scenarios.</p>		
4	List the basic guidelines required to manage conflicts	1	<p>Tips to manage conflicts</p> <p>Each group will share their list of guidelines to manage conflicts, post which the lecturer can share the standard list provided (as a hand-out) and discuss the main points in the class.</p>	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			After that the lecturer will ask them to reflect on what are the changes they need to bring about in their behaviour, based on Belbin's Team Player roles (Sem 2 Unit 3).		
4	Recognize the key features of corporate etiquette	1	Corporate etiquette Mock interview rounds for each group with a prospective employer followed by discussions on corporate etiquette (leverage Interview Ready app)	Activity	60 mins
4	Recognize the business idioms and corporate terms Apply the business idioms and corporate terms	1 3	Business idioms and Corporate Terms This will begin with a quiz in which in the first four rounds each group needs to identify the business idioms and corporate terms from given excerpts. In the next four rounds they will be asked to supply the correct idiom or term in a given business scenario. After the quiz, the lecturer would share handouts of common business idioms and guide them to download the TCS BizVocab on their smart phones.	Lab activity	60 mins
4	Recognize the impact of stress in life and work	1	Managing Stress Participants will first watch a short YouTube video: Managing Stress - Brainsmart – BBC (2:24 mins) Then the lecturer will discuss stress and its impact through the following questions:	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<ol style="list-style-type: none"> 1. Have you ever felt stressed? 2. What are the situations that make you feel stressed? 3. Does the stress help you in overcoming the situation? 4. Do you know how stress affects your health? <p>After this they will watch a video on how stress impacts health:</p> <p>YouTube: The Long-term Effects of Stress (5 mins)</p> <p>Finally, each group will be asked to create a poster with stress management tips to be presented in the next class and uploaded on their Fb/Insta pages.</p>		
5	Identify the best practices to manage stress	1	<p>Tips to manage stress</p> <p>Each group will present their posters and the class will come up with a list of stress management tips to be put up on the Fb/Insta page.</p> <p>They should also note this in their journals so that they can refer to it whenever they feel stressed.</p>	Discussion Activity	60 mins
	Recognize the importance of time management	1	<p>Time management</p> <p>Session begins with an introductory activity that establishes the fact that we often manage time poorly and as a result experience stress.</p> <p>After that participants will watch the YouTube video:</p>	Lecture	45 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Importance of Time Management For Better Life Style (3:33 mins)</p> <p>Now the lecturer will conduct an open house discussion, where the participants will share their challenges to manage time.</p> <p>Now the lecturer will ask the participants to evaluate their ability to handle their daily task within 24 hrs on a scale of 10. This is a confidential rating which participants needs to note down in their satori book with date and time for future reference. (this activity will be repeated at a later stage)</p>		
	Identify the best time management practices	1	<p>Managing your time better</p> <p>The class will start with the YouTube video:</p> <p>A valuable lesson for a happy life (2:33 mins)</p> <p>After viewing this, the facilitator will ask the participants to identify the rocks, pebbles and sands in their life.</p> <p>This will be followed by the</p> <p>Time Squared Activity: Each participant gets 3 pages with 24 squares representing the hours in a day.</p> <p>Participants need to fill out:</p> <p>The first page with the everyday activities in their day (example, brushing teeth, bathing, meals, travelling, etc)</p>	Activity	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>The second page with the non-productive work that they do every day (social media, mobile-games, etc)</p> <p>On the third page they can add everything from the first two pages to find out the empty spaces. That is their productive time when they can study. This gives them a view of what they can adjust in order to increase their study time.</p> <p>Reference video: Study Skills – Managing your time (4:29 mins)</p> <p>Participants to repeat the self-evaluation exercise. In this instant, the participants will evaluate their ability to plan their daily task on a scale of 1 to 10 with date and time. Lecturer to encourage participants to evaluate their time management skills on a regular basis.</p>		
	NA		<p>Let's relax</p> <p>This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).</p>	Activity	45 mins
		1	<p>Create memories</p> <p>Recap activity on the entire BCVS Course.</p>		30 mins
				Total	30 hours

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Project</p> <p>Each group to create a POC (Proof of Concept) for their start-up applying their learnings from the CSBS course (core subjects + BCVS).</p> <p>The evaluation for this POC will be done as part of the Sem end assessment by the TCS team. During the assessment, students need to share the journey of creating their start-up: from inception to POC.</p>		10 hours

Course Name: Robotics and Embedded Systems
Course Code: CB603A
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Course Outcome(s):

- To acquire knowledge about microcontrollers embedded processors and their applications.
- Ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
- Ability to understand the role of embedded systems in industry.
- Ability to understand the design concept of embedded systems.
- Design and engineer autonomous robots using various sensors

Topics to Be Covered:

UNIT – I

Introduction to Embedded System: Embedded system Vs General computing systems, History of Embedded systems, Purpose of Embedded systems, Microprocessor and Microcontroller, Hardware architecture of the real time systems.

UNIT – II

Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Intrnet embedded system network protocols, USB, Bluetooth.

UNIT – III

Program Modeling Concepts; Fundamental issues in Hardware software co-design, Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

UNIT – IV

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

UNIT – V

Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc. Popular microcontrollers used in embedded systems, sensors, actuators.

UNIT – VI

Robotics: Introduction, Elements of robots -- joints, links, actuators, and sensors

Kinematics: Kinematics of serial robots, Kinematics of parallel robots, Motion planning and control

Advanced Topics on Robotics: Sensing distance and direction, Line Following Algorithms, Feedback Systems, Other topics on advance robotic techniques

Home Assignments:

State machine programming model of Fibonacci sequence generator, actuator behavior, multiprocessing and multitasking, task synchronization, CAN protocol, timer/counter in embedded systems

Text Books:

1. Introduction to Embedded Systems: Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems : Rajkamal (TMH)
4. Embedded Systems : L. B. Das (Pearson)
5. The 8051 Microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.
6. Robotics: Fundamental Concepts and Analysis, Oxford University Press

Reference Books:

1. Embedded System design : S. Heath (Elsevier)
2. Embedded microcontroller and processor design: G. Osborn (Pearson)
3. Embedded systems design by Steve Heath, Newnes

Course Name: Robotics and Embedded Systems Lab

Course Code: CB693A

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

1. Arithmetic Operations using 8051
2. Interfacing ADC and DAC
3. Interfacing LED and PWM
4. Interfacing real time clock and serial port
5. Interfacing keyboard and LCD
6. Flashing of LEDS
7. Interfacing stepper motor and temperature sensor.
8. Study of robotic arm and its configuration
9. Study the robotic end effectors

Course Name: Data Mining and Analytics

Course Code: CB603C

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Course Outcome(s):

Students will be able to

1. Understand basic concepts and techniques of Data Mining
2. Develop skills of using data mining software for solving practical problems
3. Understand and apply several statistical analysis techniques: regression, ANOVA, data reduction

Topics to Be Covered:

UNIT – I

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 – II

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization

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 – III

Data mining algorithms - Association rules: Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis

Data mining algorithms - Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules

Data mining algorithms – Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models

UNIT – IV

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 regression, 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 semiparametric regression models, additive regression models. Introduction to nonparametric regression methods

UNIT – V

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.

Home Assignments:

1. Experiments with Weka – Visualization Techniques, using filters and statistics, mining association rules, decision trees rules, Prediction
2. Mining real data: Preprocessing data from a real domain (Medical/ Retail/ Banking);Applying various data mining techniques to create a comprehensive and accurate model of the data
3. Analytics Assignment 1: Conduct and Present a summary report on an End to end statistical model building exercise using sample data – Data preprocessing, Descriptive Analysis (Exploratory Data Analysis), Hypothesis building, Model Fitting, Model Validation and Interpretation of results
4. Analytics Assignment 2: Build statistical models using any two linear and non-linear regression techniques: Simple Linear Regression; Multiple Regression; Variable Selection Problem; Multicollinearity and Ridge Regression; Nonlinear regression; Non-parametric regression; Logistic regression (binary and multiple); Poisson/Negative binomial regression (Use sample data sets)

Text Books:

1. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, “Data Mining and Knowledge Discovery Handbook”, Springer, 2nd edition, 2010
3. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.

Reference Books:

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).

Course Name: Modern Web Applications

Course Code: CB603B

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Pre requisites:

NIL

Course Objectives:

- To enable students to develop modern web application by leveraging latest technologies.
- To build strong foundation in students making them job ready as per industry requirements.
- To enable them to learn new technologies by applying foundation paradigms
- To build strong expertise to develop end to end application – web frontend and backend development.

Course Outcomes:

Upon completion of the course, students shall have ability to

C922.1	Understand and Incorporate HTML, XML, JSON and dynamic website to design websites that effectively communicate using visual elements.	[U]
C922.2	Apply the concept of web development and Design web-based information systems to meet business needs using HTML5, CSS UI Design	[AP]
C922.3	Apply the Object-Relation mapping, form validations and interpret the objects using JavaScript	[AP]
C922.4	Analyse the features of various server and message request services for strong backend development.	[A]
C922.5	Analyse the frontend framework and respective services	[A]

Course Contents:

Introduction: 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. **HyperText Mark Up Language:** - 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

Cascading Style Sheets (CSS3): Basics of Cascading Style sheets, Advantages of CSS, External Style sheet, Internal style sheet, Inline style sheet, CSS Syntax, color, background, Font, images **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

Java Script: Features of JavaScript, extension of JavaScript, Syntax of JavaScript: 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. **Back End Technologies:** Introduction to RESTful services, Resources, Messages (Request, Response), Addressing, Methods – (GET, POST, PUT, DELETE)

Text Books:

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. Brandon D. M. Software Engineering for modern web applications: methodologies and technologies, First Edition, IGIGlobal(2008)
3. Sebasta R.W. Programming the World Wide Web,8thedition, Pearson (2014).
4. Pressman R.and Lowe D. Web Engineering: a practitioner's approach, First Edition, McGrawHill (2008)

Web References:

1. <https://www.coursera.org/courses?query=web%20application> Online Resources: 2.
2. <https://nptel.ac.in/courses/106/106/106106156/>
3. <https://www.udemy.com/topic/web-app-development/>

4th Year 1st Semester: 7th Semester

Sl No	Course Code	Paper Code	Theory	Contact /Week			Hours	Credits
				L	T	P	Total	
A. THEORY								
1	Professional Elective courses	CB701	Usability Design of Software Applications	2	0	0	2	2
2	Professional Elective courses	CB702	IT Workshop Skylab / Matlab	2	0	0	2	2
3	Professional Elective courses	BS701	Financial Management	3	0	0	3	3
4	Humanities and Social Sciences	BS702	Human Resource Management	2	0	0	2	2
5	Professional Elective courses	PE-CB703A	Cognitive Science and Analytics	2	1	0	3	3
		PE-CB703B	Introduction to IoT					
		PE-CB703C	Cryptology					
6	Professional Elective courses	PE-CB704A	Quantum Computation and Quantum Information	2	1	0	3	3
		PE-CB704B	Advanced Social, Text and Media Analytics					
		PE-CB704C	Mobile Computing					
B. PRACTICAL								
7	Professional Elective courses	CB791	Usability Design of Software Applications Lab	0	0	2	2	1
8	Professional Elective courses	CB792	IT Workshop Skylab / Matlab Lab	0	0	2	2	1
9	Professional Elective courses	PE-CB793A	Cognitive Science and Analytics Lab	0	0	2	2	1
		PE-CB793B	Introduction to IoT Lab					
		PE-CB793C	Cryptology Lab					
10	Professional Elective courses	PE-CB794A	Quantum Computation and Quantum Information Lab	0	0	2	2	1
		PE-CB794B	Advanced Social, Text and Media Analytics Lab					
		PE-CB794C	Mobile Computing Lab					
11	PROJECT	CB781	Project Evaluation I	0	0	4	4	2
TOTAL CREDIT								21

Course Name: Usability Design of Software Applications

Course Code: CB701

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Pre requisites: Nil

Course Objectives:

- 1 To describe the fundamentals of User Centered Design and User Experience.
- 2 To elucidate the facets of User Experience Design.
- 3 To gain knowledge in appreciation of user research, solution conceptualization and validation activities in the design and development lifecycle.

Course Outcomes:

Upon completion of the course, students shall have ability to

- CB701.1 To sensitize the students to the fundamentals of User Centered Design and User Experience their relevance and contribution to businesses
- CB701.2 Familiarize them to the facets of User Experience (UX) Design, particularly as applied to the digital artefacts
- CB701.3 Relate the Design Thinking Technique for the design and development lifecycle
- CB701.4 Appreciation of user research and solution conceptualization and validation as interwoven activities in the design and development lifecycle

- CB701.5 Explore various UX research techniques for a better UI experience

Course Contents:

Introduction to 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, 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. Group Assignment Presentations and reviews.

Design Thinking Technique: Discovery and brainstorming, Concept Development, Task flow detailing for the Project, Prototyping Techniques: Paper, Electronic, Prototyping Tools, Project Prototyping Iteration 1, Project Prototyping Iteration 2, Review and feedback, Final presentation of solution – Exam.

Group Project Identification: Students will identify a project such as a website or mobile app to redesign. They will take this redesign project through the design lifecycle: Discovery, Define, Design Implement (Design Prototype), Usability Testing, the below design methods and techniques will be imparted w.r.t. the group project selected by the students, UX Research: Understanding users, their goals, context of use, environment of use, Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX, Scenarios and Persona Technique.

Total Hours: 45

Lab Components:

1. Identify a website or an App to redesign, with justification.
2. Analysis of the mobile app or the website through the design life cycle.
3. Identifying Personas and Scenarios for the App or the website.
4. Concept development and task flow detailing.
5. Prototype development with Iterations and justification.
6. Usability testing and demonstration.

Text Books:

1. Helen Sharp, Jenny Preece and Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 5th Edition, Wiley, 2019.
2. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, Observing the User Experience, Second Edition: A Practitioner's Guide to User Research, 2nd edition, Morgan Kaufmann, 2012.

Reference Books:

- 1 Jesse James Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond, 2nd Edition, New Riders, 2010.
- 2 Jonny Schneider, Understanding Design Thinking, Lean, and Agile, First edition, Shroff/O'Reilly, 2020
- 3 Alan Cooper and Robert Reimann, About Face, 4th Edition, Wiley, 2014.
- 4 Online forum links, reference articles, blogs

Web References:

- 1 <https://usabilitygeek.com/user-centered-design-introduction/>
- 2 <https://www.invisionapp.com/inside-design/user-centered-design-definition-examples-and-tips/>
- 3 <https://uxplanet.org/usability-first-why-usability-design-matters-to-ui-ux-designers-9dfb5580116a>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	-	2	-	-	-	-	-	1	1	2	-
CO2	-	2	2	-	2	-	-	-	1	-	1	-
CO3	-	3	3	1	-	-	-	-	2	-	-	-
CO4	-	-	1	1	-	-	-	-	2	-	-	-
CO5	-	1	1	-	3	-	-	-	3	-	-	-

Course Name: Financial Management
Course Code: BS701
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Pre Requisite(s):

Good knowledge of Financial & Cost Accounting (Covered in Year 3, Semester 2)

Course Outcome(s):

This course will help students to,

- Understand the financial environment of business, and financial markets.
- Know different sources for raising funds for business and cost associates with that.
- Developing skills for interpretation business information and application of financial theory in financing related decisions.

Topics to Be Covered:

UNIT – I

Financial Management

- Corporate Finance- Objectives and Functions
- Financial Planning- Steps, Estimation of Financial Requirements of a Firm, Capitalization

UNIT – II

Financial Analysis

- Ratio analysis (liquidity ratios, profitability ratios, turnover ratios, structural ratios, etc.)
 - Comparative balance sheet
 - Common size statement analysis
 - Trend analysis
 - Sickness prediction
- Funds Flow analysis
- Corporate Investment Decisions- Cash Flow Projection, Evaluation Techniques
- Risk and Return Portfolio Theory

UNIT – III

Time Value of Money

- Future Value, Present Value, Time Value of Money
- Valuation of bonds and shares

UNIT – IV

Cost of Capital, Leverage, Capital Structure, Capital Budgeting:

- Cost of different Sources of Funds
- Weighted Average Cost of Capital
- Leverage, Operating Leverage, Financial Leverage, Combined Leverage
- Capital Structure, Factors Affecting Capital Structure, Theories of Capital Structure
- Capital Rationing, Types, Steps Involved in Capital Rationing, Various Approaches
- Various techniques of Capital Budgeting
- Risk Analysis in Capital Budgeting, Types Risk Adjusted Discount Rate, Certainty Equivalent Approach, Probability Distribution Approach, Sensitivity Analysis, Simulation Analysis, Decision Tree Approach

UNIT – V

Valuation of a Firm: Methods, Comparison

UNIT – VI

Introduction to Financial Markets

- Capital Markets
 - Primary Market- capital market mechanism, instruments, financing and rating institutions, and legal environment related to this.
 - Secondary Market- Basics of stock exchanges and their role, regulatory framework, and transactions on stock exchange
- Money Markets
 - Money market mechanism, instruments, institutions, and legal environment

Home Assignment:

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Text Books:

1. Brealey, Myers and Allen, Principles of Corporate Finance
2. Case Study Materials: To be distributed for class discussion

Course Name: Human Resource Management

Course Code: BS702

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Course Pre Requisite(s):

Good knowledge of Fundamentals of Management (Covered in Year 2, Semester 1)

Course Outcome(s):

Students must be aware of the basic principles of Human Resource Management because success in today's complex business environment depends on effective management of its human resources. This introductory course on Human Resource Management will familiarize the students with the basic concepts, roles, functional areas and activities of HR and help students understand organization's employees, their interest, motivation and satisfaction, and their belief of fair treatment- all of which actually impact the firm's current performance and sustainability in the long run.

Topics to Be Covered:

UNIT – I

Human Resource Management: Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.

UNIT – II

Human Resource System Design: 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: 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: Demand Forecasting, Action Plans– Retention, Training, Redeployment & Staffing, Succession Planning

UNIT – V

Strategic Management of Human Resources: SHRM, relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace

UNIT – VI

Human Resource Management in Service Sector- Special considerations for Service Sector including

- Managing the Customer – Employee Interaction
- Employee Empowerment and Customer Satisfaction
- Service Failure and Customer Recovery – the Role of Communication and Training
- Similarities and Differences in Nature of Work for the Frontline Workers and the Backend
- Support Services - Impact on HR Practices Stressing Mainly on Performance
- Flexible Working Practices – Implications for HR

Home Assignment:

Further, the topic for class discussion will be mentioned beforehand. Students are required to meet in groups before coming to class and prepare for the topic to be discussed. Instructor may ask the student groups to present their analysis and findings to the class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

5. Topic: Understanding the issues and challenges involved in managing a diverse workforce
6. Topic: Is The Only Purpose of a Corporation to Maximize Profit?
7. Topic: Similarities and Differences in Manufacturing and Service Sector - Impact on HR Practices

Text Books:

Gary Dessler, Human Resource Management

Course Name: Cognitive Science and Analytics

Course Code: CB703A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre requisites: NIL

Course Objectives:

- 1 To understand the foundational areas of analytics.
- 2 To understand the foundational areas of Cognitive Science.
- 3 To learn about data theory and taxonomy of data.
- 4 To learn about multivariate data analytics and cognitive analytics
- 5 To analyse the role of AI and Machine learning in Cognitive data analytics

Course Outcomes:

Upon completion of the course, students shall have ability to

- C931.1 Understand about the foundational areas of Analytics
- C931.2 Understand the foundational areas of Cognitive Science
- C931.3 Apply the concept of data theory and use the data efficiently for scaling and measurement.
- C931.4 Apply the concept of multivariate data analytics and cognitive analytics.
- C931.5 Analyze the role of Artificial Intelligence and Machine Learning in the Cognitive data analytics

Course Contents:

Foundational Areas Of Analytics: Introduction to Analytics: Definition, Description & Evolution of Analytics, History of Analytics, and Applicability of Analytics with development of Technology and Computer, How Analytics entered mainstream. **Concepts of Analytics:** Various overlapping concepts and fields of Analytics such as Data Mining, Machine Learning, Artificial Intelligence and Simulation. **Emerging Areas in Analytics:** Understanding of emerging research areas of Analytics: Mathematical programming, Evolutionary computation, Simulation, Machine learning/data mining, Logic-based models, and, Combinations of categories. **Value Chain of Analytics:** Descriptive Analytics Covering Exploratory Data Analysis & Basic of Statistics, Diagnostics Analytics: BI/Analysis, Trend, Pattern, Simultaneous Relationship, Predictive Analytics: Cause-Effect Relationship and Futuristic prediction in terms of probabilities, Continuous & Categorical Predictions, Simulation, Optimization, Multi-faceted Intelligent Technology driven Analytics combining Machine Intelligence with Human Brain Processing Abilities

Foundational Areas Of Cognitive Science: Introduction & Evolution of Cognitive Science: Introduction to the study of cognitive sciences, Brief history of cognitive science development and Methodological concerns in philosophy. **Understand Brain and Sensory Motor Information:** Fundamentals of Neuro Science, Processing of sensory information in the brain, and Brain Imaging Elements. **Language & Linguistic Knowledge:** Background and details of Syntax & Semantics, Understanding of Generative Linguistic. **Memory & Processing:** Theory of Information Processing, Fundamentals of Short term Memory. **Data Theory & Taxonomy Of Data: Data as a whole:** Understanding of Data as a whole for distinguishing and relating various types of data and Categorization of Data: Structured, Unstructured Data, Quantitative & Qualitative Data. **Views of Data:** Understanding Data as an interdisciplinary framework for learning methodologies: covering statistics, neural networks, and fuzzy logic. **Measurement & Scaling Concepts:** Measurement of variables and commonly used statistical tools: Number of procedures for measurement of the variables,

Categorization procedures, Scale construction procedures and Techniques of data processing for qualitative as well as quantitative data; Various types of Scales: Nominal, Ordinal, Interval & Ratio Scales.

Multivariate Data Analytics & Cognitive Analytics: Overview: High level overview of Categorization of Techniques: Inter-dependence Relationship Techniques and Dependence Relationship Techniques. **Overview of Commonly Used Inter-dependence Techniques:** Factor Analysis, Principal Component Analysis (PCA), Cluster Analysis. **Overview of Commonly Used Dependence Techniques:** Regression, Logistic Regression. **Analytics Value Chain & Application of Analytics across Value Chain, Artificial Intelligence & Machine Learning: Fundamentals of Artificial Intelligence:** Various areas of AI, Spectrum of AI. **Approach & Methodology: World Standard Methodology:** CRISP-DM Methodology, SEMMA Methodology. **Real Life Work around Multi-Variate Analytics:** A few Selected Commonly used Techniques: Predictive & Classification Models, Regression, and Clustering. **Real Life Work around Artificial Intelligence, Machine Learning and Deep Learning:** A few Selected Commonly used Techniques & Algorithms: ANN (Artificial Neural Network), CNN (Convolutional Neural Network), RNN (Recurrent Neural Network); RN Architecture: LSTM, Bidirectional LSTM, Gated Recurrent Unit (GRU), CTRNN (Continuous Time RNN) CNN Architectures: VGG16, Alexnet, InceptionNet, ResNet, GoogLeNet Object Detection models: R-CNN, Fast R-CNN, Faster R-CNN, cascade R-CNN. Mask RCNN, Single Shot MultiBox Detector (SSD), You Only Look Once (YOLO), Single-Shot Refinement Neural Network for Object Detection (RefineDet), Retina-Net Autoencoders: Denoising Autoencoder, GAN. Transformers: Attention based Encoder and Decoder: Eg-BERT (Bidirectional Encoder Representations from Transformers), Generative Pretrained Transformers GPT-3, GPT-2, BERT, XLNet, and RoBERTa

Total Hours: 45

Text Books:

1. Hall, P., Phan, W., & Whitson, K. Evolution of Analytics. O'Reilly Media Incorporated (2016).
2. Cognitive Science: An Introduction to the Science of the Mind by José Luis Bermúdez
3. Cherkassky, V., & Mulier, F. M. Learning from data: concepts, theory, and methods. John Wiley & Sons (2007).
4. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. Multivariate data analysis. EnglewoodCliff. New Jersey, USA, 5(3), 207-2019 (1998).
5. Kao, A., & Poteet, S. R. (Eds.). Natural language processing and text mining. Springer Science & Business Media (2007).
6. Maimon, O., & Rokach, L. (Eds.). Data mining and knowledge discovery handbook (2005).

Reference Books:

1. Cognitive Computing and Big Data Analytics by Judith S. Hurwitz (Author), Marcia Kaufman (Author), Adrian Bowles (Author)
2. Cognitive Science and Artificial Intelligence Advances and Applications: Authors: Gurumoorthy, Sasikumar, Rao, B Narendrakumar, Gao, Xiao-Zhi
3. The visual display of Quantitative Information: Edward Tufte, Graphics Press, 2001.
4. Scaling Measurement and Statistical Tools for Extension Workers by Krunal D. Gulkari, Hemant V. Borate, Mayur S. Shitap, 2016.
5. Kumar, U. D. Business analytics: The science of data-driven decision making. Wiley (2017).

6. Özköse, H., Arı, E. S., & Gencer, C. Yesterday, today and tomorrow of big data. *Procedia-Social and Behavioral Sciences*, 195, 1042-1050 (2015).
7. Gudivada, Venkat N., M. T. Irfan, E. Fathi, and D. L. Rao. "Cognitive analytics: Going beyond big data analytics and machine learning." In *Handbook of statistics*, vol. 35, pp. 169-205. Elsevier, 2016.
8. Demystifying Artificial intelligence: Simplified AI and Machine Learning concepts for Everyone (English Edition) Paperback – Import, 5 by Prashant Kikani January 2021
9. Kelleher, J. D., Mac Namee, B., & D'Arcy, A. *Fundamentals of machine learning for predictive data analytics: algorithms, worked examples, and case studies*. MIT press (2020).
10. Goodfellow, Ian, Yoshua Bengio, Aaron Courville, and Yoshua Bengio. *Deep learning*. Vol. 1, no. 2. Cambridge: MIT press, 2016.
11. *Practical Deep Learning for Cloud, Mobile, and Edge: Real-World AI & Computer-Vision Projects Using Python, Keras & TensorFlow 1st Edition*,
12. *Conversational Chatbots for Analytics Third Edition* by Gerardus Blokdyk
13. BORNET, P. B. *Intelligent automation: Welcome to the world of hyperautomation*. World Scientific Publishing Company (2020).

Web References:

1. <https://cognitiveclass.ai/learn/cognitive-analytics-ibm>
2. <https://www.analyticsinsight.net/cognitive-science-future-ai/>

Online Resources:

1. <https://nptel.ac.in/courses/109/103/109103134/>
2. <https://nptel.ac.in/courses/109/104/109104126/>

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	1	1	1	1	1	-	-	-	-	-	-	1	1	1	1	1
CO2	1	1	1	1	1	-	-	-	-	-	-	1	1	2	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	1	2	2	2
CO4	2	2	2	2	2	-	-	-	-	-	-	2	1	3	3	3
CO5	2	2	2	2	2	-	-	-	-	-	-	2	1	3	3	3

Course Name: Introduction to IoT
Course Code: CB703B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Outcome(s):

This course will help students understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. Students will get an overview of an end to end IoT system encompassing the edge, cloud and application tiers. This course will build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own. The lab exercises will consist of hands-on experiments that will lead to building an IoT application end-to-end. Some of the specialized topics will be covered via student seminars where students are expected to research and present their findings in a seminar format.

Topics to Be Covered:

UNIT – I

Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains,

UNIT – II

Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing

UNIT – III

Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions

UNIT – IV

Networking and Communication for IoT: 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)

UNIT – V

IoT Data Processing and Storage: 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,

IoT Seminars:

Selected topics in IoT should be handled via student seminars. Recommended that students form a group do research on at least one of the following topics and present it through seminars. They are expected to do a literature survey of the topic and present their survey paper to the class. The suggested topics are –

- a) IoT Applications

- Smart Cities
 - Connected Vehicles and Telematics
 - Smart Grids
 - Smart Homes
- b) IoT data visualization
 - c) Survey of cloud based IoT platforms
 - d) Low power wide area networks for IoT
 - e) IoT device management
 - f) Survey of chips, embedded modules and development boards for IoT devices
 - g) Embedded and real-time operating systems for IoT
 - h) IoT Security
 - Security risks in IoT
 - Securing IoT endpoint devices and secure communication protocols for IoT
 - Security and Privacy of IoT data

Lab Exercises

1. Setting up the Arduino Development Environment, connecting analog sensors to an Arduino Boarding and reading analog sensor data
2. Digital Input and Output reading using an Arduino board and Arduino Development Environment
3. Integrate an Arduino Board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi
4. Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language
5. Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images and video
6. Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication
7. Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol
8. Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi via MQTT protocol. On receipt of the message, toggle the LED lights on the Arduino
9. Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file
10. Develop a mobile application to view the images captured by the R Pi camera

Text Books:

4. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

Reference Books / Links:

1. Industrial Internet Reference Architecture - <http://www.iiconsortium.org/IIRA.htm>
2. World Economic Forum Report on Industrial Internet of Things - <https://www.weforum.org/reports/industrial-internet-things>
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iiot_sensor_applications_ranking/
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzai, O'Reilly Media
7. GSMA IoT Security Guidelines & Assessment - <https://www.gsma.com/iiot/future-iiot-networks/iiot-security-guidelines/>

Course Name: Cryptology
Course Code: CB703C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: NIL

Course Objectives:

1. To understand the concepts of cryptology.
2. To learn about the basic security services.
3. To apply the concepts of Symmetric key cryptosystems
4. To apply the concepts of Block Cipher.
5. To analyse the concept of public key cryptosystems

Course Outcomes:

Upon completion of the course, students shall have ability to

- CB703C.1 Understand the concepts of cryptology.
- CB703C.2 Apply the concepts of Symmetric key cryptosystems
- CB703C.3 Apply the concepts of Block Cipher
- CB703C.4 Analyse the concept of public key cryptosystems
- CB703C.5 Understand the concepts of post quantum cryptography

Course Contents:

Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems. **Basic security services:** confidentiality, integrity, availability, non-repudiation, privacy.

Symmetric key cryptosystems: 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, Modes of Operation; Hash Functions; Authentication.

Public Key Cryptosystems: RSA, ECC; Digital signatures. **Security Applications (Selected Topics):** Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis. **Introductory topics in Post-Quantum Cryptography: Refer to <https://csrc.nist.gov/projects/post-quantum-cryptography>. May discuss any two ciphers from this list.**

Total Hours: 45

Text Books:

1. Cryptography, Theory and Practice. D. R. Stinson, CRC Press.
2. Handbook of Applied Cryptography. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, CRC Press

Reference Books:

1. A course in number theory and cryptography. N. Koblitz:, GTM, Springer.
2. Cryptography and Network Security. W. Stallings, Prentice Hall.
3. Security Engineering, R. Anderson, Wiley
4. RC4 Stream Cipher and Its Variants. G. Paul and S. Maitra: CRC Press, Taylor
- 5.

5. & Francis Group, A Chapman & Hall Book, 2012
6. Design & Cryptanalysis of ZUC – A Stream Cipher in Mobile Telephony. C. S. Mukherjee, D.Roy, S. Maitra, Springer 2020
7. Contact Tracing in Post-Covid World – A Cryptologic Approach. P. Chakraborty, S. Maitra, M.Nandi, S. Talnikar, Springer 2020
8. Presskil Lecture notes: Available online: <http://www.theory.caltech.edu/~preskill/ph229/>

Web References:

- 1 https://onlinecourses.nptel.ac.in/noc20_cs02/preview
- 2 https://onlinecourses.nptel.ac.in/noc20_cs21/preview
- 3 <https://crypto.stanford.edu/~dabo/courses/OnlineCrypto/>
- 4 <https://www.coursera.org/learn/crypto>

Online Resources:

- 1 <https://towardsdatascience.com/cryptography-crash-course-for-the-intimidated-892b7889528a?gi=efa990eb6c02>
- 2 <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-875-cryptography-and-cryptanalysis-spring-2005/>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	2	-	3	3	-	-	-	-	-	-	-
CO2	2	3	1	3	3	-	1	-	-	-	-	-
CO3	2	3	1	3	3	-	1	-	-	-	-	-
CO4	2	3	1	3	3	-	1	-	-	-	-	-
CO5	1	2	1	3	3	-	1	-	-	-	-	-

Course Code: CB704A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: NIL

Course Objectives:

1. To understand the basics of Quantum Computing.
2. To learn the various Quantum algorithms.
3. To learn about the quantum key generation.

Course Outcomes:

Upon completion of the course, students shall have ability to

C941.1	Understand about the basics of Quantum Information		[R]
C941.2	Apply the Quantum algorithms towards cryptosystems.	[AP]	
C941.3	Apply the concept of Quantum key distribution	[AP]	
C941.4	Analyse the detailed designs and issues of Quantumness		[A]
C941.5	Discuss the Post quantum cryptography		[R]

Course Contents:

Introduction to Quantum Information: States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits

Quantum Algorithms: 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

Quantum True Random Number Generators (QTRNG): Detailed design and issues of quantumness, Commercial products and applications

Quantum key distribution (QKD): BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products

Introductory topics in Post-Quantum Cryptography: Refer to <https://csrc.nist.gov/projects/post-quantum-cryptography>. May discuss any two ciphers from this list.

Total Hours: 45

Text Books:

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 Books:

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/post-quantum-cryptography/round-2-submissions>

5. Quantum Algorithms for Cryptographically Significant Boolean Functions – An IBMQExperience. SAPV Tharmashastha, D. Bera, A. Maitra and S. Maitra, Springer 2020.
6. Quantum Algorithm Zoo. <https://quantumalgorithmzoo.org/>
7. Handbook of Applied Cryptography. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone. CRC Press

Web References:

- 1 <https://www.cs.cmu.edu/~odonnell/quantum18/>
- 2 <https://quantum.phys.cmu.edu/QCQI/>
- 3 <https://nptel.ac.in/courses/115/101/115101092/>
- 4 https://onlinecourses.nptel.ac.in/noc19_cy31/preview

Online Resources:

- 1 <https://ocw.mit.edu/courses/mathematics/18-435j-quantum-computation-fall-2003/>
- 2 <https://www.edx.org/course/quantum-information-science-i-part-1>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	2	-	3	3	-	-	-	-	-	-	-
CO2	2	3	1	3	3	-	1	-	-	-	-	-
CO3	2	3	1	3	3	-	1	-	-	-	-	-
CO4	2	3	1	3	3	-	1	-	-	-	-	-
CO5	1	2	1	3	3	-	-	-	-	-	-	-

Course Name: Advanced Social, Text and Media Analytics
Course Code: CB704B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Pre Requisite(s):

Computational Statistics, Data Mining and Analytics

Course Outcome(s):

Students will be able to

- To be able to use various tools for Text Mining and carry out Pattern Discovery, Predictive Modeling
- Explore the use of social network analysis to understand the growing connectivity and complexity in the world around us on different scales – ranging from small groups to the World Wide Web
- Perform social network analysis to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites such as Twitter, Facebook, and YouTube

Topics to Be Covered:

UNIT – I

Text Mining: Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications

Methods & Approaches: Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction

UNIT – II

Web Analytics: Web analytics tools, Click stream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models

UNIT – III

Social Media Analytics: Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis

Home Assignments:

1. Language Analysis: Students are expected to analyze the language of a category of text (e.g., literary, academic, social media) of their selection. Based on the analysis, students are expected to provide a critical description of the texts involved and possibly distinguishing them from other texts and/or uncovering relationships or concepts communicated by the text authors.
2. Students are required Perform sentiment analysis using Twitter. Students will be required to use off the-shelf software and/or code of their own to detect sentiment/emotion in the data and write a description of the methods they use and the results.

Text Books:

1. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011 Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 304
3. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
4. Hanneman, Robert and Mark Riddle. 2005. Introduction to Social Network Method

Reference Books:

1. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press.
2. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press. <http://nosh.northwestern.edu/vita.html>

Course Name: Mobile Computing
Course Code: CB704C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Computer Networks

Course Objectives:

- 1 To be exposed to technology and business trends impacting mobile applications.
- 2 To express Mobile design Principles.
- 3 To understand the importance of Wireless Networks across the globe
- 4 To evaluate applications using specific mobile development frameworks

Course Outcomes:

Upon completion of the course, students shall have ability to

- CB704C.1 Remember the concepts of Networking and Communication
- C704C.2 Understand the Network and transport layers of Mobile Communication
- C704C.3 Analyze next generation Mobile Communication System
- C704C.4 Learn the details of implementing wireless transmission and Ad-hoc networks
- C704C.5 Analyze the real-time sensor networks, Cognitive radio networks and D2D in 5G

Course Contents:

Introduction, Location and handoff management: Overview of wireless and mobile infrastructure; Preliminary concepts on cellular architecture; Design objectives and performance issues; Radio resource management and interface; Propagation and path loss models; Channel interference and frequency reuse; Cell splitting; Channel assignment strategies; Overview of generations:- 1G to 5G. 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).

Wireless transmission fundamentals, Mobile Ad-hoc networks: 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). Mobile Ad-hoc networks - Characteristics and applications; Coverage and connectivity problems; Routing in MANETs.

Wireless sensor networks, Cognitive radio networks, D2D communications in 5G cellular 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). Cognitive radio networks - Fixed and dynamic spectrum access; Direct and indirect spectrum sensing; Spectrum sharing; Interoperability and co-existence issues; Applications of cognitive radio networks. D2D communications in 5G cellular 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.

Text Books:

1. Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2008
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005

Reference Books:

- 1 Theodore Rappaport, Wireless Communications: Principles and Practice, Pearson Education.
- 2 Ezio Biglieri, Wireless Communications MIMO, Cambridge University Press.
- 3 Ivan Stojmenovic, Handbook of Wireless Networking and Mobile Computing, Wiley.
- 4 James Cowling, Dynamic Location Management in Heterogeneous Cellular Networks.
- 5 Gordon L. Stber, Principles of Mobile Communication, Springer.
- 6 Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, Wireless Device-to- Device Communications and Networks, Cambridge University Press.
- 7 Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, Principles of Cognitive Radio, Cambridge University Press.
- 8 Edgar H. Callaway, Jr. and Edgar H. Callaway, Wireless Sensor Networks: Architectures and Protocols, CRC Press.

Web References:

- 1 A Discrete-Event Network Simulator. <https://www.nsnam.org/docs/manual/html/index.html>
- 2 MIT Thesis. <http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov04.pdf>
- 3 Location Management in Wireless Cellular Networks. Travis Keshav, https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf
- 4 Location Management in Wireless Data Networks. Fahd A. Batayneh, https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_location.pdf

Online Resources:

- 1 <https://www.coursera.org/learn/android-programming>
- 2 <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/>
- 3 <https://www.mooc-list.com/course/mobile-computing-app-inventor-cs-principles-edx>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1	1	1	-	1	-	-	-	-	1
CO2	2	1	1	1	1	-	1	-	-	-	-	1
CO3	2	2	2	1	2	-	1	-	-	-	-	2
CO4	2	2	2	2	2	-	1	-	-	-	-	2
CO5	2	2	2	2	2	-	1	-	-	-	-	2

4 th Year 2 nd Semester: 8 th Semester					
Sl	Course Code	Paper Code	Theory	Contact Hours /Week	Credit

No				L	T	P	Total	Points
A. THEORY								
1	Professional Elective courses	BS801	Services Science and Service Operational Management	3	0	0	3	3
2	Professional Elective courses	BS802	IT Project Management	2	0	0	2	2
3	Professional Elective courses	BS803	Marketing Research and Marketing Management	2	0	0	2	2
4	Open Elective courses	PE-CBS804A	Behavioral Economics	3	0	0	3	3
		PE-CBS804B	Computational Finance and Modeling					
		PE-CBS804C	Psychology					
		PE-CBS804D	Enterprise Systems					
5	Open Elective courses	PE-BS805A	Advance Finance	3	0	0	3	3
		PE-BS805B	Image Processing and Pattern Recognition					
B. PRACTICAL								
6	Professional Elective courses	BS891	Services Science and Service Operational Management Lab	0	0	0	2	1
7	Professional Elective courses	BS892	IT Project Management Lab	0	0	0	2	1
8	Open Elective courses	PE-BS894A	Behavioral Economics Lab	0	0	2	2	1
		PE-BS894B	Computational Finance and Modeling Lab					
		PE-BS894C	Psychology Lab					
		PE-BS894D	Enterprise Systems Lab					
9	Open Elective courses	PE-CS895A	Advance Finance Lab	0	0	2	2	1
		PE-CS895B	Image Processing and Pattern Recognition Lab					
10	Project	BS881	Project Evaluation II	0	0	12	12	6
TOTAL CREDIT								23

Course Name: Services Science and Service Operational Management
Course Code: BS801
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Pre Requisite(s):

Fundamentals of Management, Operations Research

Course Outcome(s):

Students will be able to

- Understand concepts about Services and distinguish it from Goods
- Able to identify characteristics and nature of Services
- Comprehend ways to design Services and evaluate them using Service qualities
- Understand how various methods can be used to operate and manage Service businesses
- Understand how innovation can be approached from Services point of view

Topics to Be Covered:

UNIT – I

Introduction: 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 Competitiveness: 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: How to provide Service guarantee? How to recover from Service failure?

UNIT – IV

Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting.

Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services.

Managing Facilitating Goods: Review of inventory models, Role of inventory in services

Managing service supply relationship: Understanding the supply chain/hub of service, 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: Services Productivity, Need for Services Innovation

Student Project:

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.

Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

Text Books:

1. Fitzsimmons & Fitzsimmons, *Service Management: Operations, Strategy, Information Technology*, McGraw Hill publications (7th edition)

Reference Books:

1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). *Services marketing: Integrating customer focus across the firm*. McGraw Hill.
2. Lovelock, C. (2011). *Services Marketing*, 7/e. Pearson Education India
3. Reason, Ben, and Lovlie, Lavrans, (2016) *Service Design for Business: A Practical Guide to Optimizing the Customer Experience*, Pan Macmillan India,
4. Chesbrough, H. (2010). *Open services innovation: Rethinking your business to grow and compete in a new era*. John Wiley & Sons.

Reference Papers:

1. Karmarkar, U. (2004). Will you survive the services revolution? *Harvard Business Review*, 100-107.
2. Vargo, S. L., & Lusch, R. F. (2008). From goods to service (s): Divergences and convergences of logics. *Industrial marketing management*, 37(3), 254-259.
3. Vargo, S. L., & Lusch, R. F. (2008). "Service-Dominant Logic: Continuing the Evolution," *Journal of the Academy of Marketing Science* (36:1), pp. 1-10
4. Silvestro, R., Fitzgerald, L., Johnston, R., & Voss, C. (1992). Towards a classification of service processes. *International journal of service industry management*, 3(3), 62-75.
5. Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European management journal*, 26(3), 145-152.
6. Shostack, G.L., (1984), "Designing Services That Deliver," *Harvard Business Review*, January-February 1984, pp. 132-139
7. Evenson, S., & Dubberly, H. (2010). Designing for service: Creating an experience advantage. *Introduction to service engineering*, 403-413.
8. Edvardsson, B., & Olsson, J. (1996). Key concepts for new service development. *Service Industries Journal*, 16(2), 140-164.
9. Goldstein, S. M., Johnston, R., Duffy, J., & Rao, J. (2002). The service concept: the missing link in service design research? *Journal of Operations management*, 20(2), 121-134.
10. Kumar, A., Zope, N. R., & Lokku, D. S. (2014, April). An approach for services design by understanding value requirements, identifying value carriers, developing value proposition, and subsequently realizing value. In *Global Conference (SRII), 2014 Annual SRII* (pp. 298-304). IEEE.
11. Parasuraman, A., Zeithaml, V.A., and Berry, L.L., (1985), "A Conceptual Model of Service Quality and Its Implications for Future Research," *The Journal of marketing*, Vol. 49, No. 4, pp. 41-50
12. Cronin, J.J., and Taylor, S.A., (1992), "Measuring Service Quality: A Reexamination and Extension," *The Journal of Marketing*, Vol. 56, No. 3, pp. 55-68

13. Van Ree, H. J., (2009), *Service Quality Indicators for Business Support Services*, Ph.D. Thesis, University College London, London.
14. Zope, N. R., Anand, K., & Lokku, D. S. (2014, April). Reviewing Service Quality for IT Services Offerings: Observations in the Light of Service Quality Models & Determinants. In *Global Conference (SRII), 2014 Annual SRII* (pp. 43-49). IEEE.
15. Heskett, J.L., Jones, T.O., Loveman, G.W., Sasser, W.E., and Schlesinger, L.A., (2008), "Putting the Service-Profit Chain to Work," *Best of HBR, Harvard Business Review*, July-August 2008, pp. 118-128
16. Clatworthy, S. (2011). Service innovation through touch-points: Development of an innovation toolkit for the first stages of new service development. *International Journal of Design*, 5(2).
17. Barras, R. (1986). "Towards a Theory of Innovation in Services," *Research Policy* (15), pp. 161-173.
18. Gustafsson, A., and Johnson, M. (2003). *Competing in a Service Economy: How to Create a Competitive Advantage Through Service Development and Innovation*, San Francisco: Jossey-Bass.
19. Barrett, M., Davidson, E., Prabhu, J., & Vargo, S. L. (2015). "Service innovation in the digital age: key contributions and future directions". *Mis Quarterly*, 39(1), 135-154.
20. Lusch, R. F., and Nambisan, S. (2015). "Service Innovation; A Service-Dominant Logic Perspective," *MIS Quarterly* (39:1), pp.155-175

Course Name: Behavioral Economics
Course Code: PE-CBS804A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: **NIL**

Course Objectives:

- 1 To acquire knowledge about current ideas and concepts regarding decision making in Economics
- 2 To learn Economics, particularly from a behavioral science perspective
- 3 To understand regularities in actual individual and strategic decision making.
- 4 To get an insight about behavior of firms, households and other economics entities
- 5 This course will help you understand why people make the decisions, improve your own decision making, and predict how others behave in situations in which they interact with you strategically.

Course Outcomes:

Upon completion of the course, students shall have ability to

C951.1	Students will be able to learn and understand various concepts in traditional and modern Microeconomics	[U]
C951.2	Can able to understand decision making and improve policies	[U]
C951.3	Understand the concept of Beliefs, heuristics and biases for self-evaluation and self-projection	[U]
C951.4	Develop a holistic understanding of these concepts and their interconnections	[AP]
C951.5	Analysing the game theory and Nash equilibrium strategies and its applications	[A]

Course Contents:

Introduction: 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. **Basics of choice theory:** 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

Beliefs, heuristics and biases: 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. **Choice under uncertainty:** 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.

Intertemporal choice: 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. **Strategic choice:** 1. Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signaling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry. 2. 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; policy analysis – norms and markets, labor markets, market clearing, public goods; applications logic and knowledge, voluntary contribution, compensation design

Text Books:

1. An Introduction to Behavioral Economics, by N. Wilkinson and M. Klaes
2. Behavioral Economics: The Basics, by Philip Corr , Anke Plagnol
3. Advances in Behavioral Economics, by Colin F. Camerer, George Loewenstein, Matthew Rabin

Web References:

1. <https://www.adelaide.edu.au/course-outlines/106436/1/sem-1/#:~:text=Behavioural%20economics%20explains%20these%20departures,they%20interact%20with%20you%20strategically>.
2. <https://www.macmillanihe.com/page/detail/a-course-in-behavioral-economics-erik-angner/?sf1=barcode&st1=9781352010800%C2%A0>
3. <https://www.uio.no/studier/emner/sv/oekonomi/ECON4260/>

Online Resources:

1. <https://www.youtube.com/watch?v=dqxQ3E1bubI>
2. <https://www.youtube.com/watch?v=9cTp5tiElnw>
3. <https://www.youtube.com/watch?v=ReFqFPJHLhA>
4. <https://www.coursera.org/learn/neuroeconomics>

<https://www.coursera.org/learn/neuromarketing>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	1	1	1	1	-	1	2	2	-	2	1
CO2	2	1	1	1	1	-	1	3	2	-	2	1
CO3	2	1	2	2	2	-	1	3	2	-	2	2
CO4	2	1	2	2	2	-	1	3	2	-	2	2
CO5	2	1	2	2	2	-	1	3	1	-	2	1

Course Name: Computational Finance and Modeling
Course Code: CBS804B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Nil

Course Objectives:

On successful completion of this course, students will be able to:

1. Understand existing financial models in a quantitative and mathematical way.
2. Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering.
3. Explain the approaches required to calculate the price of options.
4. Identify the methods required to analyse information from financial data and trading systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

- | | |
|------------|--|
| CBS804B.1 | Learn about numerical methods to be used in financial markets. |
| CBS804B.2 | Know about the various frameworks adopted in derivatives segment like option trading. |
| CBS804B..3 | Understand and apply the concept of mathematics to trade online like equity, cryptocurrency and in IPOs. |
| CBS804B..4 | Analyse the suitable methods to trade in ADRs, GDRs etc. |
| CBS804B..5 | Perform Statistical Analysis of financial returns |

Course Contents:

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.

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 smooth pasting condition. Volatility considerations - actual, historical, and implied volatility; local vol and volatility surfaces. **Simulation including random variable generation**, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature.

Financial Products and Markets: Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging. Application areas include 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. **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. Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage.

Text Books:

1. R. Seydel: Tools for Computational Finance, 2nd edition, Springer-Verlag, New York, 2004.
2. P. Glasserman: Monte Carlo Methods in Financial Engineering, Springer-Verlag, New York, 2004.
3. W. Press, S. Teukolsky, W. Vetterling and B. Flannery, Numerical Recipes in C: The Art of Scientific Computing, 1997. Cambridge University Press, Cambridge, UK. Available on-line at: <http://www.nr.com/>
4. A. Lewis: Option Valuation under Stochastic Volatility, Finance Press, Newport Beach, California, 2000.
5. A. Pelsser: Efficient Methods for Valuing Interest Rate Derivatives, Springer-Verlag, New York, 2000.
6. D. Ruppert, Statistics and Data Analysis for Financial Engineering
7. R. Carmona: Statistical Analysis of Financial Data in S-Plus
8. N. H. Chan, Time Series: Applications to Finance
9. R. S. Tsay, Analysis of Financial Time Series
10. J. Franke, W. K. Härdle and C. M. Hafner, Statistics of Financial Markets: An Introduction

Web References:

1. <https://nptel.ac.in/courses/111/103/111103126/>
2. <https://www.youtube.com/watch?v=IRMn6JQvU8A>
3. <https://www.youtube.com/watch?v=Fwl0yPeOzOM>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1	1	1	-	-	-	1	-	1	1
CO2	1	1	1	1	1	-	-	-	1	-	2	1
CO3	2	2	2	2	2	-	-	-	1	-	2	2
CO4	2	2	2	2	2	-	-	-	1	-	2	2
CO5	2	2	2	2	2	-	-	-	1	-	2	2

Course Name: Psychology
Course Code: CBS804C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Nil

Course Objectives:

- 1 Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues
- 2 To get an insight about employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety.
- 3 Using an applied approach, this course will help prepare students for their roles as employees and managers

Course Outcomes:

Upon completion of the course, students shall have ability to

- CBS804C.1 Become conversant about the major content areas of Industrial Psychology (i.e., job analysis, recruitment, selection, employment law, training, performance management, and health/well-being issues in the workplace).
- CBS804C.2 Gain further comfort with statistical concepts in the context of making personnel decisions to reinforce content learned in PSY203 or an equivalent introductory statistics course.
- CBS804C.3 Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being.
- CBS804C.4 Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions.
- CBS804C.5 Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management.

Course Contents:

What is I/O 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.

Identifying Criteria & Validating Tests and Measures: Screening Methods, Intensive Methods, Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.

Employee Motivation: Satisfaction and Commitment, Fairness and Diversity. Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behavior. Stress Management: Demands of Life and Work.

Text Books:

1. Landy, F. J. and Conte, J. M. (2013). Work in the 21st Century (4th Edition). Oxford: Blackwell Publishing.

Web References:

1. https://youtube.com/playlist?list=PLWa_ma1ggOHIXVLceYk78br_y6JxAJZq-
2. https://www.youtube.com/watch?v=bu_yh3h0n3U&t=5s
3. <https://www.youtube.com/watch?v=qOyJ-ZZSMWU>

Online Resources:

<https://www.udemy.com/course/master-of-industrial-and-organizational-psychology/>

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	2	2	1	3	-	3	3	3	1	1
CO2	1	1	1	1	1	1	-	1	1	1	1	1
CO3	2	2	3	3	3	2	-	1	2	2	2	2
CO4	2	2	2	2	2	1	-	1	2	1	1	2
CO5	1	1	1	2	1	1	-	-	1	1	1	1

Course Name: Advance Finance
Course Code: BS805A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: Fundamentals of Management

Course Objectives:

- 1 This course will help students to develop in-depth knowledge about the financial techniques and instruments.
- 2 To Imbibe knowledge about the decisions and decision variables involved with financial activities of the firm.
- 3 To Develop skills for interpretation business information and application of financial theory in corporate investment decisions, with special emphasis on working capital management.
- 4 To Familiarizing the students with the corporate and financial restructuring

Course Outcomes:

Upon completion of the course, students shall have ability to

- BS805A.1 Remember in-depth knowledge about the financial techniques and instruments.
- BS805A.2 Understand knowledge about the decisions and decision variables involved with financial activities of the firm.
- BS805A.3 Apply business information and application of financial theory in corporate investment decisions, with special emphasis on working capital management.
- BS805A.4 Analyze the corporate and financial restructuring
- BS805A.5 Understand the details of derivatives calculate.

Course Contents:

Sources of Funds and Dividend Decision: 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

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 - Financial Restructuring - Share Split – Consolidation - Cancellation of Paid-up Capital - Other Mechanisms - Evaluation of Lease Contracts

Working Capital Management and derivatives: Working Capital Planning - Monitoring and Control of Working Capital - Working Capital Financing - Managing the Components of Working Capital - Cash Management - Receivable Management - Inventory Management - **Introduction to derivatives** - 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.

Home Assignment:

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class. Further, the topic for class discussion will be mentioned beforehand and students should be prepared to discuss these topics in class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

1. Topic: Historical perspectives of markets like major boom and busts, bull and bear cycles, major market crashes, bubbles
2. Topic: Major scams in the market, e.g. Satyam case

Text Books:

Brealey, Myers and Allen, Principles of Corporate Finance, 12th Edition 2018

Prasanna Chandra, Corporate Valuation: A Guide for Analysts – Managers and Investors

Reference Books:

Pandey. I. M, Financial Management, Ninth Edition, Vikas Publishing House, 2013

James C Van Horne, Financial Management and Policy, Prentice Hall of India, 2009

Prasanna Chandra, Fundamentals of Financial Management, Tata McGraw Hill, 2009

Web References:

www.mca.gov.in

www.bseindia.com

Course Outcome (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	-	1	-	-	1	-	-	-	-	-	2	2
CO2	-	2	2	2	1	1	-	1	-	1	1	1
CO3	1	2	2	2	1	1	-	-	-	1	2	2
CO4	1	2	2	2	1	1	1	1	1	1	2	2
CO5	1	2	2	2	1	1	1	1	1	1	2	2

Course Name: Image Processing and Pattern Recognition

Course Code: BS805B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre requisites:

Course Objectives:

- 1 To get adequate background knowledge about image processing and pattern recognition.
- 2 To get practical knowledge and skills about image processing and pattern recognition tools
- 3 To get necessary knowledge to design and implement a prototype of an image processing and pattern recognition application.

Course Outcomes:

Upon completion of the course, students shall have ability to

- BS805B.1 Understand Basics of Image formation and transformation using sampling and quantization
- BS805B.2 Understand different types signal processing techniques used for image sharpening and smoothing
- BS805B.3 Apply compression and coding techniques used for image data
- BS805B.4 Understand the nature and inherent difficulties of the pattern recognition problems
- BS805B.5 Apply Morphological Filtering Basics upon different images

Course Contents:

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, neighbourhood metrics. **Intensity transformations and spatial filtering:** Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

Segmentation: 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. **Image/Object features extraction:** Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties.

Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation. **Colour image processing:** Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab; False colour; Pseudo colour; Enhancement; Segmentation. **Morphological Filtering Basics:** Dilation and Erosion Operators, Top Hat Filters

Text Books:

1. Digital Image Processing. R. C. Gonzalez and R. E. Woods, Prentice Hall.

Reference Books:

- 1 Image Processing: The Fundamentals. Maria Petrou and Panagiota Bosdogianni, John Wiley & Sons, Ltd.
- 2 Visual Reconstruction. A. Blake and A. Zisserman, MIT Press, Cambridge.
Digital Pictures. A. N. Netravali and B. G. Haskell, Plenum Press.
Digital Images and Human Vision. A. B. Watson, MIT Press, Cambridge.

Web References:

<https://github.com/TareqK/Image-Processing-And-Pattern-Recognition-Course/blob/master/Notes/introduction.markdown>

<https://www.coursera.org/courses?query=image%20processing>

<https://www.edx.org/learn/image-analysis>

<https://handbook.uts.edu.au/subjects/details/31256.html>

Online Resources:

<https://nptel.ac.in/courses/117/105/117105101/>

https://onlinecourses.nptel.ac.in/noc21_ee23/preview

Course Name: Marketing Research and Marketing Management
Course Code: BS803
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Course Outcome(s):

Students will be able to

- Understand basic marketing concepts
- Comprehend the dynamics of marketing and analyze how its various components interact with each other in the real world
- Leverage marketing concepts for effective decision making
- Understand basic concepts and application of statistical tools in Marketing research

Topics to Be Covered:

UNIT – I

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.

Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social

Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behavior

Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

UNIT – II

Product Management: 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: 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: 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: Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

UNIT – VI

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

Home Assignments:

1. Written Analyses of Cases – Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g. “Marketing Myopia”
2. Field visit & live project covering steps involved in formulating Market Research Project
3. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics

Text Books:

1. Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler
2. Fundamentals of Marketing – William J. Stanton & Others
3. Marketing Management – V.S. Ramaswamy and S. Namakumari
4. Marketing Research – Rajendra Nargundkar
5. Market Research – G.C. Beri
6. Market Research, Concepts, & Cases – Cooper Schindler

Reference Books:

5. Marketing Management –Rajan Saxena
6. Marketing Management –S.A. Sherlekar
7. Service Marketing – S.M. Zha
8. Journals – The IUP Journal of Marketing Management, Harvard Business Review
9. Research for Marketing Decisions by Paul Green, Donald, Tull
10. Business Statistics, A First Course, David M Levine at al, Pearson Publication

Course Name: IT Project Management

Course Code: BS802

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Course Pre Requisite(s):

Good knowledge of Services Science & Service Ops Management (Covered in Year 4, Semester 1)

Course Outcome(s):

After completion of this course, students will learn the techniques to effectively plan, manage, execute, and control projects within time and cost targets with a focus on Information Technology and Service Sector. Students will also learn Agile project management techniques such as Scrum and DevOps.

Topics to Be Covered:

UNIT – I

Project Overview and Feasibility Studies- Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal

UNIT – II

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 – III

Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling

UNIT – IV

Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination

UNIT – V

Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).

UNIT – VI

Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum.

UNIT – VII

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.

UNIT – VIII

Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal

Workshop:

Workshops will be conducted as a part of this course which is mandatory for students to attend. The primary objective of the workshops is to teach the students the Agile project management including Scrum and DevOps through group activities.

Home Assignment:

Case studies will be distributed to students beforehand and students should prepare and try to solve these cases before coming to class. Students will be asked submit and present their understanding of the cases and solutions before the class.

Text Books:

1. Mike Cohn, Succeeding with Agile: Software Development Using Scrum
2. Notes to be distributed by the course instructor on various topics

Reference Books:

1. Roman Pichler, Agile Product Management with Scrum
2. Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional)