Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

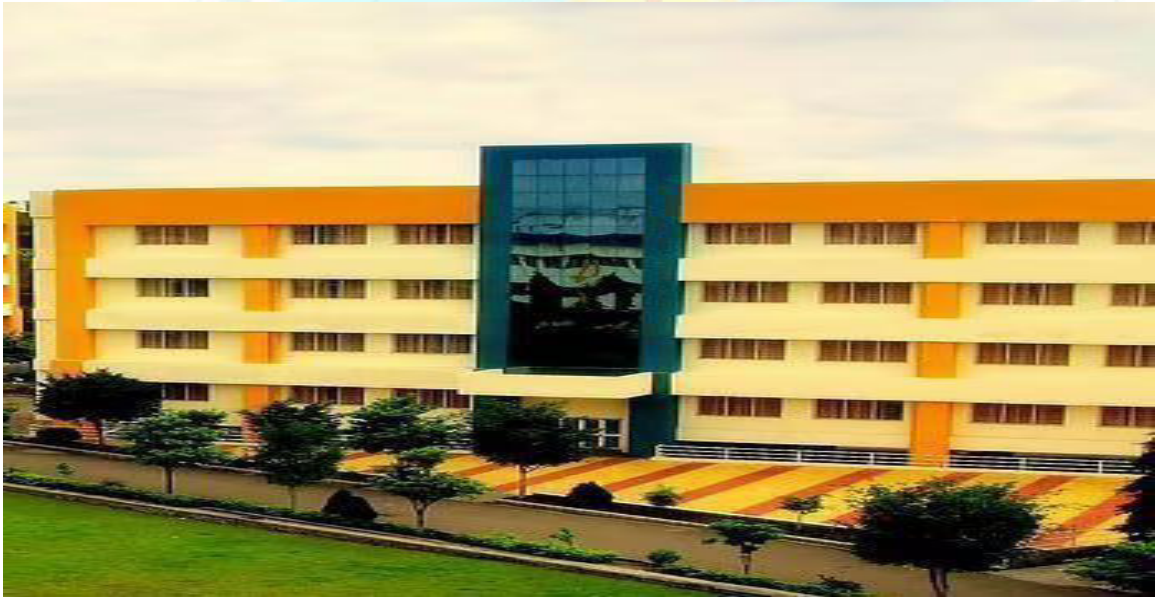
DEPARTMENT OF COMPUTER ENGINEERING

Curriculum Structure and Syllabus

of

TY B Tech Computer Engineering

(Regulations 2020)



Effective from Academic Year 2024-25

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

	Pimpri Chinchwad Education Trust's Pimpri Chinchwad College of Engineering	
Course Approval Summary		

A) Board of Study - Department of Applied Sciences and Humanities

Sr.No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1	Statistical Data Analysis using R	BAS5607	39-40	
2	Principles of Management	BHM5113	53-54	
3	Professional Development Training - I	BHM5917	59-60	
4	Emotional Intelligence	BHM9963	61-62	
5	Entrepreneurship Development	BHM9964	63-64	
6	Research Article Writing	BHM9965	65-66	
7	Multivariate Data Analysis using R	BAS6608	96-97	
8	Project Management	BHM6114	122-123	
9	Financial Management	BHM6115	124-125	
10	Entrepreneurship Development	BHM6116	126-127	
11	Professional Development Training - II	BHM6918	132-133	
12	Environmental Sciences	BHM9961	134-135	

B) Board of study - Department of Civil Engineering

Sr.No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1	Total Quality Management (TQM)	BCI5602A	41-42	
2	Intelligent Transport System (ITS)	BCI5602B	43-44	
3	Remote Sensing and GIS	BCI6603A	98-99	
4	Building Services and Maintenance	BCI6603B	100-101	
5	Smart Cities & Building Automations	BCI6604A	110-111	
6	Mechanical Electrical Plumbing (MEP) Systems	BCI6604B	112-113	

C) Board of study - Department of Computer Engineering

Sr.No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1	Theory of Computation	BCE5410	11-12	
2	Design and Analysis of Algorithm	BCE5411	13-14	
3	Design and Analysis of Algorithm Laboratory	BCE5412	15-16	
4	Technical Seminar - 1	BCE5413	17-18	
5	Data Mining and Warehousing	BCE5501	19-20	
6	Information & Cyber Security	BCE5502	21-22	
7	Web Technology	BCE5503	23-24	
8	Computer Graphics and Gaming	BCE5504	25-26	
9	Wireless Sensor Networks	BCE5505	27-28	
10	Management Information System	BCE5506	29-30	
11	Project Based Learning - III	BCE5507	31-38	
12	Programming with ASP.Net	BCE5913	55-56	
13	Advanced JAVA Programming - I	BCE5914	5758	
14	Operating Systems	BCE6414	68-69	
15	Operating Systems Laboratory	BCE6415	70-71	
16	Skill Development Lab - I	BCE6416	72-73	
17	Technical Seminar - 2	BCE6417	74-75	
18	Machine Learning	BCE6508	76-77	
19	Fundamentals of Blockchain	BCE6509	78-79	
20	Full Stack Development	BCE6510	80-81	
21	Image and Video processing	BCE6511	82-83	
22	Internet of Things	BCE6512	84-85	
23	Software Project Management	BCE6513	86-87	
24	Project Based Learning - IV	BCE6514	88-95	
25	Android Application Development	BCE6915	128-129	
26	Advanced JAVA Programming - II	BCE6916	130-131	

D) Board of study - Department of E &TC

Sr.No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1	Smart City: An Electronic Perspective	BET5601	45-46	
2	Modeling and Simulation	BET5602	47-48	
3	Designing with Raspberry Pi	BET6601	102-103	
4	Basics of Automotive Electronics	BET6602	104-105	
5	Designing with Arduino platform	BET6603	114-115	
6	Communication Protocols for e- Vehicle	BET6604	116-117	

E) Board of study - Department of Mechanical Engineering

Sr.No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1	Industry 4.0	BME5602A	49-50	
2	Safety, Health and Environment	BME5602B	51-52	
3	3D Printing and Modeling	BME6603A	106-107	
4	Material Informatics	BME6603B	108-109	
5	Model Based System Engineering	BME6604A	118-119	
6	Electronics Cooling	BME6604B	120-121	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

INDEX

LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sr. No.	Abbreviation	Type of Course
1.	BSC	Basic Science Course
2.	ECC	Engineering Core/ Science Course
3.	HSMC	Humanities, Social Sciences and Management Course
4.	PCC	Programme / Professional Core Course
5.	PEC	Programme / Professional Elective Course
6.	OEC	Open Elective Course
7.	PROJ	Project
8.	INTR	Internship
9.	AC	Audit Course
10.	MC	Mandatory Course
11.	LS	Life Skill
12.	PFC	Proficiency Course
13.	MO	MOOC Course
14.	L	Lecture
15.	P	Practical
16.	T	Tutorial
17.	H	Hours
18.	CR	Credits
19.	FA	Formative Assessment
20.	SA	Summative Assessment
21.	TW	Term Work
22.	OR	Oral
23.	PR	Practical

CURRICULUM FRAMEWORK

(2020-2021; 2021-2022; 2022-2023; 2023-2024)

The Course and Credit Distribution

SR. NO.	TYPE OF COURSE	NO. OF COURSES	TOTAL CREDITS	
			NO.	%
1.	Basic Science Course (BSC)	**8**	**23**	**14**
2.	Engineering Core/ Science Course (ECC)	**15**	**22**	**14**
3.	Humanities, Social Sciences and Management Course (HSMC)	**6**	**13**	**8**
4.	Professional Core Course (PCC)	**20**	**48**	**30**
5.	Professional Elective Course (PEC)	**9**	**18**	**11**
6.	Open Elective Course (OEC)	**6**	**18**	**11**
7.	Project (PROJ)	**2**	**16**	**10**
8.	Internship (INTR)	**1**	**3**	**2**
9.	Audit Course (AC)	**3**	**0**	**0**
10.	Mandatory Course (MC)	**2**	**0**	**0**
11.	Life Skill (LS)	**4**	**0**	**0**
12.	Proficiency Course (PFC)	**3**	**0**	**0**
13.	MOOC Course	**1**	**0**	**0**
	Total	**80**	**161**	**100**

Semester wise Course Distribution

COURSE DISTRIBUTION: SEMESTER WISE										
SR NO	TYPE OF COURSE	NO. OF COURSES / SEMESTER								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	3	3	2	-	-	-	-	-	**8**
2.	Engineering Core Course (ECC)	5	6	2	2	-	-	-	-	**15**
3.	Humanities, Social Sciences and Management Course (HSMC)	1	1	1	1	1	1	-	-	**6**
4.	Professional Core Course (PCC)	-	-	4	5	4	4	3	-	**20**
5.	Professional Elective Course (PEC)	-	-	-	-	3	3	3	-	**9**
6.	Open Elective Course (OEC)	-	-	-	1	1	2	2	-	**6**
7.	Project (PROJ)	1	-	-	-	-	-	-	1	**2**
8.	Internship (INTR)	-	-	-	-	-	-	-	1	**1**
9.	Audit Course (AC)	-	-	-	1	1	1	-	-	**3**
10.	Mandatory Course (MC)	-	-	-	-	1	1	-	-	**2**
11.	Life Skill (LS)	1	1	1	1	-	-	-	-	**4**
12.	Proficiency Course (PFC)	-	-	-	1	1	1	-	-	**3**
13.	MOOC Course	-	-	-	-	-	-	-	1	**1**
Total		**11**	**11**	**10**	**12**	**12**	**13**	**8**	**3**	**80**

Semester wise Credit Distribution

CREDIT DISTRIBUTION: SEMESTER WISE										
1 Lecture hour = 1 Credit, 2 Lab Hours = 1 Credit, 1 Tutorial Hour = 1 Credit										
SR NO	TYPE OF COURSE	NO. OF COURSES / SEMESTER								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	9	9	5	-	-	-	-	-	**23**
2.	Engineering Core Course (ECC)	7	9	3	3	-	-	-	-	**22**
3.	Humanities, Social Sciences and Management Course (HSMC)	2	2	3	2	2	2	-	-	**13**
4.	Professional Core Course (PCC)	-	-	12	12	8	8	8	-	**48**
5.	Professional Elective Course (PEC)	-	-	-	-	6	6	6	-	**18**
6.	Open Elective Course (OEC)	-	-	-	3	3	6	6	-	**18**
7.	Project (PROJ)	2	-	-	-	-	-	-	14	**16**
8.	Internship (INTR)	-	-	-	-	-	-	-	3	**3**
9.	Audit Course (AC)	-	-	-	-	-	-	-	-	**0**
10.	Mandatory Course (MC)	-	-	-	-	-	-	-	-	**0**
11.	Life Skill (LS)	-	-	-	-	-	-	-	-	**0**
12.	Proficiency Course (PFC)	-	-	-	-	-	-	-	-	**0**
13.	MOOC Course	-	-	-	-	-	-	-	-	**0**
Total		**20**	**20**	**23**	**20**	**19**	**22**	**20**	**17**	**161**

Curriculum structure

TY B Tech

Computer Engineering

CURRICULUM STRUCTURE

Structure for Third Year B.Tech. (Computer Engineering) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						
			L	P	T	H		FA 1	FA 2	SA	TW	PR	OR	Total
BCE5410	PCC	Theory of Computation	3	-	-	3	3	20	20	60	-	-	-	**100**
BCE5411	PCC	Design and Analysis of Algorithm	3	-	-	3	3	20	20	60	-	-	-	**100**
BCE5412	PCC	Design and Analysis of Algorithm Laboratory	-	2	-	2	1	-	-	-	25	50	-	**75**
BCE5413	PCC	Technical Seminar - 1	-	2	-	2	1	-	-	-	25	-	-	**25**
BCE5501 -503	PEC	Professional Elective Course - 1	2	-	-	2	2	20	20	60	-	-	-	**100**
BCE5504 -506	PEC	Professional Elective Course - 2	2	-	-	2	2	20	20	60	-	-	-	**100**
BCE5507	PEC	Project Based Learning - 3	-	4	-	4	2	-	-	-	50	-	50	**100**
	OEC	Open Elective Course - 2	3	-	-	3	3	20	20	60	-	-	-	**100**
BHM5113	HSMC	HSMC - 5 Principles of Management	2	-	-	2	2	10	20	20	-	-	-	**50**
BCE5913 -914	PFC	Proficiency Course - 2	-	2	-	2	-	-	-	-	-	-	-	**-**
BHM5917	MC	Professional Development Training - 1	3	-	-	3	-	-	-	-	-	-	-	**-**
BHM9963 -965	AC	Audit Course - 2	1	-	-	1	-	-	-	-	-	-	-	**-**
Total			**19**	**10**	**-**	**29**	**19**							**750**

L-Lecture, **P**-Practical, **T**-Tutorial, **H**-Hours, **CR**-Credits, **FA-** Formative Assessment, **SA-** Summative Assessment, **TW**- Term Work, **OR**- Oral, **PR**- Practical

Semester - V

List of courses – Professional Elective Course - I

Course Code	Course Name	
BCE5501	Data Mining and Warehousing	Choose any one
BCE5502	Information & Cyber Security	
BCE5503	Web Technology	

List of courses – Professional Elective Course – II

Course Code	Course Name	
BCE5504	Computer Graphics and Gaming	Choose any one
BCE5505	Wireless Sensor Networks	
BCE5506	Management Information System	

List of courses – Open Elective Course - II

Course Code	Department	Course Name	
BAS5607	AS&H	Statistical Data Analysis Using R	Choose any one
BCI5602A	CIVIL	Total Quality Management	
BCI5602B		Intelligent Transportation System	
BET5601	E&TC	Smart City: An Electronic Perspectives	
BET5602		Modeling and Simulation	
BME5602A	MECH	Industry 4.0	
BME5602B		Safety, Health and Environment	

List of courses – Proficiency Course – II

Course Code	Course Name	
BCE5913	Programming with ASP.Net	Choose any one
BCE5914	Advanced JAVA Programming - I	

List of courses – Audit Courses - II

Course Code	Course Name	
BHM9963	Emotional Intelligence	Choose any one
BHM9964	Entrepreneurship Development	
BHM9965	Research Article Writing	

CURRICULUM STRUCTURE

Structure for Third Year B.Tech. (Computer Engineering) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						
			L	P	T	H		FA 1	FA 2	SA	TW	PR	OR	Total
BCE6414	PCC	Operating Systems	3	-	-	3	3	20	20	60	-	-	-	**100**
BCE6415	PCC	Operating Systems Laboratory	-	4	-	4	2	-	-	-	25	25	-	**50**
BCE6416	PCC	Skill Development Laboratory - 1	-	4	-	4	2	-	-	-	25	25	-	**50**
BCE6417	PCC	Technical Seminar - 2	-	2	-	2	1	-	-	-	25	-	-	**25**
BCE6508 -510	PEC	Professional Elective Course - 3	2	-	-	2	2	20	2	60	-	-	-	**100**
BCE6511 -513	PEC	Professional Elective Course - 4	2	-	-	2	2	20	20	60	-	-	-	**100**
BCE6514	PEC	Project Based Learning - 4	-	4	-	4	2	-	-	-	25	-	50	**75**
	OEC	Open Elective Course - 3	3	-	-	3	3	20	20	60	-	-	-	**100**
	OEC	Open Elective Course - 4	3	-	-	3	3	20	20	60	-	-	-	**100**
BHM6114 -116	HSMC	HSMC - 6	2	-	-	2	2	10	20	20	-	-	-	**50**
BCE6915 -916	PFC	Proficiency Course - 3	-	2	-	2	-	-	-	-	-	-	-	**-**
BHM6918	MC	Professional Development Training - 2	3	-	-	3	-	-	-	-	-	-	-	**-**
BHM9961	AC	Audit Course - 3 Environmental Science	1	-	-	1	-	-	-	-	-	-	-	**-**
Total			**19**	**16**	**-**	**35**	**22**	-						**750**

L-Lecture, **P**-Practical, **T**-Tutorial, **H**-Hours, **CR**-Credits, **FA-** Formative Assessment, **SA-** Summative Assessment, **TW**- Term Work, **OR**- Oral, **PR**- Practical

Semester - VI

List of courses – Professional Elective Course – III

Course Code	Course Name	
BCE6508	Machine Learning	Choose any one
BCE6509	Fundamentals of Blockchain	
BCE6510	Full Stack Development	

List of courses – Professional Elective Course – IV

Course Code	Course Name	
BCE6511	Image & Video Processing	Choose any one
BCE6512	Internet of Things	
BCE6513	Software Project Management	

List of courses – Open Elective Course - III

Course Code	Department	Course Name	
BAS6608	AS&H	Multivariate Data Analysis Using R	Choose any one
BCI6603A	CIVIL	Remote Sensing and GIS	
BCI6603B		Building Services and Maintenance	
BET6601	E&TC	Designing with Raspberry Pi	
BET6602		Basics of Automotive Electronics	
BME6603A	MECH	3D Printing and Modeling	
BME6603B		Material Informatics	

List of courses – Open Elective Course - IV

Course Code	Department	Course Name	
BCI6604A	CIVIL	Smart Cities & Building Automations	Choose any one
BCI6604B		Mechanical Electrical Plumbing (MEP) Systems	
BET6603	E&TC	Designing with Arduino platform	
BET6604		Communication Protocols for eVehicle	
BME6604A	MECH	Model Based System Engineering	
BME6604B		Electronics Cooling	

List of courses – Humanities, Social Sciences and Management Course - VI

Course Code	Course Name	
BHM6114	Project Management	Choose any one
BHM6115	Financial Management	
BHM6116	Entrepreneurship Development	

List of courses – Proficiency Course – III

Course Code	Course Name	
BCE6915	Android Application Development	Choose any one
BCE6916	Advanced JAVA Programming - II	

Course Syllabus

TY B Tech Semester - V

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Theory of Computation					Code: BCE5410	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Discrete Mathematics
is essential.

Course Objectives:

1. To study abstract computing models.
2. To model problems mathematically using basic types of Automata.
3. To develop skills of solving problems efficiently.
4. To learn Grammar, Push Down Automata, Turing Machine for language processing and algorithm design.
5. To learn about the theory of complexity for algorithm design.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze and design basic mathematical model of computation like deterministic and non-deterministic finite automata.
2. Design the Regular Expression for defining the search patterns.
3. Design formal languages using Context Free Grammar.
4. Construct Push Down Automata for problem solving for different requirements.
5. Design advanced model of computation like Turing Machine
6. Analyze different classes of problems with understanding of computational complexity.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Finite Automata** Finite Automata (FA), Finite State Machine (FSM), Deterministic FA, Non-Deterministic FA, Equivalence of NFA and DFA, Non-Deterministic FA with epsilon moves, Equivalence of NFA with epsilon moves and NFA without epsilon moves. Minimization of DFA, Moore and Mealy machines, Inter-conversion of Moore and Mealy machine, Properties and Limitations of FSM. **Case Study**: Applications of Finite State Machine such as Vending Machine (OR) Lexeme recognition for set of keywords for any programming language.	**09**
II	**Regular Expressions (RE)** Introduction, Equivalence of Regular Expressions and Finite Automata, RE to DFA Conversions, DFA to RE Conversions using Arden's theorem, Regular Languages, Non regular Languages: The pumping lemma for regular languages. **Case Study:** RE in text search and replace (OR) GREP utility in Unix.	**07**
III	**Context Free Grammars (CFG)** Introduction, Regular Grammar, Context Free Grammar- Definition, Derivation. Sentential form, parse tree, Ambiguous Grammar, Simplification of CFG: Eliminating unit productions, useless production, useless symbols, Greibach normal form, Chomsky normal form. Types of Grammar: Chomsky Hierarchy, Context Free Language (CFL): Closure properties of CFL. **Case Study-** CFG for Parenthesis Match- XML and Document Type	**08**

	Definitions, Natural Language Processing- Text Parsing	
IV	**Pushdown Automata (PDA)** Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack. Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG. PDA vs CFLs. Deterministic CFLs.	**06**
V	**Turing Machines (TM)** Introduction of Turing Machine Model, Language Acceptability by Turing Machines. Design of TM, Description of Turing machine, Techniques for TM Construction, Non- deterministic Turing machines, Multi tape Turing Machines, TM's Halting Problem.	**08**
VI	**Complexity Theory** Complexity Classes: Time and Space Measures. The Class P, Examples of problems in class P, The Class NP, Examples of problems in NP, P Problem Versus NP Problem, NP- completeness and NP-hard Problems. **Case Study:** Traveling salesman problem, Post Correspondence Problem	**07**
Total		**45**

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Pearson, 3rd Edition, 2008, ISBN-13: 978-8131720479.
2. Vivek Kulkarni "Theory of Computation", Oxford University Press, 2013, ISBN-13 978-0198084587

Reference Books:

1. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Pearson, 2nd edition, ISBN- 13: 978-0132624787
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGraw-Hill Education, 4th edition, 2010, ISBN-13: 978-0073191461.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Design and Analysis of Algorithm					Code: BCE5411	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Data Structure and Algorithms, Advance Data Structure
is essential.

Course Objectives:

1. To develop problem solving abilities using mathematical theories
2. To analyze the performance of algorithms
3. To apply algorithmic strategies while solving problems
4. To develop time and space efficient algorithms
5. To study algorithmic examples in concurrent and parallel environments.

Course Outcomes:

After learning the course, the students will be able to:

1. Compare the performance of various algorithms using time and space complexity.
2. Illustrate the performance of algorithms using amortized analysis.
3. Apply different problem-solving strategies to solve computational problems.
4. Determine the optimal solutions for various problems.
5. Design solution for a complex optimization problem using suitable mathematical techniques.
6. Classify the various problems through the analysis of programming constructs.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Problem solving and Algorithmic Analysis** Asymptotic notations, lower bound and upper bound: Best case, worst case, average case analysis, classification of time complexities (linear, logarithmic etc), Recurrences: Formulation and solving recurrence equations using Master Theorem, Proving correctness of algorithms.	08
II	**Divide and Conquer Strategy** Problem subdivision – Divide and Conquer: Binary search, Quick sort, Merge sort, Integer Arithmetic, Maximum sub-array, Master's theorem and its uses. **Greedy Strategy** Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem, Job scheduling algorithm, Single Source Shortest Path Dijkstra's.	08
III	**Dynamic Programming Strategy** Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, multistage graphs, 0/1 knapsack, All Pair Shortest Path - Floyd- Warshall, OBST,Bellman-Ford, sum of subset.	08
IV	**Backtracking Strategy** Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem and Hamiltonian cycle.	08

V	**Branch and Bound Strategy** Principle, control abstraction, time analysis of control abstraction, strategies – FIFO, LIFO and LC approaches, knapsack problem, Branch and Bound using TSP	**07**
VI	**Complexity Theory** Polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover, Maximum Clique and 3-SAT.	**06**
Total		**45**

Text Books:

1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithms", The MIT Press; 4th edition, April 5, 2022, ISBN-13: 978-0262046305
2. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson, 2nd edition, 2013, ISBN-13: 978-1292023946.
3. Horowitz, Sahani, "Fundamentals of computer Algorithms", Galgotia. 2Nd Edition, 1998.ISBN 81-7515-257- 5

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, ISBN 978-81-265-0986-7
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Design and Analysis of Algorithm Laboratory					Code: BCE5412	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	50	-	75

Prior knowledge of
Data Structure and Algorithms, Advance Data Structure
is essential.

Course Objectives:

1. To apply various design strategies of algorithms.
2. To develop time and space efficient algorithms.
3. To compare different strategies and find exact solutions.
4. Decide a suitable design strategy to solve a real-world problem.

Course Outcomes:

After learning the course, the students will be able to:

1. Implement different problem solving strategies to solve computational problems.
2. To analyze, and compare algorithms
3. Implement search algorithms for finding solutions to different search problems.
4. Design and Implement time and space efficient algorithms.
5. Find the optimal solution to a problem by analyzing the it's performance.
6. Develop an application to provide a solution to a selected problem by developing problem solving ability.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

1. Recommended Tools for the implementation of above assignments: Python, Java etc.
2. For mini project, select a real world application in the group of 3-4 students and formulate a problem statement for application to be developed.
3. Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.
4. Student should perform any 6 assignments out of 8.

Suggested List of Assignments

Assignment No.	Assignment Title
1.	Write a program to compute square of 20-digit large integer numbers using divide and conquer strategy.
2.	Consider the scheduling problem. n tasks to be scheduled on single processor. Let d1, ...,dn be deadline and p1,….pn be the profit of each task to execute on single processor is known. The tasks can be executed in any order but one task at a time and each task take 1 unit of time to execute. Design a greedy algorithm for this problem and find a schedule or sequence of jobs that gives maximum profit.
3.	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by Floyd-Warshall algorithm.
4.	You have been given a network of 'N' nodes from 1 to 'N' and 'M' edges. For each edge, you are given three values (ui, vi, wi) where "ui" and "vi" denote the nodes and "wi" denotes an integer value which represents the time taken by a signal to travel from "ui" to "vi". Now, you are supposed to find the time which a signal takes to travel from a given node 'K' to all nodes. If it is impossible for all nodes to receive the signal then print -1. Implement the given Network Delay Time using Dijkstra's algorithm.
5.	A classic problem that can be solved by backtracking is called the Knight's tour Problem. It is a problem in which we are provided with a NxN chessboard and a knight. For a person who is not familiar with chess, the knight moves two squares horizontally and one square vertically, or two squares vertically and one square horizontally. In this problem, there is an empty chess board, and a knight starting from any location in the board, our task is to check whether the knight can visit all of the squares in the board or not. When It can visit all of the squares, then place the number of jumps needed to reach that location from the starting point.
6.	Let there be N students and N clubs. Any student can be assigned to any club, incurring some cost that may vary depending on the student club assignment. It is required to allocate all clubs by assigning exactly one student to each club and exactly one club to each agent in such a way that the total cost of the assignment is minimized. Implement club assignment problem using Branch and bound.
7.	Mini-Project

Text Books:

1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithms", The MIT Press; 4th edition, April 5, 2022, ISBN-13: 978-0262046305
2. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson, 2nd edition, 2013, ISBN-13: 978-1292023946.
3. Horowitz, Sahani, "Fundamentals of computer Algorithms", Galgotia. 2Nd Edition, 1998.ISBN 81-7515-257- 5

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, ISBN 978-81-265-0986-7
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2.

Program:	B. Tech. (Computer Engineering)			Semester: V			
Course:	Technical Seminar - 1			Code: BCE5413			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	-	-	25

Course Objectives:

1. To apply the knowledge and skills for understanding realistic problem.
2. To review of literature for project work from appropriate sources such as books, manuals, research journals and from other sources, and in turn increase analytical skills.
3. To emphasizes learning activities that are long-term, Collaborative learning, interdisciplinary.
4. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes:

After learning the course, the students will be able to:

1. Identify and define the real life engineering problem from societal need point of view.
2. Develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem.
3. Choose and compare alternative approaches with the help of literature survey to select most feasible one.
4. Analyze and synthesize the identified problem from technological perspective.
5. Demonstrate Collaborative learning, Interpersonal Skills, Meta cognitive skills through different seminar activities.
6. Prepare good quality technical reports based on the selected problem statement.

Guidelines for Students:

1. Seminar is one of the significant contributory team works that has to be completed based on the required number of credits as per academic regulations.
2. It is necessary to explore the domain of interest / research/ thrust area/ society needs.
3. **Seminar teams:** 3-4 students can form a team within the same or different discipline and their area of interest is to be registered with seminar Coordinator.
4. **Selection of Seminar Topic:**
   . Student shall identify the area or topics in recent trends and developments in consultation with seminar guide or industry or any research organization.
2. **Guide Allotment:**
   . Considering registered team's area of interest/domain and expertise of guide, the Seminar coordinator in consultation with **panel of experts** allots Seminar guides.
   a. Guide should be allotted from the **same program**.
   b. **In case of interdisciplinary Seminar**, along with the guide from same program, co-guide should be allotted from the other program
3. Teams in consultation with guide will prepare **Seminar Synopsis**.
4. **Seminar Review:**
   . The Seminar coordinator with the Head of the department shall constitute a review committee comprising of domain experts and senior faculty members.
   a. The review committee will approve the Seminar group and title. Discussion / presentation may be arranged covering topics listed in the synopsis.
   b. The seminar Review committee will evaluate the timely progress of the projects.
   c. Student with group members is expected to appear for minimum three reviews as per the seminar calendar.

d. Attendance for all 3 reviews is mandatory.

e. Student will be evaluated thrice in the semester based on seminar evaluation guidelines/Rubrics as follows:

Sr. No.	Review	Rubrics
1	Review-1 (10 Marks)	1. Problem Identification & definition (2 Marks) 2. Scope, Feasibility and Objectives (2 Marks) 3. Synopsis Preparation and Submission (2 Marks) 4. Societal Contribution. (2 Marks) 5. Communication & Presentation skills, Attendance (2 Marks)
2	Review-2 (20 Marks)	1. Literature Review (5 Marks) 2. Algorithmic Study (5 Marks) 3. Draft of Literature Review Paper (5 Marks) 4. Communication & Presentation skills, Attendance (5 Marks)
3	Review-3 (20 Marks)	1. Seminar Report Submission (5 Marks) 2. Paper Publication/ IPR/ Participation in Technical Awards/ Awards/ Consultancy (5 Marks) 3. Technical Knowledge (5 Marks) 4. Team work & Attendance (5 Marks)
Total- (50 Marks)		Scaled down to (25 marks)

8. **Report:**

f. Report should be prepared using Latex only as per the template provided by the department.

g. Seminar reports shall be submitted in softcopy form/ (Hard bound reports could be avoided).

h. In case of Interdisciplinary Seminar, students must submit **Completion certificate with signature of Co-Guide from another department.**

9. **Technical Seminar1 Outcomes:**
   - Identification of topic/domain for each student seminar team
   - Student seminar team shall divide topic into sub topic and individually work on sub topic and perform literature survey.
   - Tentative Problem statement for Technical Seminar 2 must be finalized.

Seminar Work syllabus guidelines:

- The student is expected to complete the Seminar1 work which will consist of selection of Domain Selection, Topic Identification, Finalization of sub topics for each student in group literature review, Problem Statement for Technical Seminar 2.
- The student shall prepare and submit the report of Seminar work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide (Internal External (in case of sponsored project)/ Co-Guide (in case of interdisciplinary project)) and head of the Department/Institute.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Data Mining and Warehousing (PEC-1)					Code: BCE5501	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Database Management Systems, Engineering Mathematics
is essential.

Course Objectives:

1. To introduce the fundamentals of Data mining and Data Warehousing.
2. To develop skills to select appropriate multi-dimensional schemas to design data warehouse model.
3. To develop skills to identify the appropriateness and need of data mining.
4. To study and use preprocessing techniques for preparing suitable dataset for data mining.
5. To apply data similarity and dissimilarity measures for statistical analysis
6. To study and apply various methods and algorithms in data mining for solving real world problems.

Course Outcomes:

After learning the course, the students will be able to:
1. Use data preprocessing techniques for preparing suitable dataset for data mining.
2. Select appropriate multi-dimensional schema to design data warehouse model.
3. Apply data similarity and dissimilarity measures for statistical analysis.
4. Apply Data Mining functionalities to solve real world problems.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction** Data Mining, Need of data mining, Data, Information and Knowledge, Knowledge Discovery form Data (KDD), Attribute Types: Nominal, Binary, Ordinal and Numeric attributes; Data pre-processing: Data Cleaning, Data Integration, Data transformation, data reduction, Data Discretization, Binning techniques.	08
II	**Data Warehouse** Data Warehouse, Operational Database Systems and Data Warehouses (OLTP Vs OLAP), Data Warehouse and Data Mining, Data Warehouse Architecture, Data Lake, AMultidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model.	08
III	**Measuring Data Similarity and Dissimilarity** Measuring Central Tendency of Data, Measuring Dispersion of Data, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data: Euclidean distance and Manhattan distance; Cluster analysis- partitioning methods: k-means	06
IV	**Data Mining Functionalities** Cluster analysis- Hierarchical Methods, Density-Based Methods Association Rule Mining: Market basket Analysis, Frequent Item Sets, Association Rules, Apriori Algorithm. Classification: Decision Tree Classification, Lazy Learner-	08

	K Nearest Neighbor Classifier	
Total		**30**

Text Books:

1. Jiawei Han, Micheline Kamber, “Data mining: concepts and techniques", Morgan Kaufmann Publisher 2012, third edition, ISBN 978-0-12-381479-1.
2. G. K. Gupta, “Introduction to Data mining with Case Studies", PHI Learning Private Limited, Delhi 2014, third edition, ISBN-978-81-203-5002-1.
3. William H Inmon, “Building the data Warehouse”, Wiley Publication 2005, fourth edition, ISBN: 978-0-764- 59944-6.

Reference Books:

1. Dunham, M. H., “Data mining: Introductory and advanced topics”, Upper Saddle River, N.J: Pearson education/Prentice Hall 2003.
2. Ralph Kimball, Margy Ross, “The Data Warehouse Toolkit”, 3rd Edition, Wiley 2013, ISBN-13: 978-1118530801.
3. Ian H. Witten and Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Second Edition, Morgan Kaufmann Publishers 2005, ISBN: 0-12-088407-0

Web references:

1. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf
2. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/DataMining/Witten_and_Frank_DataMining_ Weka_2nd_Ed_2005.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Information & Cyber Security (PEC-1)					Code: BCE5502	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Basic concepts of Computer Networks
is essential.

Course Objectives:

1. To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
2. To make students aware about the basics and different algorithms of Cryptography.
3. To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.

Course Outcomes:

After learning the course, the students will be able to:

1. Identify computer and network security threats, classify the threats and develop a security model to prevent, detect and recover from the attacks.
2. Use Cryptographic Techniques to encrypt and decrypt the messages.
3. Use different Hash & Message Authentication Code Techniques to provide the Authentication and to check the Integrity of messages in transit.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Security Basics** **Computer Security Concepts** - Confidentiality, Integrity & Availability (CIA), additional Security considerations, The challenges of Security, Threats, Attacks and Assets, Operational Model of Security; **Basics:** Symmetric and Asymmetric Cipher Model; Cryptography; Cryptanalysis and Brute-Force Attack **Classical Encryption Techniques** - Substitution Techniques: Caesar Cipher, Monoalphabetic Ciphers, Polyalphabetic Ciphers, Playfair Cipher;Transposition Techniques: Rail Fense Technique **Case Study:** Study of Campus Network and identification of possible Threats, Attacks and Assets.	08
II	**Symmetric Cipher** **Traditional Cipher Structure:** Stream ciphers and Block Ciphers; Feistel Cipher Structure **Data Encryption Standard (DES):** DES Encryption; DES Decryption; DES Example; Strength of DES, Double DES and triple DES (with 2 & 3 keys) **Block Cipher Modes of Operations:** Electronic Code Book (ECB), Cipher Block Chaining Mode (CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB),Counter Mode (CTR)	07
III	**Asymmetric Cipher** **Public-Key Cryptosystems:** Secrecy, authentication, secrecy & authentication; applications, requirements; **The RSA Algorithm:** Algorithm, Example, The security of RSA;	08

	Diffie-Hellman Key Exchange: The Algorithm, Key Exchange Protocol, Man-in-the- middle attack; **Key Management and Distribution:** Symmetric Key Distribution using Symmetric key Encryption, Symmetric Key Distribution using asymmetric key Encryption, Distribution of Public Keys. **Case Study:** Introduction to X.509	
IV	**Cryptographic Hash Functions & Massage Authentication Codes** **Cryptographic Hash Functions:** Applications, Secure Hash Algorithm (SHA)-512, MD5 **Message Authentication Codes (MAC):** Requirements, Functions, Security of MACs	**07**
Total		**30**

Text Books:

1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN: 978-93-325-1877-3
2. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN: 978- 0-07-064823-4.

Reference Books:

1. Eoghan Casey, "Digital Evidence and Computer Crime Forensic Science, Computers and the Internet", ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
3. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080
4. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Web Technology (PEC-1)					Code: BCE5503	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Computer Networks, Database Management Systems
is essential.

Course Objectives:

1. To understand the basics of Web Designing using HTML, DHTML, and CSS.
2. To learn about the Client-side scripting languages.
3. To learn the basics about Server-side programming languages.
4. To learn and understand Server-side frameworks.

Course Outcomes:

After learning the course, the students will be able to:

1. Elaborate the basic building blocks of web design for web application. (L2)
2. Use of XML schema and XSLT to render the data on the client side. (L3)
3. Apply JavaScript and DOM concepts to validate the web contents. (L3)
4. Illustrate working of servlet to handle session management of web server. (L4)
5. Apply JSP script to create dynamic actions in web applications. (L3)
6. Analyze the process of business logic for web applications using PHP programming. (L4)

Detailed Syllabus

Unit	Description	Duration (H)
I	**Web Essentials and Mark-up language- HTML, XML** **HTML**- List, Tables, Images, Forms, Frames, Cascading Style sheets. Inserting CSS in an HTML page, CSS selectors **XML**- Document type definition, XML Schemas, XSLT, Introduction to bootstrap.	07
II	**Client-Side Technologies: JavaScript and DOM** **JavaScript**: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. **DOM**: Introduction to Document Object Model, intrinsic event handling, modifying element style, the document tree, DOM event handling.	07
III	**Server-Side Technologies: Servlet and JSP** **Servlet**: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, Session Tracking, Cookies. Servlet and JDBC **JSP**: Introduction to JSP, advantages of JSP over Servlet, elements of JSP page: directives, comments, Implicit objects, scripting elements, JSP actions, Servlet Vs. JSP Vs. JSF	08
IV	**Server-Side Technologies: PHP** **PHP**- Basics, String Processing and Regular Expressions, PHP session and cookies, Form Processing and Business Logic, PHP and MySql connectivity. **Web servers** –IIS (XAMPP, LAMPP) and Tomcat Servers.	08
Total		30

Text Books:

1. Jeffrey C.Jackson, “Web Technologies: A Computer Science Perspective”, Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Robert W. Sebesta, “Programming the World Wide Web”, 4th Edition, Pearson education, 2008.
3. Achyut Godbole & Atul Kahate, “Web Technologies: TCP/IP to Internet Application Architectures”, McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
4. Ralph Moseley & M. T. Savaliya, “Developing Web Applications”, Wiley publications, ISBN 13: 9788126538676.

Reference Books:

1. Marty Hall, Larry Brown, “Core Web Programming”, Second Edition, Pearson Education, 2001, ISBN 978- 0130897930.
2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, “Internet & World Wide Web How To Program”, Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, “The web Warrior Guide to Web Programming”, Thomson, 2003.
5. Adam Bretz & Colin J Ihrig, “Full Stack Javascript Development with MEAN”, SPD, ISBN-13: 978-0992461256
6. Giulio Zambon, “Beginning JSP, JSF and Tomcat”, Apress Publication, ISBN-10: 1430246235; ISBN-13: 978- 1430246237
7. Jeremy McPeak& Paul Wilton, “Beginning JavaScript”, Wrox Publication, ISBN-13: 978-0470525937
8. Robin Nixon, “Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5”, O'REILLY, ISBN: 13:978- 93-5213-015-3

Web references:

1. https://www.w3.org/html/
2. HTML, The Complete Reference http://www.htmlref.com/
3. http://w3schools.org/
4. http://php.net/
5. http://www.tutorialspoint.com/css/

MOOCs Courses link

1. http://www.nptelvideos.in/2012/11/internet-technologies.html
2. https://freevideolectures.com/course/2308/internet-technology/25 video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
3. https://www.digimat.in/nptel/courses/video/106105191/L01.html
4. http://www.nptelvideos.com/php/php_video_tutorials.php

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Computer Graphics and Gaming (PEC-2)					Code: BCE5504	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Matrix Operations
is essential.

Course Objectives:

1. To make students aware of Computer Graphics primitives, system, and color models.
2. To make students understand 2D and 3D Transformation primitives and operations.
3. To make students understand the line clipping and polygon clipping operations.
4. To introduce the different gaming tools and animation software.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend the graphics primitives and fundamentals of Computer Graphics.
2. Use transformation operations for suitable applications.
3. Use polygon filling and clipping methods for appropriate applications
4. Design computer animation and games using different gaming tools and animation software.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Basics of Computer Graphics** Data, Images, and Computer Graphics, Applications of Computer Graphics, Graphics Primitives, Random- and Raster-Scan Systems, Graphics Software and Standards, Color Models.	07
II	**2 D Transformation** Introduction, Matrix Representation, 2D Transformation – Translation, Scaling, Rotation. 3 D Transformation: Translation, Scaling, Rotation, Reflection and Shear transformations.	08
III	**Polygon** Polygon Drawing, Fill Area Primitives – Seed Fill and Scan Fill methods. Clipping: Clipping and Viewing, Line Clipping, Polygon Clipping Algorithms.	08
IV	**Gaming** Introduction to various tools - Blender, 3D Studio, Maya, Flash, Unity, OpenGL Utility Toolkit (GLUT), Case Study: Gaming Animation using Unity / Flash /Maya.	07
Total		**30**

Text Books:

1. Jonas Gomes, Luiz Velho,Mario Costa Sousa, “Computer Graphics Theory and Practice”, CRC Press, ISBN 9781568815800, 2012.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, Pearson Education India.

Reference Books:

1. Paris Buttfield-Addison et al., Unity Game Development Cookbook: Essentials for Every Game, 1st Edition, O'Reilly Media, 2019.
2. Donald Hearn and M. Pauline Baker, Computer graphics with OpenGL, Pearson Education Limited 20143.
3. Marcello Ferri, Autodesk® 3ds Max Design -The Designer's Handbook Notes

Web references:

1. https://graphics.stanford.edu/courses/cs448b-01-fall/LEARNINGMAYA2.pdf
2. https://www.blender.org/support/tutorials/
3. https://www.tutorialboneyard.com/simple-flash-animation/

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Wireless Sensor Networks (PEC-2)					Code: BCE5505	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Computer Networks
is essential.

Course Objectives:

1. To learn wireless networks and topologies.
2. To understand the fundamental concepts of WSN protocols and technologies.
3. To understand the basics of Ad-hoc & Sensor Networks.
4. To understand the nature and applications of Ad-hoc and sensor networks.
5. To provide an overview of Wireless Communication networks area and its applications in communication engineering.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend various wireless networking concepts.
2. Illustrate basic concepts of WSN.
3. Identify different issues in wireless ad hoc and sensor networks
4. Describe and compare various data link layer and routing protocols and algorithms.
5. Establish a Sensor network environment for different type of applications.
6. Compare protocols developed for ad hoc and sensor networks.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Basics of Wireless & Sensor Networks** Introduction to Wireless Network: ZigBee, Bluetooth, WiMax, Infrastructure based (satellite n/w, Cellular n/w) and Infrastructure less (Adhoc n/w) wireless topologies. Background of Sensor Network Technology, Types of WSN (C1WSN, C2WSN), WSN Architecture: Sensor Type and Technology, WSN Protocol Stack, RFID based data communication & Architecture, Applications: Building Automation, Sensors and Robots, Health Care and Military Applications.	08
II	**Data link layer protocols** Link Layer: Error control (Introduction & ARQ Protocol), Framing, Link management. MAC Layer: Low duty cycle protocols and wakeup concepts: STEM, S-MAC, Mediation device protocol, Contention-based protocols: PAMAS, Schedule-based protocols: LEACH, TRAMA, SMACS. Fundamentals of Naming and Addressing.	07
III	**Routing Protocols for WSN** Data Dissemination and Gathering, Routing Challenges and Design Issues in WSN, Routing Strategies (Proactive and Reactive) in WSN. Routing Techniques: Flooding, SPIN. Infrastructure Establishment: Topology Control, Clustering, time synchronization. Low energy adaptive Clustering, Power efficient gathering in sensor information system.	08

IV	**Infrastructure Establishment for WSN** **Sensor Tasking and Control:** Task driven Sensing, Rolls of Sensor nodes and utilities. Sensor Network Database: Introduction & Challenges, Querying the physical environment, High level database organization: Centralized storage and in-network storage. **Operating System for WSN:** Introduction, Design Issues. Examples of OS: Tiny OS, Mate, Magnet OS, MANTIS, Nano-RK, LiteOS, Architecture of LiteOS.	**07**
Total		**30**

Text Books:

1. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Networks: An information Processing Approach", Elsevier ISBN: 978-81-8147-642-5.
2. Kazim Sohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols and Applications", Wiley ISBN: 978-81-265-2730-4 (Students Edition).

Reference Books:

1. Paris Buttfield-Addison et al., Unity Game Development Cookbook: Essentials for Every Game, 1st Dipankar Raychaudhari, Mario Cerla, "Emerging Wireless Technologies and the Future Mobile Internet", Cambridge University Press, ISBN-13: 978-1-107-67864-4(Paperback)
2. Robert Faludi, "Wireless Sensor Networks", O'REILLY, ISBN 13: 978-93-5023-289-7

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Management Information System (PEC-2)					Code: BCE5506	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Software Engineering
is essential.

Course Objectives:

1. Discrimination among types of Information Systems with Comprehension of the fundamentals of MIS.
2. Identification and description of MIS in data resource management.
3. Demonstration of the significance of MIS in Business Applications with Comprehension of the building blocks of CRM, SCM and ERP
4. Evaluation of the importance of MIS in Supporting Decision Making.

Course Outcomes:

After learning the course, the students will be able to:

1. Discriminate among types of Information System and Comprehend the fundamentals of MIS.
2. Identify and describe MIS in data resource management.
3. Demonstrate the significance of MIS in Business Applications with comprehension of the building blocks of CRM, SCM and ERP.
4. Evaluate the importance of MIS in Supporting Decision Making.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Foundations of Information Systems** Systems concepts: A foundation, Components of Information Systems, Information System Resources, Information System Activities, The Role of e-Business in Business, Trends in Information Systems, types of Information Systems, Managerial challenges of Information Technology. **Real World Case Study.**	**08**
II	**MIS in Data Resource Management** Fundamental Data Concepts, Types of Databases, Data Warehouses and Data Mining, The Database Management Approach, Implementing Data Resource Management, challenges of Data Resource Management, Accessing Databases, Database Development, Data planning and Databases Design **Real World Case Study.**	**07**
III	**MIS in Business Applications** Introduction to e-Business Systems, Functional Business Systems, IT in Business, Marketing systems, Manufacturing systems, Human Resource Systems, Accounting systems, Financial Management Systems Enterprise e-Business Systems: Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Supply Chain Management (SCM), e-Commerce processes, Electronic Payment Processes. **Real World Case Study.**	**08**
IV	**MIS in Supporting Decision Making** Business and Decision Support, Decision Support Trends, Decision Support	**07**

	Systems, Executive Information Systems, Enterprise Portals and Decision Support, an overview of Artificial Intelligence Technologies in Business. **Real World Case Study.**	
Total		**30**

Text Books:

1. James A. O'Brien "Management Information Systems", McGraw-Hill/Irwin, ten Edition, ISBN: 0073376817, 2011.
2. W.S. Jawadekar, "Management Information Systems", Tata McGraw Hill, 4th Edition, ISBN: 9780070146624, 0070146624, 2011.

Reference Books:

1. Kenneth C. Laudon & Jane P. Laudon, "Management Information Systems Managing the Digital Firm", Pearson Education Limited, 13TH Edition, ISBN: 978-0-13-305069-1, 2014
2. Stephen Haagand Maeve Cummings, "Management Information Systems for the Information Age", McGraw- Hill Companies, ISBN: 007337678, 2010.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Project Based Learning - III					Code: BCE5507	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	50	-	50	100

Course Name		Group A		Group B
	Part I	Data Mining and Warehousing	Part IV	Computer Graphics and Gaming
	Part II	Information & Cyber Security	Part V	Wireless Sensor Networks
	Part III	Web Technology	Part VI	Management Information System

Course Objectives:

1. To make students aware about the latest tools of Programme / Professional Elective Course.
2. To develop skills for implementing a project using various technologies.
3. To analyze the result of implemented solutions.

Course Outcomes:

After learning the course, the students will be able to::

1. Apply the practical knowledge and latest tools of Programme / Professional Elective Course.
2. Design and develop a project using technologies of Programme / Professional Elective Course.
3. Interpret the implemented solutions in the team.

Common Guidelines for PBL-III:

Students must choose one part from Group A which is inline with his/her choice for PEC-1 and another part from Group B which is inline with his/her choice for PEC-2.

Group A

Part I: Data Mining and Warehousing

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include timely completion and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

Guidelines for Laboratory Conduction:

1. Recommended Tools for the implementation of above assignments: Python, R, Jupyter Notebook etc. Use of Anaconda platform is encouraged.
2. For mini project, select a real-world application in the group of 3-4 students and formulate a problem statement for application to be developed.
3. Student groups are required to continue the same problem statement throughout all the assignments in order to design and develop an application as a part of a mini project. Further assignments will be useful for students to develop an application.

Suggested List of Assignments

<table>
<tr><th>Assignment No.</th><th>Assignment Title</th></tr>
<tr><td>1</td><td>Data Preprocessing
Create a dummy dataset or with missing values and duplicate entries or select any data set with missing values (such as Iris dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Write a program or use a suitable tool to perform the following operations on the selected dataset and display the result.
1. Removal of duplicates
2. Handle missing values
3. Normalizing the data using normalizing technique
4. Apply min-max scalar / Robust scalar / standard scalar to scale the data
5. Use measures of Central Tendency and Dispersion of Data</td></tr>
<tr><td>2</td><td>K-Means Clustering
Consider a normalized dataset collected from schools showing details of student performance in two subjects S1 and S2. For clustering of data instances in different groups, apply k-mean clustering with initial centroids as C1=P1 =Cluster#1 and C2=P8=cluster#2. Answer the following and visualize the clusters using suitable method.
1. Which cluster does P6 belong to?
2. What is the population of cluster around C2?
3. What is the updated value of C1 and C2?
<table><tr><th>Points</th><th>S1</th><th>S2</th></tr><tr><td>P1</td><td>0.1</td><td>0.6</td></tr><tr><td>P2</td><td>0.15</td><td>0.71</td></tr><tr><td>P3</td><td>0.08</td><td>0.9</td></tr><tr><td>P4</td><td>0.16</td><td>0.85</td></tr><tr><td>P5</td><td>0.2</td><td>0.3</td></tr><tr><td>P6</td><td>0.25</td><td>0.5</td></tr><tr><td>P7</td><td>0.24</td><td>0.1</td></tr><tr><td>P8</td><td>0.3</td><td>0.2</td></tr></table></td></tr>
<tr><td>3</td><td>Association Rule Mining
Apply Apriori algorithm to find frequently occurring items from selected data set and generate strong association rules using support and confidence thresholds.
For Example: Market Basket Analysis of shopping mall dataset.</td></tr>
<tr><td>4</td><td>Mini Project
Using Data mining functionalities covered in the assignments and Data Mining and Warehouse theory course, design and develop an application/Decision Support System for the selected problem statement. Visualize the results using suitable tools and methods.
For Example: Health Care Domain for predicting disease, Shopping mall application for Market Basket Analysis. (Decision Tree/ KNN/ Apriori techniques can be used or algorithms may be modified and used).
Students should develop an application in the group of 3-4 students and submit the project report which will consist of documentation related to project design.</td></tr>
</table>

	A Mini Project in this course should facilitate Project Based Learning among students.

Reference Books:

1. Jiawei Han, Micheline Kamber, “Data mining: concepts and techniques", Morgan Kaufmann Publisher 2012, third edition, ISBN 978-0-12-381479-1.
2. G. K. Gupta, “Introduction to Data mining with Case Studies", PHI Learning Private Limited 2014, Delhi, third edition, ISBN-978-81-203-5002-1
3. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packet Publishing Ltd. 2017, ISBN: 978-1-78588- 962-2
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly Media, Inc. publisher 2017, ISBN: 9781491962299.
5. Ian H. Witten and Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Second Edition, Morgan Kaufmann Publishers 2005, ISBN: 0-12-088407-0.

Web references:

1. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
2. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/DataMining/Witten_and_Frank_Data Mining_ Weka_2nd_Ed_2005.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets
6. http://scikit-learn.org

OR

Part II: Information & Cyber Security

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.
4. Recommended Tools for the implementation of above assignments: Python, R, Jupyter Notebook etc. Use of Anaconda platform is encouraged.
5. Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.

Note:

- Instructor should maintain progress report of assignments and mini project throughout the semester from project group and assign marks as a part of the term work
- Oral examination will be on the Solution Proposed in Mini Project and Security Concepts used in the laboratory assignments.
- Mini Project in this course should facilitate Project Based Learning among students.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Write a program to implement Playfair Cipher and write a conclusion on the strength of playfair cipher.
2	Write a program to implement Simplified Data Encryption Standard (SDES) Algorithm and write a conclusion on the strength of SDES.
3	Write a program to implement RSA Algorithm and write a conclusion on the strength of RSA Algorithm.
4	Write a program to implement Diffie-Hellman Key Exchange Algorithm and write a conclusion on the strength & usefulness of Diffe-Hellman Algorithm.
5	Using the Security concepts covered in Information & Cyber Security Theory course and assignments covered in Group A above, analyze the security requirements of any organization and provide solution with following details: • Student should develop an application in group of 2-3 students • Analyze the security requirements of any organization and provide solution and implement the system • Use the existing algorithms or modified algorithms (by Proposing the modifications in existing algorithms in order to increase the strength of algorithm) Document the findings and analysis in the analysis report preferably in IEEE Research Paper format

Reference Books:

1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN: 978-93-325-1877-3
2. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN: 978- 0-07-064823-4

OR

Part III: Web Technology

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

1. For mini project, select a real-world application in the group of 3-4 students and formulate a problem statement for application to be developed.
2. Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.

Suggested List of Assignments	
Assignment No.	**Assignment Title**
1	Installation and Configuration of Web Servers Apache Tomcat,XAMPP, WebSphere, Jboss, Glassfish and use of Integrated Development Environment.
2	Design any 4 page static website using HTML and CSS/Bootstrap.
3	Design and implement a simple calculator using JavaScript.
4	Write a Servlet program to create and manage the session and cookies.
5	PHP program to create simple Login and Logout using sessions.
6	**Mini Project:** Create Static/Dynamic web application using Content management systems like Wordpress/Joomla/Drupal. Sample case study: Write a blog / e-commerce site / calendar / to-do site or any site which needs updates frequently.

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Robert W. Sebesta, "Programming the World Wide Web", 4th Edition, Pearson education, 2008.
3. Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
4. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13: 9788126538676

Reference Books:

1. Marty Hall, Larry Brown, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978- 0130897930.
2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, "The web Warrior Guide to Web Programming", Thomson, 2003.
5. Adam Bretz & Colin J Ihrig, "Full Stack JavaScript Development with MEAN", SPD, ISBN-13: 978-0992461256
6. Giulio Zambon, "Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10: 1430246235; ISBN-13: 978- 1430246237
7. Jeremy McPeak& Paul Wilton, "Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937
8. Robin Nixon, "Learning PHP, MySQL and JavaScript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3

Group B

Part IV: Computer Graphics and Gaming

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of prologue, certificate, table of contents and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithm, sample input and expected output, conclusion).

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with

appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness

Guidelines for Laboratory Conduction

1. All assignments are mandatory.
2. Assignments on all concepts covered in Group A and Group B are mandatory and should be implemented on mentioned tools/ platforms.
3. Use of open-source software such as OpenGL is to be encouraged.
4. Operating System recommended: - 64-bit Open-source Linux or its derivative.
5. Programming tools recommended: c++/java.

Suggested List of Assignments

Assignment No.	Assignment Title
1	a) Write C++/java program to draw a house and perform following basic transformations. i) Scaling ii) Translation iii) Rotation. or b) Write C++/java program to perform following basic transformations on 3D Cube. j) Scaling ii) Translation iii) Rotation
2	a) Write C++/Java program to fill the above patterns mentioned in assignment 1 with desired color using Seed fill algorithm. or b) Write C++ to fill the above patterns mentioned in assignment 1 with desired color using scan fill algorithm.
3	a) Write C++/Java program to implement Cohen-Sutherland line clipping algorithm. or b) Write C++/Java program to implement Cohen Sutherland Hodgman algorithm to clip any polygon
4	a) Create Bouncing ball animation using Direct3D/Maya/Blender. or b) Create an armature (skeleton) for a character and ring it using blender.
5	Create game/animation clip using OpenGL/Animation tool like Maya/Blender/3D Studio.

Reference Books:

1. Donald Hearn and M. Pauline Baker, Computer Graphics, Pearson Education India.

Web Reference:

1. https://www.blender.org/support/tutorials/
2. https://3dtotal.com/tutorials/3ds-max.
3. https://www.animationmentor.com/tutorials/free-maya-basic-animation-tutorials.html
4. https://www.udemy.com/course/3d-animation-with-blender/

OR

Part V: Wireless Sensor Networks

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.

2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness

Guidelines for Laboratory Conduction

1. For mini project, select a real-world application in the group of 3-4 students and formulate a problem statement for application to be developed.
2. Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.
3. Student should compulsorily perform any 4 assignments out of first 5 assignment. 6th assignment is mandatory to perform.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Create a network using configuration of a Wi-Fi adapter and Access Point. Send data from one client to another.
2	Write a program to measure room temp. using temp. Sensor. Display temp. on a kit/device/monitor.
3	Write a program to control room light (on/off) using sensors in presence/absent of human being in room.
4	Simulate the performance of DSDV, AODV and DSR routing protocols over the WSN.
5	Installation and configuration of WSN using ZigBee protocol.
6	Set up a small wireless sensor network of few nodes and show communication between two nodes using any relevant open-source simulation tool. (Project based Assignment)

Reference Books:

1. Dipankar Raychaudhari, Mario Cerla, “Emerging Wireless Technologies and the Future Mobile Internet”, Cambridge University Press, ISBN-13: 978-1-107-67864-4(Paperback)
2. Robert Faludi, “Wireless Sensor Networks”, O'REILLY, ISBN 13: 978-93-5023-289-7

OR

Part VI: Management Information System

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness

Guidelines for Laboratory Conduction

1. For mini project, select a real world application in the group of 3-4 students and formulate a problem

statement for application to be developed.
2. Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Case Study presentation on CRM functionalities and components with example.
2	Case Study presentation on SCM functionalities and components with example.
3	Case Study presentation on ERP functionalities and components with example.
4	Case Study presentation on DSS functionalities and components with example.
5	Case Study presentation on web-based MIS functionalities and components with example.
6	Study and presentation of latest research papers in area related to MIS.

Reference Books:

1. Kenneth C. Laudon & Jane P. Laudon, "Management Information Systems Managing the Digital Firm", Pearson Education Limited, 13TH Edition, ISBN: 978-0-13-305069-1, 2014
2. Stephen Haag and Maeve Cummings, "Management Information Systems for the Information Age", McGraw- Hill Companies, ISBN: 007337678, 2010.

Web Reference:

1. https://onlinecourses.nptel.ac.in/noc20_mg60/preview
2. Reading material from Harvard Business School Repository.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Statistical Data Analysis using R (OEC-2)					Code: BAS5607	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Descriptive Statistics, Inferential Statistics, Probability
is essential.

Course Objectives:

1. This course aims at enabling the students to learn data collection, visualization, and preprocessing techniques for data science.

Course Outcomes:

After learning the course, the students will be able to:

1. **Understand** the data propertiesand **Identify** theR packages related to data science.
2. **Make use of** data preprocessing methods and generate quality data for analysis.
3. **Apply** different data visualization techniques to understand the data.
4. **Analyze**the data using analytical methods for regression for numerical data using the R.
5. **Develop** a model for Prediction and Decision Making for a data set along with some of their characteristics, strengths, limitations, and applications.
6. **Construct** the hypothesis for the data and test it for data set in R.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to data analysis and R Software fundamentals** Understanding the Data, R Packages for Data Science, Importing and Exporting Data in R Software, Getting Started: Analyzing Data in R Software, Accessing Databases with R Software.	07
II	**Data Wrangling** Pre-processing Data in R Software, Dealing with Missing Values in R Software, Data Formatting in R Software, Data Normalization in R Software, Binning in R Software, Turning categorical variables into quantitative variables in R Software.	08
III	**Data Visualization in R Software** Histogram, Bar/ Line Chart, Box Plot (including group-by option), Scatter Plot (including 3D and other features), Mosaic Plot, Heat Map, Correlogram (GUIs)	08
IV	**Data Analysis** **Statistical Data Analysis:** Probability, Sampling & Sampling Distributions **Exploratory Data Analysis:** Central & Descriptive Statistics, Hypothesis Testing.	07
V	**Model Development** Linear regression and multiple linear regression, model evaluation using visualization, prediction and decision making	08
VI	**Data Analysis Using R** Use a dataset from kaggle (Link is given below). Identify the problem	

	statement for the given data and by applying data analysis techniques analyze the data. Draw inferences from the data. https://www.kaggle.com/code/cvaisnor/heart-2020/datahttps://www.kaggle.com/code/kailash068/crop-recommendation/datahttps://www.kaggle.com/datasets/debajyotipodder/co2-emission-by-vehicleshttps://www.kaggle.com/datasets/csafrit2/higher-education-students-performance-evaluation	**07**
Total		**45**

Reference Books:

1. Montgomery and Runger, "Applied Statistics and Probability for Engineers", Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, "Probability and Statistics for Engineers", Prentice India Ltd, 8 Edition, ISBN 13:978-8120342132.
3. S.P.Gupta, "Statistical Methods", Paper book publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Victor A. Bloomfield, "Using R for Numerical Analysis in Science and Engineering", CRC Press, First Edition, ISBN: 9781315360492

e-sources:

NPTEL Course lectures links:

1. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB (Probability)
2. https://nptel.ac.in/courses/111104100 (Introduction to R software)
3. https://www.youtube.com/watch?v=WbKiJe5OkUU&list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz (Descriptive statistics using R software)

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Total Quality Management (TQM) (OEC-2)					Code: BCI5602A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Quality and need of Quality in any work
is essential.

Course Objectives:

1. To understand the importance of Quality
2. To understand the need of Total Quality Mgmt& it's tools.
3. To understand role of ISO in quality management.

Course Outcomes:

After learning the course, the students will be able to:
1. Articulate quality and quality ideas as presented by many gurus and philosophers after learning.
2. Apply different quality control tools.
3. Apply ISO concepts and the cost of quality to quality assurance.
4. Apply various methods of TQM.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Quality in Construction** a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus(Juran, Deming, Crossby, Ishikawa). b) Evolution of TQM- QC, TQC, QA, QMS, TQM.	07
II	**TQM & Six Sigma** a) TQM – Necessity, advantages , Quality Function Deployment(QFD). b) Six sigma – Importance, levels.	08
III	**Cost of Quality and ISO** a) Categories of cost of Quality. b) Study of ISO 9001 principles., Quality manual – Importance, contents, documentation, Corrective and Preventive actions, Conformity and NC reports	08
IV	**Techniques in TQM Implementation** a) Benchmarking in TQM, Kaizen in TQM, b) '5-S' techniques, Zero Defects.	08
V	**Applications of Quality Control tools through Case study** a) Quality Circle Concept and applications through Quality Circle Formation b) Implementation of 7 QC tools through case study	07
VI	**Applications of Quality Control tools through Case study** a) Quality Circle Concept and applications through Quality Circle Formation b) Implementation of 7 QC tools through case study	07

Total	45

Text Books:

1. Total Quality Management-- Dr.Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.
3. Total Quality Management - Dr.S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference Books:

1. Juran's Quality Handbook – Juran Publication. (2016 Edition).
2. Management –Principal, process and practices by Bhat – Oxford University Press. (2008).
3. Financial management by Shrivastava- Oxford University Press (6th Edition 2022).
4. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd. (1993, with latest Edition).

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Intelligent Transport System (ITS) (OEC-2)					Code: BCI5602B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of

Fundamentals of Transportation and Traffic engineering, Transportation Planning and Designing **is essential.**

Course Objectives:

1. To identify all the aspects related to intelligent transportation system and its application
2. To use the fundamental concepts of transportation system management.
3. To nurture their necessary skills to develop their career in transportation industry.

Course Outcomes:

After learning the course, the students will be able to:

1. Describe the fundamentals and principles of Intelligent transport system and its background
2. Demonstrate the knowledge of telecommunication practices in Intelligent transport system
3. Distinguish the physical architecture and hardware composition in the implementation of Intelligent transport system
4. Implement the Intelligent transport system concepts in various transportation domains
5. Explain the user needs and services in the context of implementing effective strategies
6. Identify and evaluate the practical constraints in the implementation of the technology and the grass root level.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction:** Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection	07
II	**Telecommunications in ITS** Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Roadside communication – Vehicle Positioning System	08
III	**ITS architecture and Hardware** Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection	08
IV	**ITS Functional Area** Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).	07

V	**Intelligent Transport System User Needs and Services:** Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.	**08**
VI	**Case Studies:** Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.	**07**
Total		**45**

Text Books:

1. Ghosh, S., Lee, T.S.,"Intelligent Transportation Systems: New Principles and Architectures", CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, "Fundamentals of Intelligent Transportation Systems Planning", Artech House, Inc., 2003.

Reference Books:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, 1992.
3. Turban E.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
4. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987.

Standard Codes:

1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
2. Automotive Industry Standard by MoRTH, 2017 https://morth.nic.in/sites/default/files/Finalized_Draft_AIS_140_regarding_Intelligent_Transportation_Systems_.pdf

E-Resources:

1. https://nptel.ac.in/courses/105105204
2. https://archive.nptel.ac.in/courses/105/101/105101008/
3. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html
4. https://ocw.mit.edu/courses/1-212j-an-introduction-to-intelligent-transportation-systems-spring-2005/pages/lecture-notes/

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Smart City: An Electronic Perspective (OEC-2)					Code: BET5601	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Basic Electronics, Basics of electronic communications
is essential.

Course Objectives:

1. To explore the need and basics of smart city and fundamental concepts of IoT.
2. To comprehend the roles of sensors and protocols in the IoT
3. To explain different IoT frameworks and networking protocols.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the conceptual basis of a smart city.
2. Analyze physical and logical designs for IoT systems with communication protocols.
3. Analyze the different wireless communication protocols used in sensor networks.
4. Compare the features, addressing, packet fragmentation, operation, and security of the different wireless protocols.
5. Describe distributed intelligence and central planning in a smart city.
6. Interpret the role of ICTs in the development of smart cities using IoT applications.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Necessity of SMART CITY** The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework.	07
II	**Fundamentals of IOT** History of IoT, Introduction,definition and characteristics of IoT, architecture of IoT, Physical & logical design of IoT, Enabling technologies in IoT, Identifiers in IoT, M2M communication verses IoT.	08
III	**Sensor Networks** Definition, types of sensors & actuators, examples & working, RFID Principles and components, Wi-Fi, Bluetooth, etc. wireless sensor network: History, sensor node, networking nodes, WSN versus IoT.	07
IV	**Wireless Protocols for Smart Cities** IPv6overLow-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking Basics, Wireless Networking Assumptions, Bluetooth Low Energy, IoT data protocols: MQTT Protocol. COAP Protocol, AMQ Protocol.	08
V	**Distributed Intelligence and Central Planning** On the Interplay between Humans and Smart Devices, Intelligence-artificial	07

	Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamic and Algometry in Smart Cities.	
VI	**Applications of IoT in smart city: The Role of ICTs,** Applications in smart city & their distinctive advantages -smart environment, smart street light and smart water & waste management. Smart transportation and hospitality, Role and scope of IOT in present and the future marketplace, Industrial IoT.	**08**
Total		**45**

Text Books:

1. Surjeet Dalal ,VivekJaglan "Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges", CRC Press; 1st edition, 2021.
2. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT" Cambridge University Press 2021.
3. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN:978-1-84821- 140-7, Wiley Publications 2010.
4. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley Publications 2012.

Reference Books:

1. Vincenzo Piuri, Rabindra Nath Shaw, "AI and IoT for Smart City Applications", Springer; 1st ed. 2022 edition.
2. Alfredo Barton, Raymond Manning, "Smart Cities:Technologies, Challenges and Future Prospects" Nova Science Pub Inc 2017.
3. Ibrahim El Dimeery, Moustafa Baraka, Syed M. Ahmed, "Design and Construction of Smart Cities" Amin Akhnoukh, Springer; 1st ed. 2021 edition
4. Ricardo Armentano, Robin Singh Bhadoria , Parag Chatterjee , "The Internet of Things: Foundation for Smart Cities", eHealth, and Ubiquitous Computing" Chapman and Hall/CRC; 1st edition 2017
5. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN:978-1-118-47347-4,Willy Publications 2013.
6. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press 2017.

NPTEL Online Courses / MOOCs

1. NPTELcourse on Fundamentals of Electric vehicles: Technology & Economics, IIT Madras, Prof. Ashok Jhunjhunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannan
2. https://nptel.ac.in/courses/108106170
3. NPTEL course onElectric Vehicles - Part 1, IIT Delhi, Prof. Amit Jain https://nptel.ac.in/courses/108102121
4. NPTEL Archives on Electricvehicles and renewable energy, IIT Madras https://archive.nptel.ac.in/courses/108/106/108106182/
5. Electric Vehicles Comprehensive Course, Udemy.com https://www.udemy.com/course/electric-vehicles-comprehensive-course/

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Modeling and Simulation with MATLAB(OEC-2)					Code: BET5602	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Engineering Mathematics, Basics of OOPs
is essential.

Course Objectives:

1. To apply basic modeling techniques and tools to develop Simulink block diagrams.
2. To Model and simulate continues and discrete systems in Simulink.
3. To get acquainted with neural networks and its modeling.
4. To get acquainted with fuzzy set and its modeling.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the basic tools used in Matlab programming
2. Understand the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems.
3. Understand different types of simulation techniques.
4. Understand different optimization methods.
5. Simulate the models for the purpose of optimum control by using software.
6. Design and simulate the Fuzzy controllers to solve engineering problems.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Matlab:** Programming environment, input and output variables, State variables, basic syntax; Deterministic linear model, Array mathematics in Matlab, Plotting, Static and Dynamic systems; Hierarchy of knowledge about a system and Modeling Strategy.	06
II	**Physical Modeling:** Dimensions analysis, Dimensionless grouping of input and output variables of find empirical relations, similarity criteria and their application to physical models. Stochastic modeling	07
III	**Modeling of System with Known Structure:** Review of conservation laws and the governing equation for heat, mass and momentum transfer, Deterministic model: distributed parameter models in terms of partial identification and their solutions and lumped parameter models in terms of differential and difference equations, state space model, transfer functions block diagram and sub systems, stability of transfer functions, modeling for control.	08
IV	**Optimizations and Design of Systems:** Summary of gradient based techniques : Nontraditional Optimizations techniques, genetic Algorithm (GA)- coding, GA operations, elitism, Application using MATLAB: Simulated Annealing, Introduction to GUI,GUI	07

	Programming.	
V	**Introduction to Neural Network Modeling:** Basics of Neural Network, Neural Network Modeling of Systems only with Input-output Database: Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multilayer feed forward network and its back propagation learning algorithm, Application to complex engineering systems and strategy for optimum output.	**09**
VI	**Modeling Based on Expert Knowledge:** Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers, Simulation of Engineering Systems: Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems.	**08**
	Total	**45**

Text Books:

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2 nd Edition. Academic press 2000
2. Ogata K “Modern control Engineering" 3 rd edition. Prentice hall of India 2001
3. Jang J.S.R. sun C.T and Mizutani E,, "Neuro-Fuzzy and soft Computing ", 3 rd edition, Prentice hall of India 2002
4. Shannon, R. E., “System Simulation: the Art and Science”, Prentice Hall Inc. 1990
5. Pratab.R " Getting started with MATLAB" Oxford university Press 2009

Reference Books:

1. Steven I Gordon. Brian Guilfoos.“Introduction to modeling and simulation using MATLAB & Python” CRC press.
2. Dr.Shailendra Jain.” Modeling and simulation using MATLAB-Simulink “,2 ndEdition,Wiley

Online course link: https://in.mathworks.com/learn/training/simulink-fundamentals.html

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Industry 4.0 (OEC-2)					Code: BME5602A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Basic programming skills, Mathematical skills
is essential.

Course Objectives:

1. The concept of smart factories for future, especially the various technical pillars of the smart manufacturing.
2. The role and importance of each technical pillar involved within smart manufacturing.
3. The applications and scope for technological pillars involved in smart manufacturing.

Course Outcomes:

After learning the course, the students will be able to:

1. Apply the knowledge of PLC language for designing a PLC system for relevant application
2. Understand the key concepts and describe the technological pillars of Industry 4.0
3. Understand the role of cloud computing and how cloud computing is applied to protect cyber-physical systems in Industry 4.0
4. Apply the knowledge of sensors and robots for designing a system
5. Understand the role of simulation techniques and how these software tools used for advanced simulations in Industry 4.0
6. Understand the importance of hardware and software technologies used in AR and VR.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Industrial Revolutions** History of industrial revolution, Industry 3.0: Automation and Mechanization, Types of automation, features of hard and soft automation, classification of production system, adaptive control, overview of terminologies like CAD, CAM, CAE, CAPP etc., Introduction to PLC, framework, and design of PLC system.	09
II	**Introduction to Industry 4.0:** Introduction to industry 4.0, need for Industry 4.0, Framework for Industry 4.0, technological pillars of industrial 4.0, applications, challenges and scope for industry 4.0	06
III	**Technological developments in Industry 4.0:** Introduction to Smart Manufacturing, overview of big data and analytic techniques, cyber security, Internet of things (IoT), Industrial Internet of things (IIoT), Cloud computing, artificial intelligence.	08
IV	**Robotics and Sensors:** Introduction to technological components of Robot, classification of sensors and its applications in Manufacturing industry, Role of robots in Industry 4.0, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for	08

	Cyber-Physical Robotics	
V	**Simulation, Augmented Reality and Virtual Reality in Industry 4.0:** Introduction to simulation, methods for simulation of physical processes, interconnectivity using simulation software, Introduction to Augmented reality and Virtual reality, classification of AR and VR, Difference between AR and VR, Hardware and Software Technology for AR and VR, Applications of AR and VR	**08**
VI	**Ecosystem for Industry 4.0:** Economic aspects, opportunities and skills required for industry 4.0, Effects of 4-M Man, Machine, Material and Method in Industry 4.0, current state of industry 4.0 in India	**06**
Total		**45**

Text Books:

1. M. P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Pearson Publication, 2005
2. Lamb, Frank. Industrial Automation: Hands On, McGraw-Hill Professional, 2013.
3. W. Leong, Nine pillars of technologies for Industry 4.0, IET publishers, 2020
4. A. Gilchrist, Industry 4.0, Apress Publication, 2016

Reference Books:

1. C. Schröder, The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, 2021.
2. Chua C. K., Leong K. F., Lim C. S., Rapid Prototyping, World Scientific, 2012.
3. A. Nayyar and A. Kumar, A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development-Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-14544-6
4. K. Kumar, D. Zindani, J. P. Davim, Industry 4.0: Developments towards the Fourth Industrial Revolution, Springer Singapore, 2019.

Online Link/Courses:

1. **https://nptel.ac.in/courses/108105063**

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Safety, Health and Environment (OEC-2)					Code: BME5602B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Course Objectives:

1. To provide exposure to the students about safety and health provisions.
2. To create awareness on safety standards in residential, commercial and agricultural applications.
3. To help students to learn about Factory act 1948, Environment act 1986 and rules framed under the act.
4. To describe the chemistry of fire & explosion and select & use appropriate fire-fighting and explosion proof equipment,
5. To teach about various safety education and training.
6. Identify ergonomic hazards and recommend appropriate controls.

Course Outcomes:

After learning the course, the students will be able to:

1. Demonstrate the safety and ethical issues that may arise from industrial processes
2. Identify the safety standards in residential, commercial and agricultural applications
3. List out important legislations related to Health, Safety and Environment
4. Select a suitable method for prevention of fire and explosion.
5. Develop appropriate safety education and training program.
6. Analyze and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and select appropriate work systems.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Concepts and Techniques:** History of safety movement – Evolution of modern safety concept, safety survey, safety inspection, safety sampling. Safety Audits- Non-Conformity Reporting (NCR), audit checklist- identification of unsafe acts of workers and unsafe conditions in the industry.	07
II	**Safety in residential, commercial, agricultural, installation & Protective equipment:** Electricity, its Usefulness and Hazards, statutory Provisions, Indian Standards, Effects of Electrical parameters on human body, Safety measures for electric shock, portable electrical apparatus, Electric work in hazardous atmosphere.	08
III	**Factories Act – 1948 & Environment Act – 1986:** **Factories Act – 1948:** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Maharashtra Factories Rules 1963. **Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001. Air Act 1981 and Water Act 1974 -audit, penalties and procedures.	08
IV	**Fires and Explosions and concepts to prevent fires and explosions:** Fire triangle, Distinction between fires and explosions, Flammability	08

	characteristics of liquids and vapors, limiting oxygen concentration and inerting, Controlling static electricity, Explosion-proof equipment and instruments, Ventilation.	
V	**Safety Education and Training:** Importance of training-identification of training needs, methods – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – domestic Safety and Training.	**07**
VI	**Ergonomics at Work Place:** Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs.	**07**
Total		**45**

Reference Books:

1. Philip E. Hagan, John F. Montgomery, James T. O'reilly "Accident Prevention Manual for Business and Industry: Administration and Programs", 14th Edition, National Safety Council, Illinois, Chicago, 2015.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
3. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Principles of Management (HSMC-5)					Code: BHM5113	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	10	20	20	50

Course Objectives:

1. To help the students gain understanding of the functions and responsibilities of managers and common frameworks used in business organizations.
2. To enable the students to analyze and understand the environment of the organization.
3. To provide them tools and techniques to be used in the performance of the managerial job.

Course Outcomes:

After learning the course, the students will be able to:

1. **Understand**the concept of Management and Strategic Management with their implications.
2. **Identify**the importance of human resource in every organization.
3. **Apply** necessary skills to incorporate innovative management in various business sectors.
4. **Analyze** organizational ecology in various business domains.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Management & Strategic Management** Concepts of Management, Definition of Management; Evolution of Management Thought: - Introduction to Scientific Management and Administrative Management, Is Management an Art, Science or Profession, Functions of Management, Levels of Management and Corresponding Skills, Four Roles of Manager, Concept of Strategic Management, Strategic Management Process, Vision and Mission, Contemporary Challenges faced by Management.	07
II	**Organizational Ecology** : Concept & Definition of Organization, Organization and its Characteristics, Types of Business Organizations, Concept of Business Environment, Internal Factors of Business Environment, SWOT Analysis and PESTLE Analysis, Adapting to the Change in Environment, Assessing Success in Organization and Managing Change, Competitive Dynamics with examples. Case studies based on Business Environment	07
III	**Organizational Design and Leadership**: Concept of Organization Design, Process of Organizational Design, Types of Organizational Design : Traditional and Contemporary Organizational Designs, Concept of Organizational Development, Process of Organizational Development, Concept of Organizational Culture, 4 Types of Organizational Cultures & their influences, Concept and definition of Leadership, Leader and Manager, Types of Leadership Styles.(Each concept to be explained with Case study / Examples)	08
IV	**Innovative Management**: Concept of Innovation, Creativity &Invention and its need. Concept and Definition of Innovative Management. Definition of Design Thinking, Stages in the Design Thinking Process, The Design Thinking Multi-	08

	Stage Model, What is the Difference between Project-Based Learning (PBL), Understanding by Design (UbD), and Design Thinking (DT). (Class Activity: Brain Storming on Innovative Management).	
Total		**30**

Text Books:

1. George R. Terry, Stephen G. Franklin; Principles of Management, A.I.T.B.S. Publishers

Reference Books:

1. Stephen Robbins, Organizational Behavior, New Delhi: Prentice- Hall, 2005
2. Veerabhadrappa and Havinal; Management and Entrepreneurship, New Age International Publishers, 2011
3. Chaudhary Omvir, Singh Prakash; Principles of Management, New Age International Publishers, 2011

e-sources:

1. https://nptel.ac.in/courses/122106031
2. https://www.coursera.org/learn/principles-of-management

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Programming with ASP .Net (Proficiency Course - 2)					Code: BCE5913	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	-	02	-	-	-	-

Prior knowledge of
C++ programming
is essential

Course Objectives:

1. To understand the basic concepts ASP.NET and its architecture.
2. To learn object-oriented Programming using ASP.NET
3. To learn and understand the concept of master pages.
4. To learn and understand publishing web application.

Course Outcomes:

After learning the course, the students will be able to:
1. Understand the ASP.NET programming concepts to implement programs.
2. Write programs using page redirection concepts.
3. Apply master pages concepts to write programs.
4. Use user control in ASP.NET.
5. Apply web configuration settings on web application.
6. Understand how to publish web application.

Suggested List of Assignments

Assignment No.	Assignment Title
1.	**Assignment based on following concept** ASP.NET Introduction & Controls: ASP.NET Architecture, First ASP.NET Application, Auto Postback Property, Event Handler Parameters, dynamically initializing Controls, IsPostBack property of Page class, ListControls, Comparison between HtmlControls and WebControls, Control Properties and Methods, FileUpload Control.
2.	**Assignment based on following concept** Redirecting User to Another Page: Redirecting Options, Response. Redirect, Server. Transfer, Cross Page Postback, determine how the pages was invoked, Passing values between pages.
3.	**Assignment based on following concept** Master Pages: Introduction to MasterPage, ContentPlaceHolder and Content tags, Accessing controls of MasterPage in ContentPage, URL's in MasterPages, UniqueID and ClientID.
4.	**Assignment based on following concept** Working with User Control: Overview of User Controls, creating a User Control, Adding Properties to User Control, Adding Events to User Control, Using User Control in Web Form, Rendering Clients Scripts Using Page, ClientScript methods.
5.	**Assignment based on following concept** WebConfiguration File and Global.asax : Introduction to Configuration files, Page setting in web.config, Custom Errors, URL Re-Writing, Tracing, Using ConfigSource Attribute, Using Location Section, HttpApplication class-Global.asax.

6.	**Assignment based on following concept** Understanding & Publishing Web Application, Introduction to ASP.NET Web Application, Advantagesof IIS Applications, creating web application in IIS, Converting File System application to IIS Application, Using Virtual Directory, Publishing ASP.NET Website, Culture specific formatting.

Text Books:

1. ASP.Net: The Complete Reference by Matthew MacDonald2.
2. Professional ASP.NET 4 in C# and VB by Bill Evjen, Scott Hanselman, Devin Rader

Program:	B. Tech. (Computer)					Semester: V	
Course:	Advanced Java Programming-I (Proficiency Course - 2)					Code: BCE5914	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	-	02	-	-	-	-

Course Objectives:

1. To understand the Java Collection Framework.
2. To learn Web Application, Web Container, Project Setup & JDBC connectivity.
3. To learn and understand the concepts of Servlets and Session Management.
4. To learn and comprehend Java Server Pages and Java Server Faces.
5. To learn REST API.

Course Outcomes:

After learning the course, the students will be able to:

1. Write Java programs using Java collection Framework.
2. Web application stack for developing Web Applications.
3. Design Web application using Servlets and JDBC.
4. Implement Web application using Java Server pages and JDBC.
5. Develop Web application using Java Server faces.
6. Design high end applications using REST API

Suggested List of Assignments

Assignment No.	Assignment Title
1.	**Java Collection Framework** Write a Java program to remove the third element from a array list/linked list/Sets.
2.	**Web Application, Web Container, Project Setup & JDBC** Web application, Web client and web server, client and server communication, HTTP protocol basics HTML language basics, TCP/IP port, URL? Need for a Web Container, JDBC Introduction, JDBC features JDBC, Drivers Setting up a database annd creating a schema, Writing JDBC code to connect to DB, CRUD Operations with JDBC, Statement types in JDBC, Types of Rowset, ResultSet in JDBC **Assignment Title: Installation, and Configuration of Server and Database**
3.	**Servlets and Session Management** Servlets Introduction, Need and Working, HTTP Methods; GET, POST, PUT, DELETE, TRACE, OPTIONS. GET/POST request; differences between the two, Servlet Lifecycle, Servlet Context and Servlet Config, Forwarding and Redirection of requests. **Assignment Title: Develop Servlet Application for Login page and demonstrate session using JDBC.**
4.	**Java Server Pages** Introduction to JSP and need for JSPs, Basic HTML tags, JSP Lifecycle, JSP Elements: Scriptlets Expressions, Declaration, Significance of above elements and fitment into the JSP Lifecycle, Directives in JSP, JSTL: JSP Standard Actions **Assignment Title: Develop Registration Form using JSP and JDBC connectivity.**

5.	**Java Server Faces** Life Cycle, Managed Beans, Components, Validations **Assignment Title: Implement Web Application using Java Server Faces**
6.	**Enterprise Java Beans** Entity Beans, Message Beans, and Session Bean **Assignment Title: Implement word count program using enterprise java beans.**

Text Books:

1. Java The Complete Reference, Ninth Edition, by Herbert Schildt, McGraw Hill Education
2. Head First Servlets and JSP, Kathy Sierra, Bryan Basham, Bert Bates, O'Reilly Media, Inc.

Web reference:

1. https://docs.oracle.com/en/java/
2. https://docs.oracle.com/javaee/6/tutorial/doc/docinfo.html
3. https://docs.oracle.com/javase/8/docs/technotes/guides/jdbc/

Program:	B. Tech. (Computer Engineering)			Semester: V			
Course:	Professional Development Training - I			Code: BHM5917			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	TW	PR	OR	Total
03	-	-	03	-	-	-	-

Course Objectives:

1. This course aims at enabling the students
2. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
3. To improve the overall professional development of students.

Course Outcomes:

After learning the course, the students will be able to:

1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills.
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Modern Maths** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	06
II	**Algebra** Linear equations, Quadratic equations, Triplets. Geometry Triangles, Polygons (questions on Area Perimeter).	06
III	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) Trigonometry Number System Statistics.	06
IV	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	06
V	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	06
VI	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	06

	Total	**36**

Reference Books:

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
4. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance.

Program:	B. Tech. (Computer Engineering)				Semester: V	
Course:	Emotional Intelligence (Audit Course - 2)				Code: BHM9963	
Teaching Scheme				Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	FA	SA	Total
01	-	-	01	-	-	-

Course Objectives:

1. To develop an awareness of Emotional Intelligence models.
2. To understand intelligence and develop emotional competence.
3. To understand how you use emotion to facilitate thought and behavior.
4. To know and utilize the difference between reaction and considered response.

Course Outcomes:

After learning the course, students will be able to:

1. Understand how to manage emotions, behaviour and self-control in any situation resulting in better productivity
2. Employ emotional intelligence competencies to effectively interact with people, colleagues and employees in building stronger relationships at work and at home
3. Articulate emotions using the right verbal and non-verbal language
4. Use tools to regulate their emotions and recognize and respond appropriately to emotions in self and others.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Emotional Intelligence (EI)** What is Emotional Intelligence, Emotional Intelligence and various EI models, The EQ competencies of self-regulation, motivation, empathy and interpersonal skills, Understand EQ and its importance in life.	03
II	**Self-awareness (SA):** Seeing the other side, giving in without giving up. **Tools:** Think, Feel, Act Cards, Plutchik's Wheel of Emotions& Emotional intelligence test **Self-Regulation/Managing Emotions:** The science of Emotions, Self-emotional quotient	03
III	**Gaining Control:** Use of Coping Thoughts and Relaxation Techniques to manage emotions, **Activities:** Be the Fog, Temperament Analysis. **Emotion recognition in others:** The universality of emotional expression, perceiving emotions accurately in others to build empathy **Activities:** Mindful Listening, Perceptual Positions	03
IV	**Emotional Intelligence at Work place** Importance of Emotional Intelligence at Work place, role of empathy and trust in relationships, building effective work relationships, conflict resolution strategy, Cohesive team building, **Tests:** My Colored Hat, ―I Am‖ Circle, Empathy Cards.	03

	Total	**12**

Text Books:

1. Daniel Goleman, ―Emotional Intelligence – Why It Matters More Than IQ,‖, Bantam, 10th Anniversary edition, 2005, ISBN: 978-0553383713
2. Steven C. Hayes, Spencer Smith, ―Get Out Of Your Mind And Into Your Life: The New Acceptance and Commitment Therapy‖, Read How You Want, [Large Print] edition, 2009, ISBN-13 : 978-1458717108

Reference Books:

1. Steven Stein, ―The EQ Edge‖, Jossey-Bass, 3rd edition, 2011, ISBN-13: 978-0470681619
2. Drew Bird , ―The Leader‘s Guide to Emotional Intelligence, Createspace Independent Pub, Kindle Edition, 2016, ISBN-13 : 978-1535176002.

Program:	B. Tech. (Computer Engineering)			Semester: V		
Course:	Entrepreneurship Development (Audit Course - 2)			Code: BHM9964		
Teaching Scheme				Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	FA	SA	Total
01	-		01	-	-	-

Course Objectives:

1. To inspire students and help them imbibe an entrepreneurial and start-up mind-set
2. To develop and strengthen entrepreneurial quality among students.
3. To understand the abilities to become an entrepreneur.
4. To acquaint with legalities in product development, IPR, Trademarks, Copyright and patenting
5. To know the facets of Business plans, Entrepreneurial Finance.

Course Outcomes:

After learning the course, the students will be able to:

1. Develop an entrepreneurial mind-set by learning key skills such as product design, salesmanship, marketing and interpersonal skills.
2. Interpret their own business plan and analyse factors that contributed to the failure of a start-up
3. understand how to determine the best source of capital for a company and how to find revenue and expense assumptions
4. Understand the legalities in product development, IPR, Trademarks, Copyright and patenting

Detailed Syllabus

Unit	Description	Duration (H)
I	**Concept and Scope** Entrepreneurship as a career, Traits of Successful Intrapreneur/ Entrepreneur, why to become entrepreneur, Entrepreneurship Development Phases, Problem Solving and Ideation Process, Design Validation, Types of Start-ups	03
II	**Creating Entrepreneurial Venture** Sources of Innovation, methods of generating ideas, Prototype preparation and validation, Legal Issue, Private/Public Limited Company formation requirements, Intellectual Property Protection: Patents Trademarks and Copyrights, **Entrepreneurial Failure:** Case study of patterns, Early failures: good idea bad planning, False start, False positive, Late-stage failures: Speed trap, Cascading miracle, False confidence	03
III	**Business Plan Preparation** Sources of product for business: Feasible study, Ownership, capital, budgeting, Marketing plan for the new venture, steps in preparing marketing plan, Business Model Canvas (BMC), Financial plan- proforma income statements, Ratio Analysis.	03
IV	**Financial Modeling and Metrics** Spreadsheets, Benchmarks, Revenue assumptions, expense assumptions, Metrics customer Acquisition cost and life time model, Metrics viral coefficient, Funnel Analysis, **Entrepreneurial Finance:** venture capital, financial institutions supporting entrepreneurs, Lease Financing; Funding	03

	opportunities for Start-ups in India, Crowdfunding, Angel investing	
	Total	**12**

Text Books:

1. Kumar Arya, ―Entrepreneurship: Creating and Leading an Entrepreneurial Organization‖, Pearson Education India, First edition, 2012, ISBN-10: 8131765784; ISBN-13: 978-8131765784
2. S.S.Khanka, ―Entrepreneurial Development‖, S Chand and Company Limited, Revised 2012th edition, 2012, ISBN : 81-219-1801-4

Reference Books:

1. Taneja, Gupta, Entrepreneur Development New Venture Creation‖, Galgotia Publishing Company, 2nd edition. 2017, ISBN: 9788185989594
2. Charantimath, Poornima, ―Entrepreneurship Development and Small Business Enterprises‖ Pearson Education, 3rd edition, 2018, ISBN: 8177582607, 9788177582604
3. Blake Masters and Peter Thiel, ―Zero to One‖, Plata Publishing, 2nd edition, 2014, ISBN-10: 9780804139298 - ISBN-13: 978-0804139298

Program:	B. Tech. (Computer Engineering)				Semester: V	
Course:	Research Article Writing (Audit Course - 2)				Code: BHM9965	
Teaching Scheme				Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	FA	SA	Total
01	-	-	01	-	-	-

Course Objectives:

1. To understand about how to write effective research article
2. To create awareness about grammar, lexical choices, citations in the text
3. To develop a full-length article, proposal or conference presentation
4. To familiarize the basic methods and techniques of research writing.

Course Outcomes:

After learning the course, students will be able to:

1. Understand necessary traits to write effective research article with appropriate grammatical and lexical choices in text
2. Comprehend the importance of citations, indexing, indexed articles and plagiarism.
3. Develop an ability of critical thinking necessary to analyse a research report.
4. Write a research article, review article, thesis chapter and other related academic research text effectively and demonstrate importance of revising and proofreading for writing research article.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Research Writing** What is a research article? Understanding what is 'Research Writing', Qualities and skills required in a Research writer, Types of Research writing, choosing a suitable journal/conference/book chapter, how to conduct an effective Research, Abstract Writing, Selection of keywords, defining problem statement.	03
II	**Sources of citations**: Understanding of giving citation to other works, identifying relevant citations, understanding impact factor, Importance of Indexing and Indexed articles, learning to scan research articles quickly and effortlessly, Using Your Sources Wisely**:** what to cite, where to find good sources and how to use them, avoiding plagiarism **Plagiarism tools**: iThenticate, Grammarly **Citation Tools:** Mendeley, BibMe, Citefast, APA, MLA	03
III	**Drafting**: Structure of a basic research paper, stages of writing and research, learn to write the first draft, Understanding the components of an article: Abstract, Introduction, Preliminary concepts, proposed system, Experimental section, result analysis and discussion, Conclusion, Reference.	03
IV	**Revising and Editing:** Importance of revision, Understanding the comments of reviewer, Point-to-Point address of reviewer comments, What/Whatnot to revise, Emphasis on Journal formats, Proper usage of Grammar and sentence formatting, Steps for submitting the revised manuscript/article	03

	Total	**12**

Text Books:

1. Charles A. MacArthur, ―Handbook of Writing Research‖, The Guilford Press; 2nd edition, 2016, ISBN 10: 1462529313, ISBN-13: 978-1462529315
2. 2. Margaret Cargill, Patrick O'Connor, ―Writing Scientific Research Articles‖, Wiley-Blackwell, 2nd Edition, 2013, ISBN: 978-1-118-57070-8

Reference Books:

1. Booth W., Colomb G. and Williams J., ―The Craft of Research, University of Chicago Press,4th edition, 2016, ISBN-13: 978-0226239736
2. Jennifer Peat, Elizabeth Elliott, Louise Baur, Victoria Keena ,―Scientific Writing Easy when you know how‖, Wiley & Sons, Inc, 2nd edition, 2013, ISBN:9780727916259

Course Syllabus

TY B Tech Semester - VI

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Operating Systems					Code: BCE6414	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Computer Organization, Data Structures and Algorithms
is essential.

Course Objectives:

1. To provide a grand tour of the major components of operating systems.
2. To introduce the notion of a process, threads and CPU scheduling
3. To explore inter process communication mechanisms, to introduce the critical-section problem and solutions which can be used to ensure the consistency of shared data.
4. To develop a description of deadlocks and a number of different methods for handling deadlocks in a computer system.
5. To explore various techniques of allocating memory to processes and explain the concepts of demand paging, page-replacement algorithms.
6. To describe the details of implementing local file systems and directory structures.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend the components and services of operating systems
2. Compare various process scheduling algorithms for a given snapshot of the system.
3. Analyze IPC mechanisms and solutions of process synchronization for critical section problems.
4. Identify a deadlock for a given system snapshot.
5. Analyze the performance of memory management algorithms for a given problem.
6. Apply disk scheduling policies for a given I/O request sequence with file management concepts.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Operating Systems** Introduction to Operating systems, Evolution of OS, Types of OS, Operating system components, O.S. Services, system calls. **System programs:** compiler, linker, loader.	**08**
II	**Process Management:** Process Concept- Process states, Process control block, Threads- Introduction, Multithreading Models, POSIX / pthreads **Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms.	**08**
III	**IPC and Process Synchronization:** Inter process Communication mechanisms: Pipes, Shared memory, Message passing **Process Synchronization:** Introduction, Critical-Section Problem, Hardware Support for Synchronization, Mutex Locks, Semaphores, Synchronization problem: Reader-writer, producer- consumer problem, Dining Philosophers problem.	**08**
IV	**Deadlocks:** Introduction, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from	**08**

	Deadlock.	
V	**Memory Management** Memory management: Introduction, Contiguous and non-contiguous, Swapping, Memory Allocation Strategies, Paging, Segmentation, Virtual Memory: Background, Demand paging, Page Replacement Policies, Thrashing.	**07**
VI	**I/O Management** File Management: Concept of Files and Directories, File-System Structure, File-System Implementation, Directory Implementation, File Allocation Methods, Free-Space Management. Disk Scheduling-Disk Scheduling policies like FIFO, SSTF, SCAN, C-SCAN. Case study: xv6 Operating System	**06**
Total		**45**

Text Books:

1. Silberschatz, Galvin, Gagne, "Operating System Principles", 10th Edition - 2018, Wiley, ISBN 978-1-118- 063330
2. Stallings W., "Operating Systems- internals and design principles", 9th Edition-2018, pearson, ISBN-13: 978- 013-467-0959.

Reference Books:

1. Dhamdhere D., "Systems Programming and Operating Systems", Revised 2nd Edition- 2009, McGraw Hill, ISBN-13: 9780074635797
2. Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 4th Edition-2015. ISBN-13: 978-0133-591620
3. H.M. Deitel, P. J. Deitel, D. R. Choffnes, "Operating Systems ", Pearson, 3rd Edition, ISBN 0131828274, 97801318282.

Web references:

1. https://pdos.csail.mit.edu/6.828/2018/xv6/book-rev11.pdf

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Operating Systems Laboratory					Code: BCE6415	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
04	-	02	04	25	-	25	50

Prior knowledge of
Theory of Computation, Data Structures and Algorithms
is essential.

Course Objectives:

1. To learn and understand data structures used in design of operating systems.
2. To understand functions of operating system.
3. To learn and understand process, resource and memory management.

Course Outcomes:

After learning the course, the students will be able to:

1. Use the system calls related to process management for Linux commands
2. Implement process scheduling algorithms
3. Develop the solutions for synchronization problems
4. Implement memory management algorithms.
5. Simulate the deadlock management technique for deadlock avoidance.
6. Implement Disk scheduling algorithms for I/O management.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, Index, and handwritten write-up of each assignment. Each assignment write-up should have Title, Objectives, Theory- Concept in brief, Algorithm/Flowchart, Test cases, Conclusion.
2. Program codes with sample output of all assignments are to be submitted in softcopy.

Guidelines for Laboratory /Term Work Assessment:

1. Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student.
2. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality ect.

Guidelines for Practical Examination:

1. Problem statements must be decided jointly by the internal examiner and external examiner.
2. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students.

Guidelines for Laboratory Conduction

1. Set of suggested assignments are provided for reference. Lab instructors may design the assignments with variations or suitable updations if required.
2. Operating System recommended: 64-bit Open-source Linux or its derivative.
3. Programming tools recommended: Open-Source/C/C++/JAVA.

Suggested List of Assignments	
Assignment No.	**Assignment Title**
1	Write a program to simulate use of Linux commands like cp, grep with the usage of fork () and exec () system calls. Also show the usage of wait (), getpid () and exit () system calls.
2	Write a program to implement scheduling algorithms – FCFS, SJF, Round Robin and Priority
3	Write a program to simulate inter process communication mechanism using pipes and redirection.
4	Write a program using pthreads to demonstrate the reader writer synchronization problem. Implement appropriate synchronization. Show the different results with and without synchronization
5	Write a program to implement Banker's Algorithm for deadlock avoidance.
6	Write a program to simulate memory allocation techniques: First Fit, Best Fit, Next Fit and Worst Fit.
7	Write a to implement paging replacement algorithms: . FCFS a. Least Recently Used (LRU) b. Optimal algorithm
8	Write a program to implement disk scheduling algorithms FIFO, SSTF, SCAN, C-SCAN

Text Books:

1. Silberschatz, Galvin, Gagne, "Operating System Principles", 10th Edition- 2018, Wiley, ISBN 978-1-118- 063330
2. Stallings W., "Operating Systems", 9th Edition-2018, pearson, ISBN-13: 978-013-467-0959.

Reference Books:

1. Dhamdhere D., "Systems Programming and Operating Systems", Revised 2nd Edition- 2009, McGraw Hill, ISBN-13: 9780074635797
2. Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 4th Edition- 2015. ISBN- 13: 978-0133-591620

Web references:

1. https://pdos.csail.mit.edu/6.828/2018/xv6/book-rev11.pdf

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Skill Development Lab - I					Code: BCE6416	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
04	-	02	04	25	-	25	50

Prior knowledge of
Computer Networks, Database Management Systems
is essential.

Course Objectives:

1. To understand the methodologies of web applications development process.
2. To apply client and server-side technologies
3. To develop current client side and server-side frameworks.
4. To use current tools used for web application developments.

Course Outcomes:

After learning the course, the students will be able to:

1. Construct UI interface for web applications.
2. Apply client-side scripting for web applications.
3. Demonstrate dynamic web-based application using server-side programming.
4. Demonstrate web applications using web frameworks.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of prologue, certificate, table of contents and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, Conclusion/Analysis).

Guidelines for Laboratory /TW Assessment

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality, and neatness.

Guidelines for Laboratory Conduction

1. All assignments are compulsory.
2. Students are expected to work in groups of 3 to 4 for mini project.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Construct a suitable static web application using HTML and CSS and Bootstrap. Use and configuration of Web Server. (Apache Tomcat)

2	Perform the user data validations. (Name, Password, Phone, Email, Address etc.) using JAVAScript/JQuery.
3	Write a XML schema to describe and validate the XML data.
4	Demonstrate the use of arrays by creating a PHP web page e.g. Create an indexed array of 20 elements (e.g. employee_name) and search whether a given name exists in the array.
5	Create a webpage using PHP to demonstrate the Inheritance concept such as: to create a Class shape and its subclass triangle, square and circle and display area of the selected shape.(use the concept of Inheritance) Display menu(use radio button) a) Triangle b) Square c) Circle
6	Design Employee Registration form and store and retrieve the data using PHP and MySql.
7	Implement the login and logout web application to handle the session management using session and cookies. (PHP)
8	Install Ruby Environment Setup and Write a Ruby program which accept the user's first and last name and print them in reverse order with a space between them.
9	Write a Ruby Script to send an Email to a specific User.
10	Design and develop mini project based on real life problems which comprises any one stack from above.

Text Books:

1. Achyut Godbole & Atul Kahate, “Web Technologies: TCP/IP to Internet Application Architectures”, McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
2. Ralph Moseley & M. T. Savaliya, “Developing Web Applications”, Wiley publications

Reference Books:

1. Web Technologies: Html, Javascript, Php, Java, Jsp, Xml And Ajax,Black Book: Kogent Learning Solutions

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Technical Seminar - 2					Code: BCE6417	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	-	-	25

Course Objectives:

1. To apply the knowledge and skills for understanding realistic problem.
2. To review of literature for project work from appropriate sources such as books, manuals, research journals and from other sources, and in turn increase analytical skills.
3. To emphasizes learning activities that are long-term, Collaborative learning, interdisciplinary.
4. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes:

After learning the course, the students will be able to:

1. Identify and define the real life engineering problem from societal need point of view.
2. Develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem from technical perspective.
3. Choose and compare alternative approaches with the help of literature survey to select most feasible one.
4. Demonstrate Collaborative learning, Interpersonal Skills, Meta cognitive skills through different seminar activities.
5. Prepare good quality technical reports based on the selected problem statement.
6. Test and evaluate the model results to develop a probable solution.

Guidelines for Students:

1. Seminar is one of the significant contributory team works that has to be completed based on the required number of credits as per academic regulations.
2. It is necessary to explore the domain of interest / research/ thrust area/ society needs.
3. **Seminar teams**: 3-4 students can form a team within the same or different discipline and their area of interest is to be registered with seminar Coordinator.
4. Finalization of Problem statement for implementation as project statement and base model implementation.
5. **Selection of Seminar Topic:**
    a. Student shall identify the area or topics in recent trends and developments in consultation with seminar guide or industry or any research organization.
6. **Guide Allotment:**
    a. Considering registered teams' area of interest/domain and expertise of guide, the Seminar coordinator in consultation with **panel of experts** allots Seminar guides.
    b. Guide should be allotted from the **same program**.
    c. **In case of interdisciplinary Seminar**, along with the guide from same program, co-guide should be allotted from the other program
7. Teams in consultation with guide will prepare Seminar **Synopsis.**
8. **Seminar Review:**
    a. The Seminar coordinator with the Head of the department shall constitute a review committee comprising of domain experts and senior faculty members.

b. The review committee will approve the Seminar group and title. Discussion / presentation
c. may be arranged covering topics listed in the synopsis.
d. The seminar Review committee will evaluate the timely progress of the projects.
e. Student with group members is expected to appear for minimum three reviews as per the seminar calendar.
f. Attendance for all 3 reviews is mandatory.

9. Student will be evaluated thrice in the semester based on seminar evaluation guidelines/Rubrics asfollows:

Sr. No.	Review	Rubrics
1	Review-1 (10 Marks)	1. Novelty, Innovation and Relevance of the topic - Societal relevance, possible topic leading to patenting / multidisciplinary 2. Scope, Feasibility, and objectives for the topic
2	Review-2 (20 Marks)	1. Design of System Architecture 2. Status of base model implementation (50% expected) followed by model testing and evaluation. 3. Presentation Skills 4. Regularity & Team work
3	Review-3 (20 Marks)	1. Status of base model implementation (100% expected) followed by model testing and evaluation. 2. Documentation and Originality of the content 3. Paper publication/I PR/Participation in various contests/ Awards / Consultancy/ sponsored project 4. Technical Knowledge
Total- (50 Marks)		Scaled down to (25 marks)

10. Report:

a. Report should be prepared as per the template provided by the department.
b. Seminar reports shall be submitted in softcopy form/ (Hard bound reports could be avoided).
c. In case of Interdisciplinary Seminar, students must submit Completion certificate with signature **of Co-Guide from another department.**

11. Technical Seminar 2 Outcomes:

a. Student seminar team shall divide topic into sub topic and individually work on sub topic and perform literature survey.
b. Finalization of Problem statement for implementation as project statement and base model implementation.

Seminar Work syllabus guidelines:

- The student is expected to complete the Seminar2 work which will consist of selection of Domain Selection, Topic Identification, Finalization of sub topics for each student in group literature review, Problem Statement finalization, Base model implementation.
- The student shall prepare and submit the report of Seminar work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide (Internal External (in case of sponsored project)/ Co-Guide (in case of interdisciplinary project)) and head of the Department/Institute.

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Machine Learning (PEC-3)					Code: BCE6508	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Database Management Systems, Data Mining, and Engineering Mathematic
is essential.

Course Objectives:

1. To introduce different machine learning primitives.
2. To introduce different feature selection techniques to prepare training and testing data set
3. To solve regression problems using regression techniques.
4. To develop skills to understand nature of the problem and apply machine learning algorithm
5. To develop classifier model using classification algorithms
6. To interpret the model results and analyze the accuracy of the model.

Course Outcomes:

After learning the course, the students will be able to:

1. Use different data preprocessing techniques to prepare training and testing data set.
2. Solve real world problems using regression algorithms and improve the model performance
3. Apply classification and clustering algorithms to solve real world problems.
4. Evaluate the performance of the model using different performance metric.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Machine learning** Introduction to Machine learning, Machine Learning approaches- Supervised Learning, Unsupervised Learning and Reinforcement Learning, Important Elements of Machine Learning- Data formats, Underfitting and Overfitting, Creating training and testing datasets, Feature Selection and Filtering, Principal Component Analysis (PCA)	**06**
II	**Linear Regression** **Linear regression**- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Robust regression with random sample consensus, Stochastic gradient descendent algorithms, Finding the optimal hyper- parameters through grid search, Basics of polynomial regression.	**08**
III	**Supervised and Un Supervised Learning** **Logistic regression-**Linear classification, Logistic regression, **Decision Trees**- Impurity measures, Decision Tree Classification, Random Forest, **Ensemble Learning**: Bagging, Boosting. **Clustering -** K-means, finding optimal number of clusters using Elbow method.	**08**
IV	**Classification and Performance Metrics** **Naive BayesClassifiers:** Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes. **K Nearest Neighbor**Classifier, Distance-Weighted KNN.	**08**

	Metrics for Evaluating Classifier Performance, Confusion Matrix, Evaluating the Accuracy of a Classifier: Holdout Method and Cross-Validation, ROC Curve	
Total		**30**

Text Books:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Ltd. 2017, ISBN 978-1-78588-962- 2
2. Jiawei Han, Micheline Kamber, "Data mining: concepts and techniques", Morgan Kaufmann Publisher 2012, third edition, ISBN 13: 978-1-55860-901-3.

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI second edition-2013, ISBN: 978-0-262-01243-0
2. Tom Mitchell, "Machine Learning" McGraw Hill Publication 1997, ISBN: 0070428077
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly Media, Inc. publisher 2017, ISBN: 9781491962299.

Web references:

1. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
2. https://www.cin.ufpe.br/~cavmj/Machine%20-%20Learning%20-%20Tom%20Mitchell.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Fundamentals of Blockchain (PEC-3)					Code: BCE6509	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Basics of Cryptography and Information Security
is essential.

Course Objectives:

1. To explain basic components of a Blockchain, its operations, underlying algorithms, and essentials of trust
2. To provide the fundamental cryptographic base for Blockchain.
3. To make students familiar with the working of Smart Contracts
4. To provide a detailed understanding of workings of a blockchain, its transactions, blocks and mining.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend the fundamental characteristics of Blockchain.
2. Apply the basic cryptographic primitives essential for Blockchain.
3. Compare the private and public Blockchain.
4. Analyze the working of Smart Contracts for verification or execution of agreement.
5. Apply appropriate distributed consensus algorithms for the real life problem.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Blockchain** Introduction to decentralized system, History, Conceptualization, Architectural principles behind Blockchain, Characteristics of Blockchain. Mining strategy.	06
II	**Basic Crypto Primitives** Hashing, public key cryptosystems, **Types of Blockchains:** private vs public Blockchain, Blockchain protocol and use cases, Hash puzzles.	08
III	**Distributed Consensus** Consensus approach, Consensus elements **Consensus Algorithms:** Proof of Work, Byzantine General problem, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn.	08
IV	**Smart Contracts and Ethereum** History, Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. P2P network in Ethereum, consensus in Ethereum, scripts in Ethereum. Developing and executing smart contracts in Ethereum. State and data structure in Ethereum.	08
Total		**30**

Text Books:

1. Artemis Caro, “Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency”, Kevin Wolhuter, 2021, ISBN: 1922590061, 9781922590060
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O'Reilly Media, Inc.2017, ISBN: 9781491954386.

Reference Books:

1. Mark Watney, Blockchain for Beginners: The Complete Step by Step Guide to Understanding Blockchain Technology”, CreateSpace Independent Publishing Platform, 2017, ISBN: 1548766887, 9781548766887
2. Alwyn Bishop, “Blockchain Technology Explained”, CreateSpace Independent Publishing Platform, 2018, ISBN: 9781986273800.

Web references:

1. NPTEL Course “Introduction to Block Chain Technology & Applications” https://nptel.ac.in/courses/106/104/106104220/
2. NPTEL Course on “Blockchain Architecture & Use Cases”https://nptel.ac.in/courses/106/105/106105184/

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Full Stack Development (PEC-3)					Code: BCE6510	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
SQL, Basics of Web Technologies
is essential.

Course Objectives:

1. To familiarize with the core concepts of frontend and backend programming.
2. To explore the latest web development technologies.
3. To get acquainted with NOSQL databases.

Course Outcomes:

After learning the course, the students will be able to:

1. Articulate the latest technological stack for web application development.
2. Apply concepts of Angular JS for web applications development.
3. Explore the concepts of Node.js and Express for web applications development.
4. Explore the features of NOSQL databases for designing data models.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to ANGULAR JS** Introduction, Features, Angular JS, Model-View-Controller, Expression, Directives and Controllers, AngularJS Modules, Arrays, Working with ng-model, Working with Forms, Form Validation, Error Handling with Forms, Nested Forms with ng-Form, Other Form Controls.	06
II	**Directives & Building Databases** Filters, Using Filters in Controllers and Services, AngularJS Services, Internal AngularJS Services, Custom AngularJS Services, Directives, Alternatives to Custom Directives, Understanding the Basic Options, Interacting with Server, HTTP Services, Building Database **Case Study:** App Development Using AngularJS	08
III	**Node JS and Express Framework** Introduction, Terminals, Editors, Building a Web server with Node, HTTP Module, Views and Layouts, Middleware, Routing, Form Handling with Express, Request and Response Objects, Handle Bars, Comments and Blocks. **Case Study:** App Development Using Node and ExpressJS	08
IV	**MongoDB** JSON and MongoDB, adopting a Non-relational Approach, Opting for Performance vs. Features, Running the Database Anywhere, Generating or Creating a Key, Using Keys and Values, Implementing Collections.	08
Total		30

Text Books:

1. Adam Freeman “ProAngular JS, Apress”, First Edition, 2014.
2. ShyamSeshadri, Brad Green “Angular JS: Up and Running: Enhanced Productivity with Structured Web Apps”, Apress, O'Reilly Media, Inc.
3. AgusKurniawan “AngularJS Programming by Example”, First Edition, PE Press, 2014.
4. David Hows, Peter Membrey, EelcoPlugge “MongoDB Basics”, Apress, 2014.
5. Ethan Brown, “Web Development with Node and Express”, Oreilly Publishers, First Edition, 2014.

Reference Books:

1. Brad Dayley “Learning Angular JS”, Addison-Wesley Professional, First Edition, 2014.
2. Steve Hoberman “Data Modeling for MongoDB”, Technics Publication, First Edition, 2014.
3. Kyle Banker, Peter Bakkum, Shaun Verch, Dough Garrett, Tim Hawkins “MongoDB in Action”, Manning Publications, Second Edition, 2016.
4. Evan M. Hahn, “Express in Action”, Manning Publications, First Edition, 2014.

Web references:

1. https://www.w3schools.com/whatis/whatis_fullstack.asp
2. https://www.geeksforgeeks.org/what-is-full-stack-development/
3. https://github.com/bmorelli25/Become-A-Full-Stack-Web-Developer

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Image and Video processing (PEC-4)					Code: BCE6511	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Matrix Operations and Binarization
is essential.

Course Objectives:

1. Application of point processing methods on digital image.
2. Application of spatial domain methods on digital image.
3. Application of image compression methods like RLE/Huffman coding and orthogonal transforms on digital image
4. Comprehension of the video processing basics.

Course Outcomes:

After learning the course, the students will be able to:

1. Apply point processing methods on digital image.
2. Apply spatial domain methods on digital image.
3. Apply the image compression methods like RLE/Huffman coding and orthogonal transforms on digital image
4. Comprehend the video processing basics.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Fundamentals of Image Processing** Basic steps of Image Processing System, Applications of Image Processing, Digital Image Acquisition: Sampling and Quantization, Basic relationship between pixels, Spatial domain image processing methods: point processing techniques: Image negation, Thresholding, gray level slicing,bit plane slicing, darkening and lightning of image.	08
II	**Spatial Domain Image Enhancement Techniques** Histogram processing: Image Histogram and Histogram Equalization, Mask processing methods, smoothing spatial filters (Low pass filter), Sharpening spatial filters (High pass filters), High boost filter, Gradient filters: Prewit, Sobel and Robert.	07
III	**Fundamentals of Image Compression** Types of redundancies: coding, spatial, temporal, Compression models: Lossy & Lossless, Lossless compression: Run length encoding (RLE) and Huffman coding, Lossy compression: Introduction to JPEG., Introduction to orthogonal transforms: Haar transform, cosine transform, significance of transforms, applying transform on image, inverse of transformed image.	08
IV	**Basic Steps of Video Processing** Introduction to Digital Video, Video frames: normal-key frames, concept of shots and scenes Time-Varying Image, Extraction of visual and audio parts	07

	from digital video, applying point and mask processing methods on video frames: Introduction to MPEG	
Total		**30**

Text Books:

1. Rafael.C,Gonzalez, Richard E Woods, "Digital Image Processing",4th Edition, Pearson India, ISBN:9353062985, 2018.
2. Jain A.K, "Fundamentals of Digital Image Processing", 4 Edition, Prentice Hall of India.

Reference Books:

1. B.Chanda, D. DuttaMajumder, "Digital Image Processing and Analysis", 2 nd Edition, Phi learning, *ISBN*- 978-81-203-4325-2, 2011.
2. William K Pratt, "Digital Image Processing", 4 Edition, Wiley, ISBN:9780471767770, 2006.

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Internet of Things (PEC-4)					Code: BCE6512	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of

Basic concepts of Computer Networks, Protocols stack in Computer Network, limitations of Computer Network

is essential.

Course Objectives:

1. To understand fundamentals of IoT including its reference architecture
2. To comprehend sensors, types of sensors and development boards
3. To provide detailed understanding of workings of various IoT protocols
4. To design and develop IoT systems for real time applications.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend fundamentals IoT building blocks and its enabling technologies
2. Analyze the challenges in IoT systems
3. Comprehend various development boards like Arduino and Raspberry-pi
4. Select appropriate sensors and development board for stated IoT problem
5. Implement interfacing of various sensors and actuators to the development boards
6. Use various IoT protocols for designing real time applications.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to IoT** Definition and characteristics of IoT, Technical building blocks of IoT, Physical design of IoT, Communication technologies, IoT enabling technologies (WSN, Cloud Computing, Big Data Analytics, RFID, NFC), IoT communication models, IoT communication APIs (Representational State Transfer (REST) API, Web Socket Based Communication APIs), IoT issues and challenges, IoT reference architecture, IoT applications.	**06**
II	**IoT Hardware** **Sensors:** Roles of sensors & actuators, Types of sensors, Active and passive, analog and digital, Contact and no-contact, Absolute and relative Working of Sensors: position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera. **Development Boards:** Types of boards - Arduino, Raspberry-pi, Interfacing of sensors with development boards.	**08**
III	**IoT Protocols** **PHY/MAC Layer:** Wireless HART, ZWave, Bluetooth Low Energy (BLE) Network Layer:6LoWPAN, RPL, COAP **Transport Layer and Application Layer:** CARP, XMPP, AMQP, MQTT	**08**

IV	**IoT Applications** Industrial IoT, IoT for smart cities, IoT in agriculture, IoT in Home automation, IoT in healthcare, IoT in remote monitoring.	**08**
Total		**30**

Text Books:

1. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0.

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0:0996025510, 13: 978-0996025515.
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN: 9781439892992
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011. ISBN: 978-3-642-19156-5
4. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1-118- 43063-7.

Web references:

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
3. https://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know-about-the-iot- right-now/

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Software Project Management (PEC-4)					Code: BCE6513	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	20	20	60	100

Prior knowledge of
Software Engineering
is essential.

Course Objectives:

1. Understand basics of software project management and its significance
2. Learn software project planning using CPM and PERT
3. Know resource scheduling in software project life cycle
4. Learn project cost estimation in software project life cycle
5. Learn project risk identification and mitigation in software project life cycle
6. Understand contemporary software project management concepts.

Course Outcomes:

After learning the course, the students will be able to:

1. Comprehend software project management concepts, viewpoints and significance
2. Prepare and analyze software project plans using CPM and PERT
3. Prepare and analyze resource scheduling in software project lifecycle.
4. Estimate the project cost in software project life cycle
5. Identify and mitigate project risk in software project life cycle
6. Comprehend contemporary software project management concepts.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction** What is a project, Project Management: the need, Systems approach to management, Project goal and project management benefits, The Person, the team, the methodology functions and viewpoints of management, Project viewpoint versus traditional management, evolution of project management, where is project management appropriate? Management by Project: A common approach, Different forms of project management: industrial, service and government.	06
II	**Advanced Project Network Analyses and Scheduling** Work Breakdown Structure (WBS), Project activities, Predecessor and successor activities, Network diagrams: (Activity on Arrow) AOA &(Activity on Node) AON, Do's and don'ts of drawing network diagrams, Project plan, Project schedule, Critical Path Method (CPM) and Time–Cost tradeoff, Variability of activity duration, Program Evaluation and Review Technique (PERT), Theory of Constraints (TOC) and Critical chain method, Introduction to Graphical Evaluation and Review Technique(GERT).	08
III	**Resource Scheduling, Cost Estimation and Budgeting:** **Resource Scheduling:** Allocating resources and multiple project scheduling, TOC method for allocating resources to multiple projects, Resource loading	08

	and leveling using CPM, Resource rescheduling in CPM **Cost Estimating and Budgeting:** Cost estimating, Cost escalation, System life cycle costs, Cost estimating process, Elements of budgets and estimates, Project cost accounting systems, Budgeting using control accounts.	
IV	**Risk, Contemporary and International Project Management:** **Project Risk Management:** Risk concepts, Risk identification, Risk assessment, Risk response planning, Risk tracking and response, Risk Mitigation, Monitoring and Management Plan(RMMM). **Contemporary Software Project Management:** Project Management Information Systems (PMIS), Web-enabled project management, Significance of informal communication, Project terminating and closeout. **International Project Management:** Problems managing international projects, Introduction to Capability Maturity Model (CMM) and People Capability Maturity Model (PCMM).	**08**
Total		**30**

Text Books:

1. John M. Nicholas, ―Project Management for Business and Technology: Principles and Practice, 2nd Edition, Pearson Education,2001
2. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Sixth Edition, Tata McGraw Hill, New Delhi, 2017.
3. Jalote Pankaj, "Software Project Management in Practice", Addison-Wesley Professional, 2002.

Reference Books:

1. Roger S.Pressman, ―Software Engineering - A Practitioner's Approach‖, 7th Edition McGraw Hill
2. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.

Web references:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview
2. Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur

Program:	B. Tech. (Computer Engineering)					Semester: V	
Course:	Project Based Learning - IV					Code: BCE6514	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	25	-	50	75

Course Name		Group A		Group B
	Part I	Machine Learning	Part IV	Image & Video Processing
	Part II	Fundamental of Blockchain	Part V	Internet of Things
	Part III	Full Stack Development	Part VI	Software Project Management

Course Objectives:

1. To make the students aware about the fundamentals of the Programme /Professional Elective Course.
2. To develop skills for implementing various tools and technologies used for Professional Electives.
3. To make the students learn about the teamwork and to analyze the result of their teamwork in the form of project/application.

Course Outcomes:

After learning the course, the students will be able to::

1. Analyze the fundamentals of Professional Electives.
2. Assess various tools and techniques available for Professional Electives.
3. Design/develop an application using functionalities of Professional Electives in a team.

Common Guidelines for PBL-IV:

Students must choose one part from Group A which is inline with his/her choice for PEC-3 and another part from Group B which is inline with his/her choice for PEC-4.

Group A

Part I: Machine Learning

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

Guidelines for Laboratory Conduction:

1. Recommended Tools for the implementation of above assignments: Python, R, Jupyter Notebook etc. Use of the Anaconda platform is encouraged.
2. For mini project, select a real-world application in the group of 3-4 students and formulate a problem statement for application to be developed.
3. Student groups are required to continue same problem statement throughout all the assignments in order

to design and develop an application as a part of mini project. Further assignments will be useful for students to develop an application.

Suggested List of Assignments

Assignment No.	Assignment Title
1	**Feature Selection** Select any data set with high dimensions (such as Bostan dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Write a program to perform the following operations on the selected dataset and display the result. 1. Reduce dimensions using SelectKBest method 2. Reduce dimensions using SelectPercentile method 3. Reduce dimensions using PCA techniques
2	**Linear and Polynomial Regression** i. The following table shows the results of a recently conducted study on the correlation of the number of hours spent driving with the risk of developing acute backache. Write a program to find the equation of the best fit line for this data using linear and polynomial regression. Evaluate and compare the performance of both the models**.** ii. Select any data set with high dimensions (such as Diabetes dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Implement Linear Regression, Ridge, Lasso and ElasticNet models. Evaluate and compare the performance of these models.
3	**KNN Classification** A dataset collected from hospital showing details of medical test reports with symptom values observed in the patient's and medical test either positive or negative. Write a program to build k-NN classifier models. If k=3, find the class of the point (6, 6). Extend the same example for Distance-Weighted k-NN. Evaluate and compare the performance of both the models.
4	**Mini Project**

No. of hours spent for of driving (X)	Risk Score on a scale 0-100 (Y)
10	95
9	80
2	10
15	50
10	45
16	98
11	38
16	93

S1	S2	Test Class
2	4	Negative
4	6	Negative
4	4	Positive
4	2	Negative
6	4	Negative
6	2	Positive

	Review and analyze the literature for various machine learning techniques and applications. Using Machine Learning concepts covered in the assignments and Machine Learning theory course, design and develop an application/Decision Support System for the selected problem statement. Visualize the results with comparative performance analysis of different models (minimum 3) using suitable methods. For Example: Health Care domain for predicting disease, Agriculture sector for Fruits Classification or Soil Classification or Leaf Disease Classification. **Note:** • Students should develop an application in the group of 3-4 students and submit the project report which will consist of documentation related to Machine Learning model design. • Document the findings and analysis in the analysis report preferably in IEEE Research Paper format. • A Mini Project in this course should facilitate Project Based Learning among students.

Reference Books:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Ltd. 2017, ISBN: 978-1-78588- 962-2
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI second edition-2013, ISBN: 978-0-262-01243-0
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Intelligent Systems Laboratory, University of Bristol, United Kingdom, First Edition 2012, ISBN-10: 1107422221; ISBN-13: 978-1107422223.
4. Tom Mitchell, "Machine Learning" McGraw Hill Publication 1997, ISBN: 0070428077.
5. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly Media, Inc. publisher 2017, ISBN: 9781491962299.

Web references:

1. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
2. https://www.cin.ufpe.br/~cavmj/Machine%20-%20Learning%20-%20Tom%20Mitchell.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets
6. http://scikit-learn.org

OR

Part II: Fundamental of Blockchain

Suggested List of Assignments

Assignment No.	Assignment Title
1	Write a smart contract in solidity to perform basic arithmetic operations.
2	Write a program using Solidity for bank Transactions such as get balance, deposit and withdrawal etc.
3	Write a program using Solidity to Contract Smart Construction.
4	Build any simple smart contract and Test it with Truffle framework.
5	Study of Geth and Ganache Tools to Create a private Block chain, Creation of Account and Mining using geth.
6	Create and Configure Genesis block.

7	Using the BlockChain Concepts in Theory course and assignments covered in Group A above, Students should develop an application in a group of 2-3 students. **Create a Blockchain on Testnet for storing any critical information**. Document the findings and analysis in the analysis report preferably in IEEE Research Paper format **Note:** • Instructor should maintain the progress report of the mini project throughout the semester from the project group and assign marks as a part of the term work. • Oral examination will be on the Solution Proposed in Mini Project and BlockChain concepts used in the laboratory assignments. • Practical examination will be on Laboratory assignments given in Professional Elective Course- Mini Project in this course should facilitate Project Based Learning among students.

Text Books:

1. Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency", Kevin Wolhuter, 2021, ISBN: 1922590061, 9781922590060
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, Inc.2017, ISBN: 9781491954386

Reference Books:

1. Mark Watney, Blockchain for Beginners: The Complete Step by Step Guide to Understanding Blockchain Technology", CreateSpace Independent Publishing Platform, 2017, ISBN: 1548766887, 9781548766887.
2. Alwyn Bishop, "Blockchain Technology Explained", CreateSpace Independent Publishing Platform, 2018, ISBN: 9781986273800

NPTEL Course lectures links:

1. NPTEL Course "Introduction to Block Chain Technology & Applications"
2. https://nptel.ac.in/courses/106/104/106104220/
3. NPTEL Course on "Block chain Architecture & Use Cases" 4. https://nptel.ac.in/courses/106/105/106105184/

OR

Part III: Full Stack Development

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of prologue, certificate, table of contents and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, Conclusion/Analysis).

Guidelines for Laboratory /TW Assessment

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality, and neatness.

Guidelines for Laboratory Conduction

1. All assignments are compulsory.
2. Students are expected to work in groups of 3 to 4 for mini project.

Suggested List of Assignments

Assignment No.	Assignment Title

1	Design a registration form using AngularJS inputs, and services for web application development.
2	Prepare product registration form using modules and controller in AngularJS
3	Design a web application for Product info, e-commerce, or any other applications that can have transaction details using Node.js and Express
4	Design a web application for e-commerce or students feedback review systems or any other applications with MongoDB Backend. using Node.js and Express.
5	Mini project -Design a web application for real world scenarios

Reference Books:

1. Brad Dayley "Learning Angular JS", Addison-Wesley Professional, First Edition, 2014.
2. Steve Hoberman "Data Modeling for MongoDB", Technics Publication, First Edition, 2014
3. Kyle Banker, Peter Bakkum, Shaun Verch, Dough Garrett, Tim Hawkins "MongoDB in Action", Manning Publications, Second Edition, 2016.
4. Evan M. Hahn "Express in Action", Manning Publications, First Edition, 2014.

Web references:

1. https://www.w3schools.com/whatis/whatis_fullstack.asp
2. https://www.geeksforgeeks.org/what-is-full-stack-development/
3. https://github.com/bmorelli25/Become-A-Full-Stack-Web-Developer

Group B

Part IV: Image & Video Processing

Guidelines for Students:

1. The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Prologue, Certificate, Table of Contents, and Handwritten Write-up of each assignment (Title, Objectives, Theory- Concept in brief, Algorithm, Flowchart, Test cases, Date of Completion, Assessment grade/marks and assessor's sign, Conclusion).
2. Program codes with sample output of all performed assignments are to be submitted as softcopy.
3. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing student's programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory/Term Work Assessment:

4. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage.
5. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

1. Each student must perform all assignments provide in a list.
2. Operating System recommended: - 64-bit Open-source Linux or its derivative.
3. Programming tools recommended: - C/ C++/ JAVA/ PYTHON/ MATLAB

Suggested List of Assignments

Assignment No.	Assignment Title

1	Apply any 4 point processing techniques on sample image.
2	Apply any 4 mask processing techniques on sample image.
3	Plot the histogram of an image and perform histogram equalization.
4	Perform Edge detection using Sobel, Prewitt and Roberts gradient operators.
5	Compress given image using cosine transform.
6	Extract the visual part from digital video and perform point processing method on video frames.
7	Mini Project based on a problem statement approved by the faculty member. Note: • Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work • Oral examination will be on the Solution Proposed in Mini Project and Image and video processing Concepts used in the laboratory assignments. • Practical examination will be on Laboratory assignments given in Project Based Learning Laboratory- Image & Video processing. • Mini Project in this course should facilitate Project Based Learning among students.

Text Books:

1. Rafael.C,Gonzalez, Richard E Woods, "Digital Image Processing",4th Edition, Pearson India, ISBN:9353062985, 2018.
2. Jain A.K, "Fundamentals of Digital Image Processing", 4 Edition, Prentice Hall of India.

Reference Books:

1. B. Chanda, D. DuttaMajumder, "Digital Image Processing and Analysis", 2 nd Edition, Phi learning, ISBN- 978-81-203-4325-2, 2011.
2. William K Pratt, "Digital Image Processing", 4 Edition, Wiley, ISBN:9780471767770, 2006

OR

Part V: Internet of Things

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of prologue, certificate, table of contents and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, algorithm, sample input and expected output, conclusion).
3. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing student's programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of students.
2. Each laboratory assignment assessment should assign grade/marks based on the parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment includes- performance, timely completion, innovation, efficiency, punctuality, and neatness

Guidelines for Laboratory Conduction

1. Operating System: 64-bit Open-source Linux or its derivative.
2. Programming Tools: Open-Source PYTHON.
3. All assignments are compulsory to perform.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Study of Raspberry Pi and Arduino Uno development boards. Understand the process of OS installation on the Raspberry Pi. Start Raspberry Pi and try various Linux commands in command terminal window: ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping etc.
2	Write an application to read temperature using LM-35 temperature sensor and Arduino board. If temperature crosses certain threshold value, then notify the user with buzzer.
3	Interface IR sensor to Raspberry Pi. Write a program to detect obstacle using IR sensor and notify it using LED.
4	Automate the T-Rex Dino Game in chrome browser using servo motor, light-dependent resistor and Arduino Uno.
5	Write a program to solve a system of linear congruence by applying the Chinese Remainder Theorem.
6	Write an application to detect fire and notify the user with buzzer or by sending SMS using GSM module
7	**Mini Project**: Implement any societal problem using suitable IoT hardware and protocols. • Security management • Health emergencies • Road traffic management • Energy Conservation • Agricultural Problems • Rural development • Smart city

Text Books:

1. Matt Richardson and Shawn Wallace, “Getting with Raspberry Pi”, MAKER MEDIA, ISBN: 978-93-5213- 450-2
2. Dr. Simon Monk, “Raspberry PiCook-Book”, O'REILLY, ISBN: 978-93-5213-389-5
3. Hands-On Internet of Things with MQTT, Packt publication

Reference Books:

1. KimmoKarvinen and TeroKarvinen, “Arduino Bots and Gadgets”, O'REILLY, ISBN: 13:978-93-5023-374-0
2. Don Wilcher, “BASIC Arduino Projects”, MAKER MEDIA, ISBN: 13:978-93-5110-503-9

Web Reference:

1. https://www.geeksforgeeks.org/what-is-arduino/
2. https://www.tutorialspoint.com/arduino/index.htm
3. https://realpython.com/python-raspberry-pi/
4. https://www.tutorialspoint.com/raspberry_pi/index.htm

OR

Part VI: Software Project Management

Guidelines for Students:

1. The laboratory assignments are to be performed and submitted by students in a group of 3-4 students in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each

assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set (if applicable), mathematical model (if applicable), conclusion/analysis.

2. Program codes with sample output of all performed assignments are to be submitted as softcopy.
3. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing student's programs maintained by Laboratory In-charge is highly encouraged.
4. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student.
2. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes and punctuality.

Guidelines for Laboratory Conduction

1. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic.
2. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.
3. Use of open-source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.
4. For the elective subject's students should form group of 3-4 students. The faculty coordinator will take care that all the assignment should be assigned to class and minimum two assignments are compulsory for each group.

Programming tools recommended: Software project management-MS project/Gantt Project/Primavera.

Suggested List of Assignments

Assignment No.	Assignment Title
1	Prepare Work breakdown structure (WBS) for identified and selected software Project.
2	Prepare Project Plan for selected Software Project using Critical Path Method.
3	Prepare Project Plan for selected probabilistic Software Project using PERT.
4	Prepare a detailed Project Schedule for selected Software Project considering resource allocation and leveling using CPM.
5	Identify the risk involved and Prepare RMMM plan for selected Software Project.
6	Prepare presentation on Contemporary Software Project Management topic as CMM, PCMM, Agile Project Management, SCRUM, etc.

Reference Books:

1. Roger S.Pressman, ―Software Engineering - A Practitioner's Approach‖, 7th Edition McGraw Hill
2. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.

Web Reference:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview
2. Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur
3. Agilealliance.org
4. Scrum.org
5. Scrumalliance.org

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Multivariate Data Analysis using R (OEC-3)					Code: BAS6608	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Descriptive Statistics, Inferential Statistics, Probability, Statistical Data Analysis using R **is essential.**

Course Objectives:

1. This course aims at enabling the students to learn multivariate data collection, visualization, and preprocessing techniques for data science.

Course Outcomes:

After learning the course, the students will be able to:

1. **Use** data preprocessing methods in R and generate quality data for analysis.
2. **Implement** R packages and related functions to data science to **analyze** multivariate data.
3. **Describe** the multivariate data. usingdifferent data visualization techniques to
4. **Analyze**the multivariate data using dependent analysis methods using the R.
5. **Analyze**the multivariate data using independent analysis methods using the R.
6. **Develop** a model for Prediction and Decision Making for a data set.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Data Wrangling** Understanding the multivariate data, Standardizing Variables, Accessing Databases with R Software, Merging multiple data sources into a single dataset for analysis, Dealing with Missing values, dealing with extreme outliers in data, discrepancies or removing.	07
II	**Multivariate Data and Multivariate Analysis** Calculating Summary Statistics for Multivariate Data: Means and Variances Per Group, Between-groups Variance and Within-groups Variance for a Variable, Between-groups Covariance and Within-groups Covariance for Two Variables, Calculating Correlationsfor Multivariate Data, The multivariate normal density function.	08
III	**Multivariate Data Visualization in R Software** Geometric projection techniques: Scatter plot matrix, Hyper box, Trellis display, Parallel coordinates, Icon-based techniques: Chernoff faces, Stick figures, Star plots, Color icons, Pixel-oriented techniques: Query-independent techniques: visualize the entire dataset, Query-dependent techniques: visualize a subset of data that are relevant to the context of a specific user query, Hierarchical techniques, Hybrid techniques	08
IV	**Dependent Analysis** Multiple linear regression, Conjoint Analysis, Multiple Discriminant Analysis, Linear Probability Analysis, Multivariate analysis of variance (MANOVA),	07

	Canonical Correlation Analysis, Structural Equation Modeling	
V	**Independent Analysis** Factor Analysis: Factor analysis model, the k-factor analysis model, Estimating the parameters in the k-factor analysis model. Cluster Analysis: Cluster analysis, K-means clustering, Displaying clustering solutions graphically, multidimensional Scaling, Correspondence Analysis	**07**
VI	**Multidimensional Scaling** Models for proximity data, Spatial models for proximities: Multidimensional scaling, Classical multidimensional scaling, non-metric multidimensional scaling. **Linear Discriminant Analysis** : Loadings for the Discriminant Functions, Separation Achieved by the Discriminant Functions, A Stacked Histogram of the LDA Values, Scatter plots of the Discriminant Functions, Allocation Rules and Misclassification Rate.	**08**
Total		**45**

Reference Books:

1. Montgomery and Runger, "Applied Statistics and Probability for Engineers", Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, "Probability and Statistics for Engineers", Prentice India Ltd, 8 Edition, ISBN 13:978- 8120342132.
3. S.P.Gupta, "Statistical Methods", Papperbook publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Everitt and Hothorn , "Use R!" series on using R for multivariate analyses, An Introduction to AppliedMultivariate Analysis with R.
5. Barbara G. Tabachnick, Using Multivariate Statistics (4th Edition), Allyn & Bacon; 4th edition (August 9, 2000), ISBN-10:0321056779.
6. Yasunori Fujikoshi, Vladimir V. Ulyanov, Ryoichi Shimizu, Multivariate Statistics: High-Dimensional and Large-Sample Approximations, John Wiley & Sons, 15-Aug-201, ISBN:0470539860

e-sources:

NPTEL Course lectures links:

1. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ma53 (Introduction to R software)
2. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ma37 (Descriptive statistics using R software)

***Instead of the conventional mode of examination for FA and SA; Examination will be conducted using R software in the laboratory through proper invigilation.**

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Remote Sensing and GIS (OEC-3)					Code: BCI6603A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of

Fundamental related to Surveying, types and Importance of various surveys, Global Positioning System **(GPS)**

is essential.

Course Objectives:

1. To comprehend fundamentals and principles of RS and GIS techniques.
2. To enhance students' capacity to interpret image and extract information of earth surface from multi-resolution imagery at multi-scale level.
3. To develop skills of Image processing and Geographical Information System
4. To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
5. To learn buffering and layer analysis for various engineering applications.

Course Outcomes:

After learning the course, the students will be able to:

1. Articulate fundamentals and principles of RS techniques.
2. Demonstrate the knowledge of remote sensing and sensor characteristics.
3. Distinguish working of various spaces-based positioning systems.
4. Analyze the RS data and image processing to utilize in civil engineering
5. Explain fundamentals and applications of RS and GIS
6. Acquire skills of data processing and its applications using GIS.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Remote Sensing:** Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering /town planning	07
II	**Remote Sensing Satellites and Sensor Characteristics:** Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image interpretation, image interpretation	08
III	**GPS and GNSS:** Introduction to GNSS and Types, IRNSS, GPS, GPS components, differential GPS, types of GPS tracking, application of GNSS in surveying, mapping and	07

	navigation	
IV	**Image Processing and Analysis:** Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.	**08**
V	**Fundamentals of GIS:** Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.	**07**
VI	**GIS Data and Case Studies:** GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies:	**08**
Total		**45**

Text Books:

1. J. George "Fundamentals of Remote Sensing", Universities Press, Hyderabad, 2005
2. Principles of Remote Sensing, Panda B C, Viva Books Private Limited, 2008
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022
4. S.K. Sinha "Fundamental of Remote Sensing and GIS", Ayushman Publication House,2014

Reference Books:

1. Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia, 4th Edition, 2017
2. Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John, 7th Edition, 2015
3. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000

e-sources:

1. https://onlinecourses.nptel.ac.in/noc22_ce84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ce52/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/
5. https://www.classcentral.com/course/swayam-remote-sensing-and-gis-14272

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Building Services and Maintenance (OEC-3)					Code: BCI6603B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Course Objectives:

1. To understand the different building services provisions.
2. To study the suitable electrical and mechanical services, fire protection, acoustic, water supply and sound Insulations.
3. To examine the purpose and type of building maintenance.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand different building services provisions.
2. Interpret the importance of building ventilation.
3. Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.
4. Discover the knowledge of Fire Protection, Acoustic, and Sound Insulations.
5. Provide awareness of laws and regulations of water supply systems related to building services.
6. Select different types of maintenance in building service.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Building Services**: Definitions, Objective and uses of servicesdifferent types building, Classification of building services, Types of services and selection of appropriate services for given project.	07
II	**Building Ventilation:** Natural and artificial lighting principles and factors, Arrangement of luminaries, Distribution of illumination, Utilization factors, Necessity of Ventilation Types – Natural and Mechanical Factors to be considered in the design of Ventilation.	08
III	**Electrical Services & Mechanical Services in Buildings:** Electrical services in the building technical terms and symbols for electrical installations and Accessories of wiring, Systems of wiring Plumbing & Air-Conditioning, Air Distribution system, Cleaners,	08
IV	**Fire Protection, Acoustic and Sound Insulations:** Introduction, causes of fire and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2005, Requirement of good Acoustic, Various sound absorbent, Factors to be followed for noise control in residential building.	08
V	**Water and Sanitation Water quality Purification and treatment**: Water supply systems-distribution systems municipal bye laws and regulations, Rain Water Harvesting Sanitation in buildings, arrangement of sewerage	07

	systems in housing.	
VI	**Building Maintenance:** Role of maintenance in durability and serviceability of buildings, Economic aspects of maintenance. Different types of maintenance.	**07**
Total		**45**

Text Books:

1. A text book on Building Services R. Udaykumar Eswar Press, Chennai
2. Building Services S. M. Patil Seema Publication, Mumbai Revised edition
3. National Building Code of India - 2005 Bureau of Indian Standards BIS, New Delhi

Reference Books:

1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd

e-sources:

1. https://nptel.ac.in/courses/105102176

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Designing with Raspberry Pi (OEC-3)					Code: BET6601	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Basics of Programming
is essential.

Course Objectives:

1. To explain fundamentals of Raspberry pi (Rpi) and installation of OS in Rpi
2. To demonstrate the Python programming and interfacing of sensors and actuators with Rpi
3. To describe the Node-RED tool used in Rpi and its applications.

Course Outcomes:

After learning the course, the students will be able to:

1. Describe the basic specifications and operating systems of Raspberry Pi.
2. Illustrate the usage of Node-RED tool for Raspberry Pi programming.
3. Understand the Python programming concepts.
4. Apply the concepts of programming for sensor interfacing with RPi.
5. Apply the concepts of programming for actuator interfacing with RPi.
6. Design IoT based applications with Python programming and Raspberry Pi.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Getting started with Raspberry Pi** Basic functionality of Raspberry Pi board, Physical design and specifications, GPIO Pin description of Rpi, Reading the datasheet of RPi, comparison of various Rpi models, Rpi as mini- computer. Introduction of various operating systems of Rpi, Installation of Raspbian/Noobs/OSMC operating system on Rpi, first boot and basic configuration of Rpi, Introduction to Linux commands required to configure Rpi, Overview of Graphic User Interface (GUI).	08
II	**Getting started with Node-RED tool on Rpi** Prerequisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED app locally and as a service on network, auto-start on boot, opening the editor, installation of various libraries for Node-RED, adding node, add debug node, wire the nodes, deploy the flow.	06
III	**Programming the Raspberry Pi** Introduction to Python programming language: Python Programming Environment, Python Expressions, Strings, Functions, Data types in python, importing libraries, flow control, conditional statement, Loops.	10
IV	**Sensor interfacing with Rpi** Basics of sensors: What are sensors? Types of sensors Sensor interfacing: Temperature and Humidity sensor (DHT11), PIR Motion sensor, obstacle detection using Ultrasonic sensor, soil moisture sensor	06

V	**Actuator interfacing with Rpi** Basics of actuators: What are actuators?, Their need in making a closed loop system Actuator interfacing: Electronic Relays, LED's, Buzzers/Fan, DC Motor, Stepper motor, LCD.	**07**
VI	**Case Study based following topics** Home Automation, Smart City, Smart Farming, Smart Transportation, Health and Lifestyle, Pollution Monitoring system	**08**
	Total	**45**

Text Books:

1. Gary Mitnick,"Raspberry Pi 3: An Introduction to using Python Scratch, javascript and more", 1st edition Createspace Independent publishing Platform 2017.
2. Tim Cox, "Raspberry Pi for python program cookbook" Packt Publishing Limited, 2nd edition, 2016
3. John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", 1st edition Apress Berkeley CA, 2016

Reference Books:

1. Sean McManus, Mike Cook, "Raspberry Pi for Dummies", Wiley Publishers, 4th edition, 2021
2. Maik Schmidt, "Raspberry Pi: A Quick-Start Guide", The pragmatic programmers, 1st edition LLC, 2012
3. Simon Monk,"Programming the Raspberry Pi", 2nd Edition, McGraw Hill publications, 2012
4. Matt Richardson,"Getting started with Raspberry pi", 3rd Edition, Make community, LLC 2016
5. Derek Molloy,"Exploring Raspberry pi", 1st Edition, Wiley, 2016

e-sources:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs74/preview

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Basics of Automotive Electronics (OEC-3)					Code: BET6602	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Electrical & Electronics
is essential.

Course Objectives:

1. To introduce Electronics Control Unit(ECU) used in Automotive applications.
2. To apply operating principles of sensors and actuators used in automotive.
3. To explore the role of electronic systems in Active and passive safety systems.

Course Outcomes:

After learning the course, the students will be able to:

1. To apply the concept of electronics systems in automotive applications.
2. To explore different sensors and actuators.
3. Illustrate vehicle motion control systems.
4. Understand algorithms used in Engine Control System.
5. Describe the role of electronics in Active and passive safety systems.
6. Make use of automotive components, subsystems, and basics of Electronic Engine Control in the automotive industry.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Automotive Systems Overview:** Automotive vehicle technology, Present trends in automobiles with emphasis on increasing role of electronics and software, Overview of typical automotive subsystems and components, Body, Chassis, and Powertrain Electronics	07
II	**Sensors:** Basic sensor arrangement, Types of sensors such as oxygen sensors, Crankshaft angle position sensors, Fuel metering/ vehicle speed sensors, Flow sensor, Temperature, Exhaust Gas Oxygen (O2/EGO), Air mass flow sensors, Throttle position sensor, Strain Gauge MAP sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Piezoelectric Knock Sensor. **Actuators:** Solenoids, Stepper Motors, Relays, Fuel Injector, EGR Actuator, Ignition System	09
III	**Vehicle Motion Control:** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)	07
IV	**Engine Control System:** Algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.	07

V	**Active and passive safety systems:** Body electronics including lighting control, Remote keyless entry, Immobilizers, Electronic instrument clusters and dashboard electronics, Antilock braking system, Computer vision based ADAS	**07**
VI	**Future Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control	**08**
Total		**45**

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", 7th edition, Butterworth-Heinemann Publications, 2017.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill, 1999
3. oliverscheid, "Autosar Compendium, Part 1: Application & RTE", Create Space Independent Publishing Platform, 2015

Reference Books:

1. Robert Bosch, "Automotive Hand Book", 10th edition, Wiley Publications, 2018
2. Kiencke, Uwe, Nielsen & Lars, "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication, 2005.
3. John F. Kershaw, James D. Halderman, "Automotive Electrical and Electronic Systems", 5thEdition, Pearson Prentice Hall, 2007

e-sources:

1. https://autosartutorials.com/
2. https://www.udemy.com/course/learn-autosar-from-scratch/

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	3D Printing and Modeling (OEC-3)					Code: BME6603A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Materials Engineering, CAD software
is essential.

Course Objectives:

1. To understand the importance of 3D Printing process for various applications.
2. To be familiar with the different 3D printing process.
3. To create CAD model that satisfy product development/prototyping requirements.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the meaning and generic steps of the 3D printing process.
2. Identify the effects of critical parameters in the Stereo lithography and Solid ground curing process.
3. Identify the effects critical parameters in the Laminated object manufacturing and Fused Deposition Modeling Process.
4. Identify the effects critical parameters in the Selective laser sintering process and Direct Energy deposition.
5. Develop the STL file and create sliced model by using open-source software
6. Understand the various application of 3D printing process.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to 3D Printing**: Meaning of 3D Printing, The Generic/steps in 3D printing Process, Materials used in 3D Printing, Types of 3D Printing process and Benefits of 3D printing, Design for Additive manufacturing (DFAM).	08
II	**Liquid based systems:** Stereo lithography apparatus (SLA): Specifications, parameters, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages. Solid ground curing (SGC): Specifications, parameters, process, working, principle, applications, advantages and disadvantages.	07
III	**Solid based systems:** Laminated object manufacturing (LOM): Specifications, parameters, Process, Working principle, Applications, Advantages and disadvantages. Fused Deposition Modeling (FDM): Specifications, Process, parameters, Working principle, Applications, Advantages and disadvantages.	07
IV	**Powder Based Systems:** Selective laser sintering (SLS): Specifications, process, parameters, working principle, applications, advantages and disadvantages. Direct Energy deposition (DED): Specification, parameters, process, working	08

	principle, applications, advantages and disadvantages.	
V	**Modelling in 3D printing:** Meaning of STL file, Special rules for the STL format, Meaning of Slicing, Components of Slicing software, Preparation of CAD models, Converting into STL file, slicing by using open source software.	**08**
VI	**Applications of 3D Printing**: Prototyping and manufacturing, medical applications, Automotive applications, Aerospace & Defence applications, Constructions applications. Art and Jewellery applications.	**07**
Total		**45**

Text Books:

1. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Third Edition, Springer Publications,2020. ISBN 978-1-4939-2112-6.
2. Vannessa Goodship , Bethany Middleton, Ruth Cherrington, Design and Manufacture of Plastic Components for Multi functionality, First Edition, Elsevier Publications, 2016, ISBN: 978-0-323-34061-8

Reference Books:

1. Henrique Amorim Almeida and Paulo Jorge da Silva Bártolo, Mathematical Modeling of 3D Tissue Engineering Constructs, First Edition, Springer International Publishing, 2018, ISBN: 978-3-319-45444-3

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Material Informatics (OEC-3)					Code: BME6603B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Data Science, Machine Learning, Python/R programming
is essential.

Course Objectives:

1. To Aquitaine students about materials, their properties, structure property relationship.
2. To create awareness about the importance of statistics in materials data analysis.
3. To imbibe significance of data science, machine learning in use, selection and analysis of materials.

Course Outcomes:

After learning the course, the students will be able to:
1. Compare different materials based on their structures.
2. Interpret material property data and draw conclusions.
3. Apply statistical methods for materials data analysis.
4. Use programming languages like python/R programming for materials data analysis.
5. Apply machine learning algorithm for interpretation of materials data.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to materials:** Classification of materials, structure of materials:atomic structure, crystal structure and microstructure, material properties: Physical, Mechanical, Electrical, Magnetic etc.	07
II	**Materials Information:** Structure property relationship**,** Applications and selection of materials, Analysis and synthesis of materials.	07
III	**Statistics and Materials:** Basic probability and statistics, basic R/ Python, Inaccuracies and error and its propagation, Descriptive data analysis, Probability distributions, Probability distributions using R/Python, fitting functions to data: regression, testing significance of fit.	08
IV	**Experimental data**: Processing of experimental data using R/Python, R/Python for graphical handling of data and fitting.	07
V	**Feature extraction:** Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in materials Engineering.	08
VI	**Classification:** Decision tree, Random Forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in materials Engineering.	08

Total	45

Text Books:

1. William D.Callister, 'Material Science and engineering an introduction', Wiley Publication, 2013
2. B Joshi, 'Machine Learning and Artificial Intelligence', Springer, 2020.
3. Emmanuel Paradis, 'R for Beginners', Open source online
4. Databases: MaterialsProject.org, MaterialsWeb.org
5. PYMATGEN, MPINTERFACES software for materials analysis

Reference Books:

1. O. Isayev, A. Tropsha and S. Curtarolo, 'Materials Informatics: Methods, Tools, and Applications', Wiley, 2019
2. K. Rajan, 'Informatics for Materials Science and Engineering', Elsevier, 2013
3. Solanki, Kumar, Nayyar , 'Emerging Trends and Applications of Machine Learning', IGI Global, 2018.mode

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Smart Cities & Building Automations (OEC-4)					Code: BCI6604A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Physics, Mathematics Programming Language
is essential.

Course Objectives:

1. To understand the concept of smart city and associated challenges
2. To understand latest technologies used in intelligent building
3. To recognize the concepts of Internet of Things and able to build IoT applications
4. To apply the programming and use of Arduino and Raspberry Pi boards for Smart Cities.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the concept of smart city and associated challenges
2. Identify latest technologies used in intelligent building
3. Implement program and configure Arduino boards for various designs
4. Demonstrate Python programming and interfacing for Raspberry Pi.
5. To design IoT applications in different domains.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Smart cities** Introduction to city planning, Concept, Principle stakeholders, key trends in smart cities developments	07
II	**Smart Cities Regulations** Understanding smart cities, Global Standards and performance benchmarks, Practice codes for smart city development	07
III	**Smart Cities Planning and Development** Smart city planning and development, Dimension of smart cities, Financing smart cities development, Governance of smart cities	07
IV	**IoT in Construction** Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.	08
V	**Introduction to Arduino Programming,** Integration of Sensors and Actuators with Arduino for smart city applications	08
VI	**Introduction to Python and Raspberry pi for Smart Cities** Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi for Smart Cities and Smart Homes Applications of classification and regression algorithms in materials Engineering.	08

Total	45

Text Books:

1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 1-85649-477-2).
2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).
3. Arup Mitra; "Insights into inclusive growth, employment and wellbeing in India"; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2).
4. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases" (2018), by Pethuru Raj and Anupama C. Raman (CRC Press).
5. "Make sensors" (2014) Terokarvinen, Kemo, Karvinen and VilleyValtokari, 1st edition, Maker media.
6. "Internet of Things: A Hands-on Approach" (2018), by Arshdeep Bahga and Vijay Madisetti.

Reference Books:

1. "Urban Planning and cultural identity" (2004); William J. V. Neill, Routledge, London (ISBN: 0- 415-19747-3)
2. "Remaking the city: Social science perspective on urban design" (2015) John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); State University of New York Press, Albany (ISBN: 0-87395-678-8)
3. "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science (2007) Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers
4. "Draft Concept Note on Smart City Scheme". Government of India – Ministry of Urban Development (http://indiansmartcities.in/downloads/CONCEPT_NOTE_-.12.2014__REVISED_AND_LATEST_.pdf)
5. "Internet of Things: A Hands-On Approach" (2018) Vijay Madisetti, Arshdeep Bahga,
6. "Fundamentals of Wireless Sensor Networks: Theory and Practice" (2018), Waltenegus Dargie, Christian Poellabauer,
7. Beginning Sensor networks with Arduino and Raspberry Pi (2013) Charles Bell, A press

e-References:

1. Smart City Mission Guidelines, India, https://smartcities.gov.in/guidelines
2. Smart Cities – Management of Smart Urban Infrastructures by Coursera, https://www.coursera.org/learn/smart-cities
3. e-Learning Course on Smart City by edx, https://www.edx.org/course/smart-city

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Mechanical Electrical Plumbing (MEP) Systems (OEC-4)					Code: BCI6604B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of

Basics of air conditioning, Basics of Electrical Engineering, Basics of Mechanical Engineering **is essential.**

Course Objectives:

1. To learn the concept of HVAC
2. To recognize the technologies used in electrical services
3. To understand the concepts of plumbing services
4. To learn the fire protection system.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyse and design HVAC system
2. Implement the technologies used in electrical services
3. Apply plumbing services
4. Design fire protection system.

Detailed Syllabus

Unit	Description	Duration (H)
I	**HVAC** Introduction to HVAC, Basic Components of Air-Conditioning and Refrigeration machines, Classification of Air-Conditioning System, Categories of Air Conditioning, Study of sychometric Charts, Load Calculation, Air Distribution System, Static Pressure Calculation, Hydronic System, VRF/VRV System, Air Conditioning Concepts, Ventilation systems.	07
II	**Basics of Electrical Implementations** General, Codes & Standards to be followed, Electrical equipment's and its application used in the installation, means of electrical distribution for installation, Major electrical loads used in the installation, Electrical design calculations, Various design stages & Sequence of electrical design procedure.	08
III	**Electrical Analysis and Design** Major electrical loads used in the installation, Electrical design calculations, Various design stages & Sequence of electrical design procedure.	07
IV	**Plumbing** Plumbing Systems, Design of Domestic Water Supply and Distribution System, Design of Sanitary Drainage System, Drawings – Plumbing Layouts.	08
V	**Fire Protection system** Introduction To Fire Fighting, Classification of Fire (Description), Fire Extinguisher Types- Using Procedure and General Maintenance, Fire Protection Systems-1. Active 2. Passive Refuge Areas – Rules & Regulations.	07

VI	**Fire Alarm System** Designing of fire alarm system, NFPA, NBA & FSAI Code for Fire Fighting System Designing, Fire Fighting, Hydraulic Calculation for High Rise Buildings, Fire norms for new project construction.	**08**
Total		**45**

Text Books:

1. Design of Mechanical & Electrical Systems. Trost, Pearson Publishing, ISBN 978-0-13097235-4 .
2. MEP Planning Manual: Become a Professional Construction Engineer: 1 (Arabmep H), ISBN-1: 1677068930, ISBN-13: 978-1677068937.
3. MEP Databook (Construction Databooks) Hardcover – 16 August 2000 by Sidney Levy, McGraw-Hill Education.
4. Electrical and Mechanical Services in High Rise Building (English, Paperback, Mittal A.K.), CBS Publisher and DistrubutorPvt.Ltd.

Reference Books:

1. MEP Guide for Planning and Scheduling by Planningengineer.net
2. Handbook of Building Construction; Data for Architects, Designing and Construction Engineers, and Contractors by Hool George, Publisher: Nabu Press.

e-References:

1. Online Mechanical, Electrical and Plumbing Design Training Course by Advance Electrical Design & Engineering Institute (AEDEI) https://www.advanceelectricaldesign.com/
2. Revit MEP Essentials by CADD Centre, India. https://www.cloudkampus.com/clp/revit-mep-essentials
3. MEP Course by MEP Training Institute, India. https://www.mepcentre.com/course/mep
4. Foundation Course on Building MEP Services by MEPA (Mechanical Electrical Plumbing engineers Association) http://www.mepaworld.com/training

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Designing with Arduino platform (OEC-4)					Code: BET6603	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
The Basics of programming
is essential.

Course Objectives:

1. To make the students aware of the Arduino platform in terms of the physical board, Arduino IDE and libraries.
2. To make the students aware of circuit prototyping, and interfacing of peripherals with Arduino.

Course Outcomes:

After learning the course, the students will be able to:
1. Summarize the features of the Arduino board.
2. Apply the programming concepts to the Arduino board.
3. Make use of analog and digital pins of Arduino.
4. Develop a system to monitor the real-time parameters using Arduino.
5. Illustrate the Object detection using Arduino.
6. Realize the Sound sensing and distance measurement using Arduino.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Knowing Your Arduino:** Introduction of Arduino Uno, Atmega328P, Arduino Shields, getting to know the Arduino Uno Pins, power, clock, Using the digital input and output pins, analog input and output pins, Introduction to Serial (UART) communications, I²C (TWI) communications, SPI communications	07
II	**Arduino Ide And Programming Concepts.** An introduction to the Arduino IDE: Getting and installing the Arduino IDE and uploading a sketch to your Arduino. An introduction to Arduino programming, Understand the basic parts of an Arduino sketch, custom functions Creating custom functions and the return keyword, Using variables, constants, Introduction to control structures: The "if”,” while", "For”,” Switch" statement	08
III	**Arduino Programming Hands On** Digital input/output - how to read the state of a button control an LED, Analog input/ output - how to read the state of a potentiometer and create a fading LED, Introduction to the RGB (color) LED, Wiring the RGB LED, RGB LED: creating colors, using a library to control an RGB LED with PWM.	08
IV	**Monitoring Real Time Parameters Using Arduino** Interfacing of Ultra -violet light sensor, RGB color sensor, DHT22 sensor, LM 35 to Arduino for monitoring the parameters like temperature, humidity, etc.	07
V	**Interfacing With Arduino - I.**	07

	Introduction to detecting acceleration with the ADXL335, Plugging the ADXL335 directly in the Arduino, and detect its orientation, A demonstration of using the IR and PIR sensor with the Arduino	
VI	**Interfacing With Arduino - II.** Introduction to the ultrasonic distance sensor, Wiring and understanding Trigger and Echo, and calculating distance. Introduction to the analog sound sensor, A demonstration and sketch of the analog sound sensor and the digital sound sensor. Case study elaborating the use of Arduino in various applications.	**08**
Total		**45**

Text Books:

1. Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury, CRC Press, Taylor & Francis Group, 1st edition 2017.
2. Arduino Made Simple by Ashwin Pajankar, BPB Publication, 1st edition 2018.

Reference Books:

1. Exploring Arduino: Tools and Techniques for Engineering Wizardry 1st Edition,byJeremy Blum , SBN- 13: 978-1118549360,ISBN-10: 1118549368.

e-References:

1. https ://www.arduino.cc/en/Tutorial/HomePage
2. https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Communication Protocols for e-Vehicle (OEC-4)					Code: BET6604	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Fundamentals of computer networks, Electric machines
is essential.

Course Objectives:

1. To make student understand basics of EVs, including EV Components, architecture, and energy management.
2. To make student able to compare various topologies of EV communication systems.
3. To introduce student about connectors and chargers in EV's
4. To make student to evaluate the impact of EVs in Connected Mobility and Autonomous Mobility.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the basics of e-vehicles
2. Illustrate the EV Components and controlling units.
3. Compare various EV Communication protocols & their need in the e-Mobility business
4. Understand the fundamentals of EVSE Communication
5. Analyze connectors and chargers in EVs
6. Apply the Knowledge of e-Mobility through Indian Roadmap Perspective.

Detailed Syllabus

Unit	Description	Duration (H)
I	**EV Basics** Overview of EVs and challenges, the architecture of EVs, EV market and promotion, infrastructure needs, energy sources used in EVs & HEVs, medium of power transfer (conductive and wireless), and wireless power transfer.	07
II	**EV Components** Battery Management System (BMS), BLDC Motors, Inverter Unit, Powertrain Unit and Couplers with Chassis, PDU (Power Distribution Unit), BCM (Body Control Module, ECU, and Tuning Parameters.	07
III	**EV Communication protocols** Communication Systems in EV (CAN and LIN), V2V, V2G and its applications in power systems, power saving & coordinated charging, the layout of power converters, electrification challenges	08
IV	**Electric vehicle supply equipment (EVSE)** Basics of EVSE, EVSE Power Module selection and technical specification, Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module), Communication gateway.	08
V	**Connectors and Chargers** Types of EV charging connectors, EV Plug Standards, Selection and Sizing of	07

	Common Types of Connectors and Applications, Selection of AC and DC charger types.	
VI	**Charging communication & e-Mobility** Communication Interface between the charger and CMS, CCS (Combined Charging System), CHAdeMO, Tesla, Specification of open charge point protocol, Connected Mobility and Autonomous Mobility, e-Mobility: Indian Roadmap Perspective, EV integration in smart grid, social dimensions of EVs.	**08**
Total		**45**

Text Books:

1. William Ribbens, Understanding Automotive. Electronics. An Engineering Perspective. 7th edition, 2017.
2. Jack Erjavec and Nathan Smith, Hybrid, Electric and Fuel-Cell Vehicles, 3rd Edition, 2022.
3. Tom Denton, Electric and Hybrid Vehicles, 2nd Edition, 2016.

Reference Books:

1. Wireless Communications Principles and Practice; by Theodore S Rappaport, Pearson Education, 2nd edition 2018
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.
3. Wei Liu (General Motors, USA), Hybrid Electric Vehicle System Modelling and Control, John Wiley & Sons, Inc., 2nd edition, 2017.
4. Teresa Donateo, Hybrid Electric Vehicles, , Published by ExLi4EvA,1st edition , 2017.

NPTEL Online Courses / MOOCs:

1. NPTELcourse on Fundamentals of Electric vehicles: Technology & Economics, IIT Madras, Prof. Ashok Jhunjhunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannanhttps://nptel.ac.in/courses/108106170
2. NPTEL course onElectric Vehicles - Part 1, IIT Delhi, Prof. Amit Jainhttps://nptel.ac.in/courses/108102121
3. NPTEL Archives on Electricvehicles and renewable energy, IIT Madrashttps://archive.nptel.ac.in/courses/108/106/108106182/
4. Electric Vehicles Comprehensive Course, Udemy.comhttps://www.udemy.com/course/electric-vehicles-comprehensive-course/

Program:	B. Tech. (Computer Engineering)						Semester: VI
Course:	Model Based System Engineering (OEC-4)						Code: BME6604A
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Course Objectives:

Students are expected to:

1. Acquire Fundamentals of systems and subsystems which should include different processes, properties.
2. Develop structural and behavioral aspects of general diagramming.
3. Perform a functional analysis.
4. Construct systems engineering requirements.

Course Outcomes:

After learning the course, the students will be able to:

1. DESCRIBE the methods, Processes and practices of systems engineering.
2. UNDERSTAND Fundamentals of systems and subsystems.
3. DIFFERENTIATE between traditional document-based and model based systems engineering.
4. ANALYZE three pillars of MBSE: languages, methods, and tools.
5. CREATE models and diagrams using modelling language.
6. APPLY Model Based Systems Engineering (MBSE) approach to Engineering problems.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Systems Engineering** History / Background, Industrial revolution, Discover Systems Engineering, Systems Engineering definition INCOSE, V-Cycle. Cyber physical systems – Advantages, Necessity and its challenges: a) Security: Control of interfaces, emergent vulnerabilities. b) Data: Privacy, data capture, analysis, access issues, data adequacy and accuracy. c) Regulations and Standards: Policy, Standards. d) Life cycle Sustainment.	**08**
II	**Fundamentals of MBSE:** Introduction, Systems, subsystems and levels, Concrete and abstract objects, Properties, States, event, process, behavior and fact, Systems of interest.	**08**
III	**Three Pillars of MBSE:** Modelling methods, Modelling tools and Modelling language	**07**
IV	**Overview of System Modeling Language** SysML Diagram overview, General diagram concepts**,** the structural aspect and the behavioural aspect, The relationships between behavioural diagrams and structural diagrams	**08**
V	**Process Modelling with MBSE** Approach, The Process Modelling Framework, Using the process modelling framework	**07**

VI	**Requirements Modelling with MBSE** Introduction, The Requirements modelling Framework, Using the Requirements modelling Framework (ACRE Process)	**07**
Total		**45**

Text Books:

1. **SysML for Systems Engineering, A model-based approach**, Jon Holt and Simon Perry, 3rd Edition, The Institution of Engineering and Technology, 2019.

Reference Books:

1. Practical Model-Based Systems Engineering, Jose L. Fernandez and Carlos Hernandez, Artech House, 2019
2. System Requirements Analysis, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
3. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. Systems Engineering: Design Principle and Models, Dahai Liu,CRC Press Taylor & Francis Group, 2016.
6. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.
7. INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, Wiley, 2015.

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Electronics Cooling (OEC-4)					Code: BME6604B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
03	-	03	03	20	20	60	100

Prior knowledge of
Engineering Physics, Electronics Components and its mountings, Electronics Packaging
is essential.

Course Objectives:

1. To describe the need for thermal management of electronic components.
2. To introduce the fundamental heat transfer mechanisms of conduction, convection and radiation.
3. To introduce the concept of thermal resistance and illustrate its applications.
4. To provide simple equations and tabulate commonly used thermal properties to enable the learner to perform a first order analysis of heat transfer from an electronic package.
5. To describe various cooling methods typically used or considered.

Course Outcomes:

After learning the course, the students will be able to:

1. Realize the need of thermal management of electronics.
2. Summarize sources of heat generation and modes of heat dissipation.
3. Apply the concept of electrical analogy to determine thermal resistance.
4. Examine the appropriate cooling methods as per the application.
5. Evaluate the cooling requirement of electronic packages.
6. Compare the methods of cooling employed in diverse electronics application.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Thermal Management:** Electronics Component Packaging Trends, Sources of heat generation, electronic component failure analysis, Need of Thermal Management, modes of heat dissipation	07
II	**Heat Transfer Principals in Electronics Cooling:** Conduction Heat Transfer, Steady and Transient Conduction, Natural Convection in Electronic Devices, Forced Convection Heat Transfer, Radiation Heat Transfer	07
III	**Thermal Resistance:** Concept of Electrical Analogy, Thermal Resistance of conduction, convection and radiation, Thermal Contact Resistance, Thermal resistance network, thermal interface material applications, thermal adhesives	08
IV	**Electronics Cooling Methods in Industry:** Thermal interface and phase change materials, Passive and novel air-cooling approaches, microchannel, jet impingement, Thermoelectric Cooling, Immersion Cooling, Vapor Chambers, Cooling Techniques for High Density Electronics.	08

V	**Evaluating Cooling Requirement:** Conduction cooling for chassis and circuit boards, Concentrated heat sources, distributed heat sources, Circuit boards with Aluminium Heat Sink, heat transfer across interfaces by conduction and convection	**08**
VI	**Electronics Cooling Applications:** Avionics, Data Centers, Mobile, High-Performance Computing, Automotive	**07**
Total		**45**

Text Books:

1. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, a Wiley-Interscience Publication, John Wiley & Sons, Inc, 1991
2. S M Sohel Murshed, Electronics Cooling, ExLi4EvA Publication, 2016.

Reference Books:

1. Y.A. Cengel and A. J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited, 2019
2. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, 2009
3. J. P. Holman, Heat Transfer, McGraw – Hill publications, 2008.

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Project Management (HSMC - 6)					Code: BHM6114	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	10	20	20	50

Course Objectives:

1. To help the students gain understanding regarding the concept of projects and Project Management
2. To enable the students to know the key components of project management including project time, cost & Risk management.
3. Recognize issues in a realistic project scenario.

Course Outcomes:

After learning the course, students will be able to:

1. Understand how to initiate, define and organize a project.
2. Optimize results while managing the triple constraints.
3. Apply appropriate approaches to plan a new project and develop project schedule
4. Analyzethe risk associated with various project.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Project Management** Concept and Definition of Project, Characteristics of Project, Concept and definition of Project Management, Functions of Project Management, Importance of Project Management, Who is a Project Manager, Roles & Responsibilities of Project Manager. Understanding the Phases in the Lifecycle of Projects and their Significance, Different types of Projects: Industrial, Telecommunication, Research and more, Project Selection Methods: Agile method & Waterfall methods	07
II	**The Triple Constraint in Project Management:** The concept of the Triple Constraint in Project Management: Scope, Cost and Time, Project Cost Management: Concept, Consideration, Five types of Costs involved in a project, Cost Management process, Project Time Management and methods of Time estimation, Communications Management in Project, Work Breakdown Structure (WBS). Case studies based on Mega Projects of the World.	07
III	**Planning and Execution of Project**: Developing a Mission, Vision, Goals of the project. Concept and definition of Project Planning. Importance of Project Planning. Concept and definition of Network Scheduling, Critical Path Method, Concept of Project Execution, Phases of Project Execution, Project Evaluation; The Review Technique – Planning and Scheduling of Activity Networks - Concept of PERT/CPM, Assumptions in PERT Modeling – Time-cost, Trade-offs, HRM issues in Project Management & How they can be tackled, Quality Circle, Reasons for Failures of Project, Case Study with respect to different Domains	08

IV	**Project Monitoring and Risk Management:** Concept of Project Monitoring, How to Building a Suitable Monitoring; Control System, Concept of Conflict Management, Concept & Definition of Risk and Risk Management, Concept of Risk Matrix Analysis, Strategies to Manage Risks, An Overview of Useful Techniques and Tools Used in Project Management. Case Studies	**08**
	Total	**30**

Text Books:

1. Joseph Heagney, Fundamentals of Project Management, American Management Association, 2012.

Reference Books:

1. Erik W Larson, Clifford Gray, Rohit Joshi; Project Management-The managerial process, MacGraw Hill Publication, 2021
2. Punmia, Project Management with CPM /PERT, Laxmi Publications, 2001
3. Robert L Kimmons, Project Management Basics, Taylor & Francis Ltd, 2018
4. N. D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd

e-sources:

1. https://www.youtube.com/watch?v=RjOA7AxOVj8&list=PLLy_2iUCG87AUusGVo2wsXvRZ4zlbbKUu
2. https://www.youtube.com/watch?v=W2EdffbwgcM&list=PL3MO67NH2XxIRneBXA3yA1RacZQIuX7Yl
3. https://www.youtube.com/watch?v=RQNZWCl6eXI&list=PLBd76GK9sWTwVXm9FlVHOTXXbGY2vZR8z

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Financial Management (HSMC - 6)					Code: BHM6115	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	10	20	20	50

Prior knowledge of
Basic Financial Literacy
is essential.

Course Objectives:

1. To develop an understanding of day-to-day working capital decisions; and also longer-term dealing, involving major capital investment decisions and raising long-term finance.
2. To improve students 'understanding of the time value of money concept and the role of finance in the current competitive business scenario.

Course Outcomes:

After learning the course, students will be able to:

1. Understand the basics of financial management and its terms and concepts
2. Understand financial markets and the role of financial institutions
3. Apply knowledge of capital budgeting; its allocation, management and funding.
4. Analyzefinancial statements and read documents and books of accounts.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Financial Management**- Concept of Business Finance, Objective function in Finance, Traditional and Modern Approaches to Financial Management, Financial Planning - Principles and Steps in Financial Planning and its practical approach.	07
II	**Financial Markets, Institutions and instruments:** Introductions to Financial Markets – Nature –Functions and Types of Financial markets, Different Financial Instruments, Sources of financing -Shares, Debentures, Term Loans, Lease & Hire Purchase, Retained Earnings, Public Deposits, Bonds, Trade Credit, Introduction to Bank Finance.	07
III	**Time Value of Money and capital budgeting:** Timelines for cash flow, Annuities, Perpetuities, Need and Importance of Capital Budgeting, Different Techniques of Evaluating the Project on the Basis of Payback Period, ARR, NPV, IRR, PPP	08
IV	**Financial Statement Analysis:** Concept of Financial Statements: Balance Sheet, Profit and Loss Statement, Cash Flow Statement, Tools of Analysis of Financial Statements: Comparative Statements, and Ratio analysis.	08
	Total	30

Text Books:

1. Prasanna Chandra, Financial Management, Tata McGraw Hill, 2011.

Reference Books:

1. Agrawal M R, Financial Management, Garima Publications, Jaipur, 2021
2. Khan and Jain, Financial Management, Tata McGraw Hill, 2008
3. Paramasivan C, Subramanian T, Financial Management, New Age International (L) Publishers, 2017
4. R. M.Srivastava, Financial Management, Himalaya Publishers, 2005
5. Vanhorne J, Financial Management & Policy, Pearson Education, Delh,2015
6. Gupta Pratik, Arora Amit, Financial Management, Vayu Education of India, 2020.

e-sources:

1. https://www.youtube.com/watch?v=TgF2XvjquUU&list=PLLy_2iUCG87CXY2B6fPex1SOIqxzzD5Wj
2. https://www.youtube.com/watch?v=CCQwz_Gwo6o
3. https://www.youtube.com/watch?v=OT5RdoJAkhY&list=PLPjSqITyvDeUTeAOGhip_ubjN3y8oqT13.

Program:	B. Tech. (Computer Engineering)					Semester: VI	
Course:	Entrepreneurship Development (HSMC - 6)					Code: BHM6116	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	FA 1	FA 2	SA	Total
02	-	02	02	10	20	20	50

Course Objectives:

1. To understand the role and importance of entrepreneurship for economic development
2. To seek necessary knowledge and develop skills required for organizing and carrying out entrepreneurial activities.
3. To develop the ability to analyze and understand business situations in which entrepreneurs act.

Course Outcomes:

After learning the course, students will be able to:

1. Understand the entrepreneurship as an opportunity
2. Optimize the business opportunities that suit aspirant entrepreneurs
3. Appraise the financial schemes and support systems for Entrepreneurship Development.
4. Design a comprehensive business plan.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to the Entrepreneurship Development**: Concept and definition of Entrepreneurship, The concept of Opportunity Window, Challenges and Misconceptions Related to Entrepreneurship with Indian Context, McClelland's Need Achievement Theory, Concept of Entrepreneur, Entrepreneurship as a Career, Traits of Successful Entrepreneur, Types of Entrepreneur (proprietary, partnership, collaboration etc), Entrepreneur v/s Intrapreneur, Woman Entrepreneur – A Paradigm Shift , Factors Affecting Entrepreneurship, Types of Enterprises and their Features: Manufacturing, Service and Trading Case Study: Indian Entrepreneurs Pre and Post Covid World, Success stories for few Entrepreneurs.	07
II	**Entrepreneurial Opportunities and Process Selection:** Concept of Business Opportunity, How to Generate Business Ideas? Identification of Ideal and Viable Business Opportunities, Elements of a good business idea. the entrepreneurial process, Challenges in the Selection of Business Opportunities, Business Opportunities Identification Process, Required Licenses, Approvals and Expertise, Business Value Chain, Different Sections of the Business Value Chain for Potential Opportunities, Understanding Product Costs and Operations Costs; Legal Aspects.	07
III	**Finance and Support Systems**: Raising Capital, Venture Capital, Angel Investors, Seed Funding, Role of Government in Promoting Entrepreneurship in India, Start-up India, Atmanirbhar Bharat, Make in India, Assistance to an Entrepreneur, Industrial Park, Special Economic Zone, MSME Act, MSME Policy in India, Financial Assistance to MSME, Various Government Schemes - PMEGP, CGTMSE, PMKVY, Mudra Loan, Incubation, Role of Incubation	08

	Centers, Support from Incubation Centers	
IV	**Business Plan:** Concept and definition of Business Plan, Contents of Business Plan: Executive Summary, Business Concept, Business Strategy, Management Summary, Marketing Plan, Operations Plan, Financial Plan, Presenting Business Plan, Procedure for setting up an Enterprise, Why Do Some Business Plans Fail?	**08**
	Total	**30**

Text Books:

1. C. B. Gupta and N. P. Srinivasan, Entrepreneurial Development, Sultan Chand & Sons, New Delhi, 2008.

Reference Books:

1. Dr. Radha, Entrepreneurial Development, Prasana Publishers, Chennai, 2007.
2. S.S.Khanka, Entrepreneurial Development, Sultan Chand & Co., Ltd., New Delhi 2005
3. Stevenson, H. Perspective on entrepreneurship. Boston: Harvard Business Press, 2007.

e-sources:

1. https://www.entrepreneur.com/
2. http://dst.gov.in/scientific-programme/t-d-tdb.htm
3. https://www.youtube.com/

Program:	B. Tech. (Computer Engineering)				Semester: VI	
Course:	Android Application Development (Proficiency Course-3)				Code: BCE6915	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Credit	Hours	FA	SA	Total
02	-	-	02	-	-	-

Prior knowledge of
Java Programming
is essential.

Course Objectives:

1. To learn Basic UI elements of android
2. To learn local Database connectivity of android.
3. To learn foreground and background services
4. To learn read/write operation on files.

Course Outcomes:

After learning the course, the students will be able to:

1. Install and configure and android.
2. Develop UI Based android applications
3. Demonstrate the data manipulation using Content Providers, embedded database SQLite
4. Choose suitable software tools, IDE and APIs for the development of Mobile Application
5. Develop android application for file sharing.
6. Acquire skill set to execute applications in Android based devices.

Suggested List of Assignments

Assignment No.	Assignment Title
1	**Introduction** Install the Android SDK, Introduction to Basic UI design and Form widgets. **Assignment Title: Build** a simple UI for sign in page for any application using UI Widgets, Layouts and Adapters. Validate the required fields.
2	**SQLite/Room Database, Handling User Input** **Assignment Title: Connect** sign in page designed in assignment 1 to database and perform data manipulation operations such as add, delete, update on it.
3	**Networking in Android** **Assignment Title:** Design an android-based application to implement chat application using socket programming
4	**Audio files, Recycler/list view, services (foreground and background services)** **Assignment Title: Develop** a mobile application to fetch all audio files and play the audio file when user clicks on any audio file from recycler/list view. Application should play music in background.
5	**Working with images** **Assignment Title:** Develop a mobile application to fetch images from the sdcard/internal memory. Also provide the facility of deleting, renaming the images.
6	**File sharing in Android.** **Assignment Title:** Develop an android-based application to implement file Sharing through

	Bluetooth/wi-fi. Use Java/ Kotlin for programming.
Text Books: 1. Java the Complete Reference, Ninth Edition, by Herbert Schildt, McGraw Hill Education.	
Reference Books: 1. Head First Servlets and JSP, Kathy Sierra, Bryan Basham, Bert Bates, O'Reilly Media, Inc.	

Program:	B. Tech. (Computer Engineering)				Semester: VI	
Course:	Advanced Java Programming – II (Proficiency Course-3)				Code: BCE6916	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Credit	Hours	FA	SA	Total
02	-	-	02	-	-	-

Prior knowledge of
Java Programming
is essential.

Course Objectives:

1. To develop web-based, network-centric or enterprise applications.
2. To create maintainable, extensible, and flexible web applications using Java Framework like Struts, Hibernate, Spring.

Course Outcomes:

After learning the course, the students will be able to:
1. Comprehend cycle of MVC architecture.
2. Design web application using Struct, hibernate and Spring framework.
3. Implement web services using java.
4. Integrate technological stack to develop an application.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives and Outcomes, Theory- Concept in brief, Algorithm, Flowchart, Test cases, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as soft copy.

Suggested List of Assignments

Assignment No.	Assignment Title
1	**MVC & Struts Framework** MVC, MVC Type1 and Type2 architecture, truts framework? Struts 1 overview, Struts 1 and Struts 2 comparison, Components of Model, Views and Controller in Struts Framework, Declarative and Annotations configuration approaches, **Assignment Title:** Develop Signin and Signout Application using Struts Framework
2	**Assignment Title:** Create Hello World Using Struts – 2
3	**Hibernate Framework** ORM, ORM principle, ORM Implementation, Introduction to Hibernate, Hibernate Architecture, Peristent classes, Hibernate CRUD, setting up connection to DB using Hibernate **Assignment Title:** Insert the Record of user in database using Hibernate Framework
4	**Spring Framework** Introduction to Spring, Spring Architecture explanation and all its components, Spring MVC, Spring DAO, setting up of Spring framework Download JARs, Configure XML files. **Assignment Title:** Create a Web Application/Page using Spring Framework

5	**Web Services Using Java** Web services such as protocols, SOAP, RESTful, java web service implementation, JAX-WS and JAX- RS **Assignment Title:** Create a Web Service in Java using SOAP & RESTful
6	**Assignment Title:** Integrate Hibernate application with spring application and use mysql database.

Text Books:

1. Java The Complete Reference, Ninth Edition, by Herbert Schildt, McGraw Hill Education.

Reference Books:

1. Spring Microservices in Action, Second Edition, John Carnell, Manning Publications
2. Cloud Native Java, Kenny Bastani, Josh Long, O'Reilly Media, Inc..
3. Core and Advanced Java, Black Book, Dreamtech Press
4. Java Web Services: Up and Running, 2nd Edition, by Martin Kalin, O'Reilly Media, Inc.

Web reference:

1. https://struts.apache.org/
2. https://hibernate.org/orm/documentation/6.0/
3. https://docs.spring.io/spring-framework/docs/current/reference/html/

Program:	B. Tech. (Computer Engineering)			Semester: VI		
Course:	Professional Development Training - II			Code: BHM6918		
Teaching Scheme				Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	FA	SA	Total
03	-	-	03	-	-	-

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes:

After learning the course, students will be able to:

1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills.
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Modern Maths** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	06
II	**Algebra** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	06
III	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics.**	06
IV	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	06
V	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	06
VI	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	06
	Total	36

Reference Books:

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
4. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance.

Program:	B. Tech. (Computer Engineering)			Semester: V		
Course:	Environmental Sciences (Audit Course - 3)			Code: BHM9961		
Teaching Scheme				Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	FA	SA	Total
01	-	-	01	-	-	-

Course Objectives:

1. To gain an understanding on the concepts and strategies related to sustainable development and identify and analyse various conservation methods for renewable and non-renewable resources.
2. To examine biotic and abiotic factors within an ecosystem and to identify energy flow in ecosystem.
3. To understand the value of biodiversity and identify current efforts for it‘s conservation at national and local level
4. To provide comprehensive overview of environmental pollution and technology associated with monitoring and control.

Course Outcomes:

After learning the course, students will be able to:

1. Demonstrate an integrative approach to environmental issues with a focus on sustainability and identify the role of organism in energy transfer in different ecosystem.
2. Distinguish between renewable and non-renewable resources and analyse consumption of resources
3. Identify key threats to biodiversity and develop appropriate policy options for it‘s conservation.
4. Analyse the impact of environmental pollution and the science behind those problems and potential solutions.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Multidisciplinary nature of environmental studies** Definition, scope and importance, Need for Public awareness, Natural Resources: Renewable and non- renewable resources: Natural resources and associated problems a) Forest b) Water c) Mineral d) Food e) Land f) Energy, Role of an individual in conservation of natural resources, Use of resources for sustainable lifestyle.	**03**
II	**Ecosystems** Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposer, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Characteristic features, Case study on Forest ecosystem, Aquatic ecosystem.	**03**
III	**Biodiversity and its conservation** Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hotspots of biodiversity, Threats to biodiversity, Conservation of biodiversity, Case study on any one Hotspot of biodiversity.	**03**

IV	**Environmental Pollution** Definition, Cause, effects and control measures of different pollution: a. Air b. Water soil d. Noise e. Thermal f. nuclear hazards, Solid waste Management, Relevance of environmental ethics for environmental protection, Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, Impact of Climate change, Innovative ideas for creating public environmental awareness.	**03**
	Total	**12**

Text Books:

1. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., ―Environmental Encyclopedia‖, Jaico Publications House, 1st edition, 2000, ISBN-13: 978-8172247867
2. 2.Agarwal, K.C, ―Environmental Biology‖, Nidhi Publishers, 2nd edition ,2008, ISBN-13978-8189153021

Reference Books:

1. BharuchaErach, ―The Biodiversity of India‖, Mapin Publishing Pvt. Ltd., 1st edition, 20021, ISBN-108188204064.

Vision and Mission of Computer Department

Department Vision

To be a premier Computer Engineering Department by achieving excellence in Academics and Research for creating globally competent and ethical professionals.

Department Mission

M1: To develop technologically competent and self-sustained professionals through contemporary curriculum.
M2: To nurture innovative thinking and collaborative research, making a positive impact on society.
M3: To provide state-of-the art computing environment and learning opportunities through Center of Excellence.
M4: To foster leadership skills and ethics with holistic development.