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 ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Curriculum Structure and Syllabus

of

TY B.Tech E&TC Engineering

(Course 2020)

Effective from Academic Year 2023-24
(Updated with Minor Changes)

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

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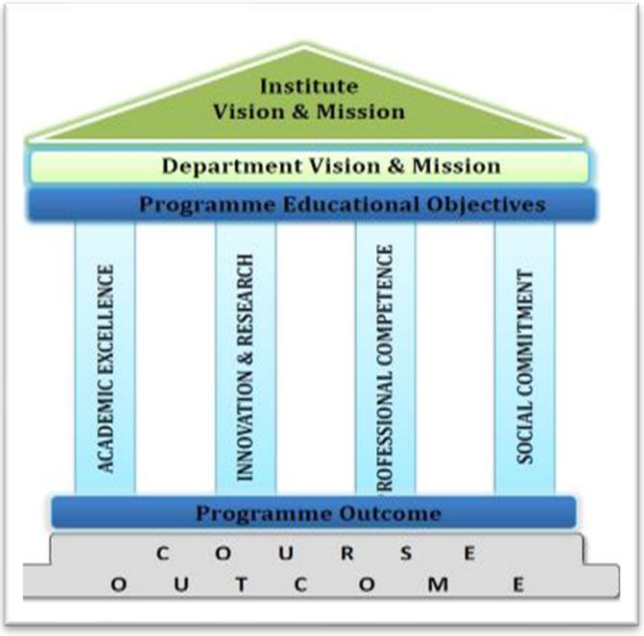
Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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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.	IE	Internal Evaluation
20.	MTE	Mid Term Evaluation
21.	ETE	End Term Evaluation
22.	TW	Term Work
23.	OR	Oral
24.	PR	Practical

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CURRICULUM FRAMEWORK

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

The Course and Credit Distribution

Sr. No.	Type of Courses	No of Courses	Total Credits No
1.	Basic Science Course (BSC)	7	23
2.	Engineering Core/ Science Course (ECC)	8	22
3.	Humanities, Social Sciences And Management Course (HSMC)	6	13
4.	Professional Core Course (PCC)	27	48
5.	Professional Elective Course (PEC)	12	18
6.	Open Elective Course (OEC)	6	18
7.	Project (PROJ)	2	14
8.	Internship (INTR)	1	3
9.	Audit Course (Audit)	3	-
10.	Mandatory Course (MC)	2	-
11.	Life Skill (LS)	4	-
12.	Proficiency Course (PFC)	3	-
13.	Massive Open Online Course (MOOC)	1	-
	Total	**82**	**161**

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	2	2	-	-	-	-	-	7
2.	Engineering Core Course (ECC)	3	3	1	1	-	-	-	-	8
3.	Humanities, Social Sciences And Management Course (HSMC)	1	1	1	1	1	1	-	-	6
4.	Professional Core Course (PCC)	-	-	7	7	4	4	5	-	27
5.	Professional Elective Course (PEC)	-	-	-	-	4	4	4	-	12
6.	Open Elective Course (OEC)	-	-	-	1	1	2	2	-	6
7.	Project (PROJ)	-	1	-	-	-	-	-	1	2
8.	Internship (INTR)	-	-	-	-	-	-	-	1	1
9.	Audit Course (Audit)	-	-	-	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	1	-	-	3
13.	MOOCs								1	1
	Total	**8**	**8**	**12**	**13**	**13**	**14**	**13**	**3**	**82**

CREDIT DISTRIBUTION : SEMESTER WISE										
1 Lecture hour = 1 Credit		2 Lab Hours = 1 Credit				1 Tutorial Hour = 1 Credit				
Sr. No.	**Type of Courses**	**No of Credits /Semester**								**Total**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
1.	Basic Science Course (BSC)	9	9	5	-	-	-	-		23
2.	Engineering Core Course (ECC)	9	7	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	14
8.	Internship (INTR)	-	-	-	-	-	-	-	3	3
9.	Audit Course (Audit)	-	-	-	-	-	-	-	-	-
10.	Mandatory Course (MC)	-	-	-	-	-	-	-	-	-
11.	Life Skill (LS)	-	-	-	-	-	-	-	-	-
12.	Proficiency Course (PFC)	-	-	-	-	-	-	-	-	-
13.	MOOCs	-	-	-	-	-	-	-	-	-
Total		**20**	**20**	**23**	**20**	**19**	**22**	**20**	**17**	**161**

Curriculum Structure

T.Y. B.Tech.

E&TC Engineering

Semester-V

STRUCTURE FOR THIRD YEAR B. TECH (E&TC ENGINEERING)
SEM-V

Course Code	Course Type	B.TECH Semester-V												
		Course Name	Teaching Scheme					Evaluation Scheme						
			L	P	T	Hrs	CR	CE	MTE	ETE	TW	PR	OR	Total
BET5414	PCC	Control System	2	-	1	3	3	10	15	50	25	-	-	100
BET5415	PCC	Digital Communication	3	-	-	3	3	20	30	50				100
BET5416	PCC	Digital Communication Lab	-	2	-	2	1	-	-	-	25	25	-	50
BET5417	PCC	Project Based Learning-V	-	2	-	2	1	-	-	-	50	-	-	50
BET5501 To BET5510	PEC	Program Elective-I	2	-	-	2	2	20	30	50	-	-	-	100
	PEC	Program Elective-I Lab	-	2	-	2	1	-	-	-	25	25	-	50
BET5511 To BET5520	PEC	Program Elective-II	2		-	2	2	20	30	50	-	-	-	100
	PEC	Program Elective-II Lab		2	-	2	1	-	-	-	25	-	25	50
xxxx	OEC	Open Elective-II	3	-	-	3	3	20	30	50				100
BHM5113	HSMC	Principles of Management	2	-	-	2	2	30	-	20	-	-	-	50
BHM5917	MC	Professional Development Training-1	3	-	-	3	-	-	-	-	-	-	-	-
BET5911 To BET5915	PFC	Proficiency Course	2	-	-	2	-	-	-	-	-	-	-	-
BHM9962	AC	Constitution of India	1	-	-	1	-	-	-	-	-	-	-	-
Total			**20**	**08**	**1**	**29**	**19**							**750**

Abbreviations:

L-Lecture, PR-Practical, T-Tutorial, H-Hour, CR-Credits, IE-Internal Evaluation, MTE-Mid-Term Evaluation, ETE-End-Term Evaluation, TW-Term work, OR-Oral

Semester -V

List of Program Elective-I

Course Code	Course Name	
BET5501	Power Electronics	Choose any one
BET5502	Power Electronics Lab	
BET5503	Advanced Microcontroller	
BET5504	Advanced Microcontroller Lab	
BET5505	Multidimensional Signal Simulation	
BET5506	Multidimensional Signal Simulation Lab.	
BET5507	Information Theory and Coding	
BET5508	Information Theory and Coding Lab.	
BET5509	Object oriented programming	
BET5510	Object oriented programming Lab.	

List of Program Elective-II

Course Code	Course Name	
BET5511	Robotics and Automation	Choose any one
BET5512	Robotics and Automation Lab.	
BET5513	Digital Design with Verilog HDL	
BET5514	Digital Design with Verilog HDL Lab.	
BET5515	Digital Image processing	
BET5516	Digital Image processing Lab.	
BET5517	Antenna Theory	
BET5518	Antenna Theory Lab.	
BET5519	Computational Tools for Data Analytics	
BET5520	Computational Tools for Data Analytics Lab.	

List of Open Elective Courses -II

Course Code	Course Name	Department	
BAS5607	Statistical Data Analysis Using R	AS&H	Choose any one
BCI5602A	Total Quality Management	Civil	
BCI5602B	Intelligent Transportation System	Civil	
BCE5601	Data Structures Using Python	Computer	
BCE5601	Programming with C++	Computer	
BIT5601	Object Oriented Programming	IT	
BME5602A	Industry 4.0	Mechanical	
BME5602B	Safety, Health and Environment	Mechanical	

List of Proficiency Courses

Course Code	Course Name	
BET5911	Basics of Lab View	Choose any one
BET5912	MATLAB Scripting	
BET5913	Embedded Product Design	
BET5914	Model based Development using MATLAB	
BET5915	PCB Design Skill	
BET5916	Synopsys EDA Tool Flow for Front-End Digital IC Design	
BET5917	Synopsys EDA Tool Flow for Back -End Digital IC Design	

STRUCTURE FOR THIRD YEAR B. TECH (E&TC ENGINEERING)
SEM-VI

Course Code	Course Type	B.TECH Semester-VI												
		Course Name	Teaching Scheme					Evaluation Scheme						
			L	P	T	Hrs	CR	CE	MTE	ETE	TW	PR	OR	Total
BET6418	PCC	Electromagnetics	2	-	1	3	3	10	15	50	25	-	-	100
BET6419	PCC	Digital Signal Processing	3	-	-	3	3	20	30	50	-	-	-	100
BET6420	PCC	Digital Signal Processing Lab	-	2	-	2	1	-	-	-		25	-	25
BET6421	PCC	Project Based Learning-VI	-	2	-	2	1	-	-	-	25		-	25
BET6501 To BET6510	PEC	Program Elective-III	2	-	-	2	2	20	30	50	-	-	-	100
	PEC	Program Elective-III Lab	-	2	-	2	1	-	-	-	-	25	-	25
BET6511 To BET6520	PEC	Program Elective-IV	2	-	-	2	2	20	30	50	-	-	-	100
	PEC	Program Elective-IV Lab	-	2	-	2	1	-	-	-	25		-	25
xxxx	OEC	Open Elective-III	3	-	-	3	3	20	30	50			-	100
	OEC	Open Elective-IV	3	-	-	3	3	20	30	50			-	100
BET6802	INTR	Internship	-	-	-	-	-	-	-	-	-	-	-	-
BHM61xx	HSMC	HSMC Course-VI	2	-		2	2	30		20			-	50
BHM6918	MC	Professional development Training-II	3	-	-	3	-	-	-	-	-	-	-	-
BET6911 To BET6915	PFC	Proficiency Course	2	-	-	2	-	-	-	-	-	-	-	-
BHM996x	AC	Audit Course	1	-	-	1	-	-	-	-	-	-	-	-
Total			**23**	**8**	**1**	**32**	**22**							**750**

Semester -VI

List of Program Elective-III

Course Code	Course Name	
BET6501	Energy harvesting and management	Choose any one
BET6502	Energy harvesting and management Lab	
BET6503	Embedded System Design & RTOS	
BET6504	Embedded System Design & RTOS Lab	
BET6505	Audio and speech processing	
BET6506	Audio and speech processing Lab	
BET6507	Mobile Communication and Networks	
BET6508	Mobile Communication and Networks Lab	
BET6509	JAVA programming	
BET6510	JAVA programming Lab	

List of Program Elective-IV

Course Code	Course Name	
BET6511	Battery Management System	Choose any one
BET6512	Battery Management System Lab	
BET6513	FPGA Architectures & Programming	
BET6514	FPGA Architectures & Programming Lab	
BET6515	Introduction to Statistical signal Processing	
BET6516	Introduction to Statistical signal Processing Lab	
BET6517	Fiber Optic Communication	
BET6518	Fiber Optic Communication Lab	
BET6519	Artificial Intelligence & Machine Learning	
BET6520	Artificial Intelligence & Machine Learning Lab	

List of Open Elective-III

Course Code	Course Name	Department	
BAS6608	Multivariate Data Analysis using R	AS&H	Choose any one
BCI6603A	Remote Sensing and GIS	Civil	
BCI6603B	Building Services and Maintenance	Civil	
BCE6603	Information Security	Computer	
BCE6604	Principles of Software Engineering	Computer	
BIT6601	Web Technology	IT	
BME6603A	3D Printing and Modeling	Mechanical	
BME6603B	Material Informatics	Mechanical	

List of Open Elective-IV

Course Code	Course Name	Department	
BME6604A	Model Based System Engineering	Mechanical	Choose any one
BME6604B	Electronics Cooling	Mechanical	
BCE6605	Fundamentals of Machine Learning	Computer	
BEC6606	JAVA Programming	Computer	
BIT6602	Mobile Application Development	IT	
BCI6604A	Smart Cities & Building Automations	Civil	
BCI6604B	Mechanical Electrical Plumbing (MEP) Systems	Civil	

List of HSMC Courses

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

List of Proficiency Courses

Course Code	Course Name	
BET6911	Basics of Lab View	Choose any one
BET6912	MATLAB Scripting	
BET6913	Embedded Product Design	
BET6914	Model based Development using MATLAB	
BET6915	PCB Design Skill	
BET6916	Synopsys EDA Tool Flow for Front-End Digital IC Design	
BET6917	Synopsys EDA Tool Flow for Back -End Digital IC Design	

List of Audit Courses

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

Course Syllabus

T.Y. B.Tech. Semester-V

Program:	B. Tech. (E&TC)	Semester:	V
Course:	Control Systems	Code:	BET5414

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	TW	Total
2	1	3	3	10	15	50	25	100

Prior Knowledge of:

1. Laplace Transforms and Partial Differential Equations.
2. Applied Mathematics

is essential

Course Objectives:

1. To make students aware of elements of control system and their modeling using various techniques.
2. To explain the methods for analyzing the time response and stability of system.
3. To make students familiar with the frequency response and stability of system.
4. To introduce the methods of root locus, Bode plots, Nyquist plots for the analysis of system.

Course Outcomes:

After completion of the course, the students will be able to:

1. Use models of physical systems in suitable forms for the analysis and design of control systems.
2. Interpret transient analysis of control systems for given input conditions.
3. Analyze the closed loop control system for stability.
4. Illustrate frequency domain analysis of control systems using various techniques

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to Control Systems & its modeling**: Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function. Modeling of Electric systems, Translational and rotational mechanical systems. Block diagram reduction Techniques. Signal flow graph	**8**
2.	**Time domain analysis:** Time domain analysis: transient response and steady state response, standard test inputs for time domain analysis, order and type of a system. Transient analysis of first and second order systems. Time domain specifications of second order under damped system from its step response. Steady state error and static error constants	**6**
3.	**Stability analysis:** Characteristic equation of a system, concept of pole and zero, response of various pole locations in s-plane, concept of stability absolute stability, relative stability, stability of system from pole locations. Routh Hurwitz stability criterion. Root locus: definition, magnitude and angle conditions, construction of root locus, concept of dominant poles, effect of addition of pole and zero on root locus. Application of root locus for stability analysis.	**8**
4.	**Frequency domain analysis:** Frequency response and frequency domain specifications. Correlation between time domain and frequency domain specifications. Polar plot. Nyquist stability criterion and construction of Nyquist plot. Bode plot, determination of frequency domain specifications and stability analysis using Nyquist plot and Bode plot. Introduction to state space representation. Advantages	**8**
	Total	**30**

Text Books:

1. N. J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2014.
2. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited; 5th Edition, 2014.

Reference Books:

1. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 8th Edition,2007.
2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2008.
3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill,2000

MOOC / NPTEL Courses:

1. NPTEL Course "Control System"
https://nptel.ac.in/courses/107/106/107106081/
2. NPTEL Course "Control System Design"
https://nptel.ac.in/courses/115/108/115108104/

List of Tutorials

1. Numericals on Block diagram reduction technique.
2. Numericals on Signal Flow Graphs.
3. Computation of transfer function of Electric Circuits, Mechanical Circuits Force-Voltage and Force Current analogy
4. Time domain specifications of the given system.
5. Steady state error and error coefficients of the type 0, 1 and 2 systems for step, ramp and parabolic inputs.
6. Stability analysis using Routh Hurwitz Criterion.
7. Computation of root locus for given G(s)H(s).
8. Frequency domain specifications of the system.
9. Computation of frequency response analysis using Bode Plot for given G(s) H(s).
10. Frequency response analysis using Nyquist

Program:B. Tech. (E&TC)				Semester: V			
Course: Digital Communication				Code: BET5415			
Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	--	03	03	20	30	50	100

Prior knowledge of

1. Signals and Systems , Modulation Techniques is essential

Course Objectives:

1. To make the students aware of various techniques of digital transmission, reception and data formats.
2. To make the students understand the concept of Passband modulation and demodulation techniques.
3. To Familiarize the students with the concepts of spread spectrum and multiuser communication techniques

Course Outcomes:

After the completion of this course, the students will be able to:

1. Equate the different waveform coding techniques and their performance.
2. Analyze the working of baseband digital transmission
3. Analyze the performance of baseband receiver systems in presence of noise.
4. Interpret the performance of pass band digital communication systems in terms of bandwidth & bit error probability.
5. Illustrate the performance of the digital communication system with the Multi User radio communication system.
6. Illustrate the digital communication system with a spread spectrum communication system.

Detailed Syllabus:

Unit	Description	Duration
1	**Digital Transmission:-**Introduction to Digital Communication System, PCM Generation and Reconstruction, Quantization Noise,Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation. Line Codes and their power spectra.	**08**
2	**Multiplexing & Synchronization Techniques:-** Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers, synchronization: BitSynchronization, Scramblers, Frame Synchronization.Inter-symbol interference,Equalization .	**07**
3	**Baseband Detection Techniques:-** Detection Theory: MAP, LRT, Minimum Error Test, Signal space representation : Geometric representation of signal, Likelihood functions, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.	**07**

4	**Digital Passband Modulation Techniques:-** Pass band transmission model, Generation and Detection of Coherent system (BASK, BFSK, BPSK, QPSK, MSK) and their error probability ,Generation and detection of - M-ary PSK, M-ary QAM and their error probability.	**08**
5	**Multiuser radio communication:-** Multi access techniques: TDMA & CDMA wireless communication systems, Multicarrier communications: OFDM – modulation and demodulation, spectral characteristics, bit and power allocation.	**07**
6	**Spread Spectrum Communications:-** Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum and its types.	**08**
	Total Hrs.	**45**

Text Books:

1. Simon Haykin, "Digital Communication Systems", 'Wiley, an Indian adaption Edition.2021
2.B.P. Lathi, Zhi Ding , "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition,2018

Reference Books:

1.Bernard Sklar, Fred Harris, "Digital Communications Fundamentals and Applications", Pearson Education, 3rd Edition,2021.
2. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5th edition, 2014
3. A.B Carlson and P.B. Crilly, "Introduction to Digital Communication", McGraw-Hill, 5th edition, 2015

NPTEL Course on "Digital Communications"

Link of the Course: https://nptel.ac.in/courses/108/102/108102096/

Program: B. Tech. (E&Tc)					Semester :V		
Course : Digital Communication Lab					Code : BET5416		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
02	-	1	2	25	--	25	50

Prior knowledge of:

Signals and Systems, Modulation Techniques is essential

Course Objectives:

1. To demonstrate the students with key modules of digital communication systems with an emphasis on digital modulation techniques.
2. To explain the students about performance of Spread spectrum techniques and use of software tools.

Course Outcomes:

After the completion of course, the students will be able to:

1. Apply the knowledge of fundamental communication systems to interpret the performance parameters.
2. Demonstrate the performance of passband communication systems.

Analyze digital modulation techniques by using software tools.

General Guidelines: Any 10 Experiments is to be performed.
GROUP-A any 7 and GROUP-B any 3

Detailed Syllabus:

Expt. No.	List of Experiments
	GROUP-A
1	Experimental study of PCM and companded PCM using 'A' law and 'μ'law
2	DM system Generation & detection: Calculation of bit rate and Bandwidth.
3	ADM system Generation & detection: Calculation of bit rate and Bandwidth.
4	Experimental study of line codes and their Spectral analysis.
5	BPSK Generation & detection: calculation of BW, observation of constellation diagram and coherent detection.
6	BFSK Generation & detection: calculation of BW, observation of constellation diagram and coherent detection.
7	QPSK Generation & detection: calculation of BW, observation of constellation diagram and coherent detection.
8	DS-SS with BPSK Generation & detection :Generation of PN sequence using N-bit, calculation of processing gain and coherent detection.
	GROUP-B
1	Implementation of PCM system using software tools
2	Implementation of BPSK system using software tools
3	Simulation study of constellation diagram of QPSK modulated signal.
4	Implementation of OFDM signal generation using software tools

Reference Books:

1.Bernard Sklar, Fred Harris, "Digital Communications Fundamentals and Applications", Pearson Education, 3rd Edition,2021.
2. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5th edition, 2014
3. A.B Carlson and P.B. Crilly, "Introduction to Digital Communication", McGraw-Hill, 5th edition, 2015

Virtual LAB Links:

1. Link: https://www.etti.unibw.de/labalive/index/digitalmodulation/
2. Link: https://vlab.amrita.edu/index.php?sub=59&brch=163&sim=262&cnt=970

Program: B. Tech. (E&Tc)					**Semester: V**		
Course: Project Based Learning-V					**Code:BET5417**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	1	2	50	-	-	50

Prior knowledge of:

1. Microcontroller and I/O interfaces
2. Electronics Circuit design

is essential.

Course Objectives:

1. To strengthen electronics and communication engineering concepts through practical implementation
2. To encourage students to develop viable solutions using multidisciplinary approach
3. To introduce fundamental steps in the prototype development

Course Outcomes:

After the completion of this course, the students will be able to:

1. Choose a viable solution for a problem based on current trends and societal needs by conducting literature surveys.
2. Apply previously acquired knowledge of electronics to design a prototype.
3. Demonstrate good presentation and writing skills and ability to work as an individual and as a team member

Detailed Syllabus:

Unit	**Description**	**Duration**
	The project selection: Project Selection should be based on Re-engineering concepts to introduce incremental advancements in the existing technology or operations. The spectrum of the project verticals can be and not limited to industries in the domain of Automobile, Health, Energy, Transportation, Security and Consumer Electronics. Emphasis should be given in the implementation of hardware related improvements in the existing system OR incremental software advancements in an application/data driven application **Project Implementation:** Hardware processing unit should be any microcontroller – Atmega, AVR with interfacing to auxiliary/ peripherals. Additionally prototype development board can be used to achieve functionalities in the project. The project with the software enhancement should demonstrate UI/dashboard development, data processing and data handling unit with interfacing to appropriate I/O. The project with hardware enhancement should be demonstrated on the PCB. **General Guidelines-** Project group shall consist of not more than 3 students per group. Project report should address technical parameter/s analysis and/or optimization of static/dynamic characteristics or power analysis or software performance parameters. All activities are required to be recorded in logbook.	

	A regular assessment of PBL work is required to be maintained at the department. It is expected that the PBL log book must include following: 1. Weekly monitoring by the PBL guide, 2. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC). The PEC consist of Head of the department, senior faculties of the department and one industry expert (optional). Continuous Assessment Sheet (CAS) is to be maintained by the department. Project shall be reviewed twice during the tenure by industry expert/ senior faculty member
	References: 1. Farid N. Nazm, Circuit Simulation, Wiley, 1st edition 2. Bossart, Printed Circuit Boards: Design and Technology, Tata McGraw Hill, 1st edition 3. Rajkumar Bansal, MATLAB and its Applications in Engineering Pearson Publishers, 2nd edition 4. Franco, Design with Operational Amplifiers & Analog Integrated Circuits, Tata McGraw Hill, 3rd edition 5. Horowitz & Hill, The Art of Electronics; Cambridge University Press, 3rd edition 6. Mitzner.K, Complete PCB Design Using Orcad Capture and Layout, Elsevier/ Newnes, 1st edition 7. Félix E. Guerrero-Castro and Ofelia Cervantes-Villagomez, Advanced Circuit Simulation Using Multisim Workbench, Morgan & Claypool Publishers, 1st edition 8. R. L. Boylstad, L. Nashlesky, Electronic Devices and circuits Theory, Prentice Hall of India, 9th edition 9. Dr. R. S. Sedha, Digital Electronics, S. Chand Publications, 3rd edition

Program Elective-I

Program: B. Tech. (E&TC)						**Semester :** V	
Course : Power Electronics						**Code: BET5501**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hour**	**Credit**	**IE**	**MTE**	**ETE**	**Total**
2	-	2	2	20	30	50	100

Prior Knowledge of:
1. Basics of electrical & electronics engineering.
2. Electronics devices and circuits & Fundamentals of mathematics,
Is essential

Course Objectives:

1. To introduce students to different power devices with construction, V-I characteristics, device ratings and typical triggering/driver circuits.
2. To make students understand working, performance analysis of various power converter circuits such as ac to dc converters, inverter, DC chopper, and AC voltage controllers.
3. To introduce various applications of power converters.

Course Outcomes:
After completion of this course students will be able to
1. Understand the construction, V-I characteristics, device ratings and typical triggering/driver circuits of different Power Devices.
2. Analyze AC to DC power converters.
3. Analyze DC to AC power converters.
4. Analyze DC to DC power converters & AC Voltage Controllers.

Detailed Syllabus:

Unit	**Description**	**Duration (Hrs)**
1	**Study of Power Devices** Construction, VI characteristics, switching characteristics of SCR, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, Device ratings of SCR, Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto-isolator) circuits for various power devices, importance of series and parallel operations of various power devices (no derivation and numerical), Protections to power devices.	**8**
2	**AC to DC Power Converters** Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads, its performance analysis and numerical. Effect of source inductance and freewheeling diode, Single Phase PWM Rectifier using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers. Application of AC to DC converters in DC motor drive for single phase separately excited dc motor.	**8**

3	**DC to AC Power Converters** Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and harmonic elimination / reduction in inverters, Control of voltage using various PWM techniques and their advantages, Applications of Inverter in Electronic Ballast, BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS.	**7**
4	**DC to DC and AC to AC Power Converters** DC to DC Power Converters: Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non-isolated). Applications of DC Chopper in DC Motor drive. AC to AC Power Converter: Single phase AC Voltage Controller using IGBT & SCR for R load. Application of AC Voltage controller in FAN regulator, Electric Furnace. Case study of power electronics in electric vehicle and photovoltaic solar system.	**7**
	Total	30

Textbooks:

1. M. H. Rashid, “Power Electronics Circuits Devices and Applications”, PHI,4th Edition 2017 New Delhi.
2. 2. M. D. Singh and K. B. Khanchandani, “Power Electronics”, TMH, 2 nd Edition 2006.

Reference Books:

1. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters Applications and Design, John Willey & sons, Singapore, 2 nd Edition Oxford University Press, New Delhi, 2005
2. Muhammad H. Rashid, “Power Electronics Handbook”, Academic Press, 2nd Edition, 2001.
3. Bogdan M. Wilamowski, J. David Irwin, “The Power Electronics and Motor Drives Handbook”, CRC Press, 1 st Edition, 2011.; eBook: ISBN 9780429165627, 2019.
4. SCR Manual by GE Company

NPTEL Courses Link

1. **https://nptel.ac.in/courses/108105066**

Program: B. Tech. (E&TC)				Semester : V			
Course : Power Electronics Lab				Code: BET5502			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	PR	OR	Total
02	-	02	01	25	25	-	50

Prior knowledge of:

1. Basics of electrical & electronics engineering.
2. Electronics devices and circuits & Fundamentals of mathematics,

Is essential

Objectives:

1. To understand the V-I Characteristics of different power devices.
2. To introduce the working and performance of various power converter circuits.
3. To introduce the applications of Power Electronics Converters.

Outcomes:

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

1. Perform the V-I Characteristics of different power devices
2. Understand the working and performance of various power converter circuits.
3. Demonstrate the power electronics converters used in applications.

List of Laboratory Experiment

Group A (Power Device Characteristics), 1 compulsory, from 2 or 3 any one	
1	VI Characteristics of SCR i) Plot output V-I characteristics to measure IH, IL and voltage before and after breakdown, ii) Observe the effect of gate current on forward breakdown iii) gate characteristics iv) compare with datasheet specifications.
2	V-I Characteristics of Power MOSFET i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications
3	V-I Characteristics of IGBT i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications
Group B (Power Converters) Simulation of the power converters mentioned in group B using Powersim (PSIM) simulation software is compulsory and the performance on trainer kits.	
4	Single phase Semi and Full Converter using SCR with R & R-L load i) Observe load voltage waveform, ii) Measurement of average o/p voltage across loads, iii) Verification of theoretical values with practically measured values.
5	Single-Phase PWM Power MOSFET / IGBT based bridge inverter for R and motor load i) Observe output voltage waveforms and measure set of rms output voltage for varying pulse width and variable input dc voltage for R and motor load, ii) compare measured output voltages with the theoretical findings
6	Step down / Step up chopper using power MOSFET / IGBT i) Measure duty cycle and observer effect on average load voltage for DC chopper
7	Single phase AC voltage controller using SCR for R and RL load i) Observe output rms voltage waveforms, ii) Measurement output voltage across load, iii) Verification of theoretical values with practically measured values.
Group C (Applications of Power Electronics Converters), Any Two Students can use PSIM Software	
8	SMPS /UPS Performance Evaluation i) find load & line regulation characteristics for no load condition and at 500 mA & 1A load ii) compare the performance with supplier specifications
9	To study speed control of DC / single phase AC motor

10	To design and implement a solar cell operated emergency lighting system.

Note: - Visit to Solar power generation plant or Electric Vehicle manufacturing plant is recommended

Reference Books:

1. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters Applications and Design, John Willey & sons, Singapore, 2 nd Edition Oxford University Press, New Delhi, 2005
2. Muhammad H. Rashid , "Power Electronics Handbook", Academic Press, 2nd Edition, 2001.
3. Bogdan M. Wilamowski, J. David Irwin, "The Power Electronics and Motor Drives Handbook", CRC Press, 1 st Edition, 2011. ; eBook: ISBN 9780429165627, 2019.
4. SCR Manual by GE Company

Program:	**B. Tech. (E&TC)**	**Semester:**	**V**
Course:	**Advanced Microcontroller**	**Code:**	**BET5503**

Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**IE**	**MTE**	**ETE**	**Total**
2	--	2	2	20	30	50	100

Prior Knowledge of:

1. Microcontroller is essential.

Course Objectives:

1. To make students understand architecture and applications of ARM processors in embedded systems.
2. To make students aware of ARM7 based microcontroller architectures and its features.
3. To explore students with interfacing of real world input and output devices.

Course Outcomes:

After completion of this course students will be able to

1. Compare the different ARM processors.
2. Illustrate the features of ARM based microcontrollers.
3. Develop embedded systems using basic peripherals.
4. Build embedded systems with advanced peripherals.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**INTRODUCTION TO ARM PROCESSORS AND ITS VERSIONS** ARM7, ARM9 & ARM11 features, advantages & suitability in embedded application ARM7 registers, CPSR, SPSR, ARM and RISC design philosophy, ARM7 data flow model, programmer's model, modes of operations	**7**
2.	**ARM7 BASED MICROCONTROLLER LPC2148** Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider), Memory Map, GPIO, Pin Connect Block, Timer, simple LPC2148 GPIO Programming examples using timers of LPC2148 to generate delay	**8**
3.	**ARM REAL WORLD INTERFACING PART I** Interrupt structure of LPC2148, Interfacing with LED, LCD, GLCD, KEYPAD, simple LPC2148 USART Programming, on-chip ADC, Waveform generation using DAC All programs in embedded C.	**8**
4.	**ARM REAL WORLD INTERFACING PART II** GSM, GPS module interfacing, Study of protocols I2C, SPI, EEPROM with I2C, All programs in embedded C. Introduction to ARM cortex series, CORTEX A, R, M processors, Firmware development using CMSIS Standard.	**7**
	Total	30

Text Books:

1. Andrew Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide – Designing and Optimizing System Software‖, 1st edition, ELSEVIER, 2004.

References:

1. Steve Furber, ARM System on Chip Architecture, 2nd edition, Addison-Wesley, March 2000.
2. LPC 214x User manual (UM10139) :- www.nxp.com
3. ARM architecture reference manual : - www.arm.com

Program: B. Tech. (E&Tc)					V		
Course : Advanced Microcontroller Lab					**Code :BET5504**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
02		2		25		25	50

Prior knowledge of:

1. Microcontroller is essential

Objectives:

1. To make students familiar with interfacing of real world IO devices with ARM7 based microcontroller.
2. To demonstrate use of hardware and software tools for embedded system.

Outcomes:

After completing the course, the students should be able to:

1. Demonstrate the interfacing of simple GPIO's.
2. Implement communication protocol between peripherals and microcontroller.
3. Implement real time interfacing application using ARM7 microcontroller.

General Guidelines: Any Ten Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	LED Blinking using software delay
2	LED Blinking using Timer
3	Square waveform Generation using Timer Interrupt
4	Interfacing with 16x2 LCD
5	KEYPAD & LCD interfacing
6	Interfacing LPC2148 with GLCD to display image on it.
7	Using UART of LPC2148 for serial reception and transmission from/to computer.
8	Interfacing GSM with LPC2148 for sending and receiving message and voice call.
9	Interfacing GPS with LPC2148 for finding current location latitude and longitude values.
10	Using built-in ADC of LPC2148 for displaying its values (Programming built-in ADC with interrupt and without interrupt)
11	Waveform Generation using DAC
12	Interfacing EEPROM to LPC2148 using I2C protocol

Reference Books:

1. Andrew Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide – Designing and Optimizing System Software‖, ELSEVIER, 2004.
2. Steve Furber, ARM System on Chip Architecture, 2nd edition, Addison-Wesley, March 2000.
3. LPC 214x User manual (UM10139) :- www.nxp.com
4. ARM architecture reference manual : - www.arm.com

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Multidimensional Signal Simulation			Code:	BET5505		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2		2	2	20	30	50	100

Prior Knowledge of:
Basic Signal Processing is essential

Course Objectives:

1. Make the students familiar to different dimensional signals.
2. Develop an ability to design an 2D, 3D, 4D and 5D applications.

Course Outcomes:
After completing the course, the students should be able to:

1. Identify the difference between different dimensional signals.
2. Apply 3D builder to design an application.
3. Design an 4D application.
4. Design an 5D application.

Detailed Syllabus:

Unit	Description	Duration
1.	Introduction to Dimension: 0D, 1D, 2D, 3D, 4D, and 5D. Difference between vector and tensor, Variables/parameters, Representation	**4**
2.	0D and 1D vectors: Introduction, representation, difference between 0D and 1D, applications, Case study: Application to battery ageing, Software tool Modelica /Python/ GT-SUITE	**8**
3.	2D and 3D vectors: Introduction, representation, difference between 0D 1D, 2D and 3D, applications, Case study: geological/geophysical exploration, Software tool 3D builder, Catia /Inventor	**9**
4.	4D and 5D vectors: Introduction, representation, difference between 3D, 4D and 5D, applications, Case study: Satellite/Medical Imaging	**9**
	Total	30

Text Books:

1. One-Dimensional Digital Signal Processing (Electrical and Computer Engineering) 1st Edition by C. Chen, 1979.
2. Two-dimensional Signal and Image Processing by Jae S. Lim, Prentice Hall, 1989
3. Maas, Steve, et al. "Reservoir Monitoring, 4D Signal, And Fiber-Optic Technology." *PGCE 2009*. European Association of Geoscientists & Engineers, 2009.

References:

1. https://rukshanpramoditha.medium.com/real-world-examples-of-0d-1d-2d-3d-4d-and-5d-tensors-100b0837ced4
2. https://medium.com/secure-and-private-ai-writing-challenge/introduction-to-tensors-1-de7dded35fea
3. http://www.differencebetween.info/difference-between-2d-3d-and-4d
4. https://www.academia.edu/41739709/Fifth_Dimension_5D_Science
5. http://dusk.geo.orst.edu/gis/lec14_3d.html
6. https://www.insightsonindia.com/2015/11/21/5-write-note-4-d-5-d-imaging-technologies-applications-150-words/
7. Tang, Yuneng, et al. "Recent Advances of 4D Printing Technologies Toward Soft Tactile Sensors." *Frontiers in Materials* 8 (2021): 658046.

Program: B. Tech. (E&Tc)							**Semester :V**
Course : Multidimensional Signal Simulation Lab							**Code : BET5506**
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	--	2	1	25		25	50

Prior knowledge of:
Programming language **is essential**.

Course Objectives:

1. To design the specific application for 1 to 5 dimensional signal.

Course Outcomes: After completing the course, the students should be able to:

1. Design an application using 3D builder.
2. Design an 4D application.
3. Design an 5D application

General Guidelines: Any Eight Experiments is to be performed. Experiments will be conducted on Modelica /Python/ GT-SUITE.

Detailed Syllabus:

Expt. No.	**List of Experiments**
1.	Study of 1 D and 2 D Library
2.	Design and Implementation of the battery ageing
3.	Verification of the battery ageing
4.	Study of 3D Library from 3D builder/ Catia/Inventor
5.	Design and Implementation of geological/geophysical exploration using 3D builder
6.	Verification of geological/geophysical exploration using 3D builder
7.	Study of 4D Library from 4D Satellite/Medical Imaging Application.
8.	Design and Implementation of 4D Satellite/Medical Imaging Application.
9.	Verification of 4D Satellite/Medical Imaging Application.
10.	Design and Implementation of 5D electronics/electrical based Application
11.	Verification of 5D electronics/electrical based Application

References:

1. https://rukshanpramoditha.medium.com/real-world-examples-of-0d-1d-2d-3d-4d-and-5d-tensors-100b0837ced4
2. https://medium.com/secure-and-private-ai-writing-challenge/introduction-to-tensors-1-de7dded35fea
3. http://www.differencebetween.info/difference-between-2d-3d-and-4d
4. https://www.academia.edu/41739709/Fifth_Dimension_5D_Science
5. http://dusk.geo.orst.edu/gis/lec14_3d.html
6. https://www.insightsonindia.com/2015/11/21/5-write-note-4-d-5-d-imaging-technologies-applications-150-words/
7. Tang, Yuneng, et al. "Recent Advances of 4D Printing Technologies Toward Soft Tactile Sensors." *Frontiers in Materials* 8 (2021): 658046.

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Information Theory and Coding			Code:	BET5507		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	--	2	2	20	30	50	100

Prior Knowledge of:

1. Basic concepts of Probability
2. Communication system **is essential.**

Course Objectives:

1. To introduce the terminology and basic concepts of information theory.
2. To encourage the students to study the different data compression methods.
3. To motivate the students to study the different error coding techniques
4. To make the students familiar with different types of error correcting codes

Course Outcomes:

After completion of this course, students will be able to,

1. To apply the basics concept of information theory.
2. To analyze the different data compression methods.
3. To construct the different error coding techniques
4. To identify the different types of error correcting codes

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to Information theory**:- Probability, Uncertainty, self-information, Entropy and information rate, mutual information and their properties, Discrete memory less channel, Channel capacity	**8**
2.	**Source Coding**:-Source coding theorem, Data compression, Huffman coding, Lempel-Ziv coding, Run-length encoding, Introduction to cryptography Review on recent Research Papers	**7**
3.	**Channel Coding:-** Channel coding theorem, Introduction to Error control codes, Block codes, linear block codes, cyclic codes, BCH and RS codes Review on recent Research Paper	**8**
4.	**Convolution Code** :- Introduction to Convolution Codes, Properties, convolution encoder and Decoder, Turbo codes, Repetition code, Golay code, LDPC code, ARQ	**7**
	Total	30

Text Books:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2001.
2. Ranjan Bose, ―Information Theory coding and Cryptography‖, McGraw-Hill, 2nd E, 4th Edition 2008

Reference Books:

1. Lin, Shu, and Daniel J. Costello. Error control coding. Vol. 2. No. 4. New York: Prentice hall, 2001.
2. Moon, Todd K. Error correction coding: mathematical methods and algorithms. John Wiley & Sons, 2020.
3. Khalid Sayood, ―Introduction to Data compression, Morgan Kaufmann Publishers, 2nd Edition 2011.

NPTEL/ MOOC courses

1. An Introduction to Information Theory https://onlinecourses.nptel.ac.in/noc22_ee49/preview
2. Information Theory https://onlinecourses.nptel.ac.in/noc20_ee96/preview

Program: B. Tech. (E&Tc)					Semester :V		
Course : I T C T Lab					Code :BET5508		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	--	2	1	25	-	25	50

Prior knowledge of:

1. Basic concepts of Probability and communication system
2. MATLAB /Simulink/ Open source platform is essential

Course Objectives:

1. To introduce the basics of Information theory
2. To inculcate the implementation of source coding techniques for data compression
3. To instill the knowledge of various channel coding techniques and their implementation.

Course Outcomes:

After completion of this course, students will be able to,

1. To analyze the different terminologies related to information theory
2. Design and verify the source coding algorithm for data compression
3. Design and verify the Channel coding algorithm for error detection and correction.

General Guidelines: Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Write a program to find the entropy for the given source
2	Write a program to find different entropies , Mutual information and channel capacity for given channel
3	Write a program to find the coding efficiency using Huffman source coding
4	Write a program to encode and decode using LBC
5	Write a program to encode and decode using Cyclic code
6	Write a program to encode and decode using BCH code
7	Write a program encode and decode using RS code
8	Write a program encode and decode using Convolution code
9	Case study on Data compression
10	To study the applications of different types of code
11	To study the Cryptography techniques

Reference Books:

1. Ranjan Bose, ―Information Theory coding and Cryptography‖, McGraw-Hill, 2nd Ed, 2008
2. Murlidhar Kulkarni, K.S.Shivaprakasha, ―Information Theory & Coding‖, Wiley Public.2010
3. Simon Haykin, ―Communication Systems‖, John Wiley & Sons, Fourth Edition. 2008
4. Shu lin and Daniel j, Cistello jr., ―Error control Coding‖ Pearson, 2nd Edition. 2001
5. Todd Moon, ―Error Correction Coding : Mathematical Methods and Algorithms‖, Wiley Publication, 2020
6. Khalid Sayood, ―Introduction to Data compression‖, Morgan Kaufmann Publishers, 2017

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Object Oriented Programming			Code:	BET5509		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	--	2	2	20	30	50	100

Prior Knowledge of:

1. Data Structures

2. C programming is essential.

Course Objectives:

1. To Make the students familiar with basic concepts and techniques of object oriented programming.
2. To Make the students aware of modern C++.
3. To Develop an ability among the students to implement programs in C++ for problem solving.

Course Outcomes:

After completion of this course, students will be able to,

1. Describe the principles of object oriented programming.
2. Apply the concepts of classes and methods to write programs in C++.
3. Implement the programs in C++11 and C++14.
4. Apply the concepts of inheritance and polymorphism to write programs C++.

Detailed Syllabus:

Unit	Description	Duration
1.	**Fundamental of Object-Oriented Programming:** Introduction to object-oriented programming, Limitations of procedural programming, Fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline function, Function overloading. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators.	8
2.	**Classes & Objects:** Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors.	8
3.	**Introduction to C++11 and C++14:** Summary of the standard C and C++ libraries, Container classes, Container adapters, Creating and accessing containers, Initializer lists, Common Container Methods, Custom allocators, std::array, Lambda Functions, Filling a container, Non-modifying operations.	6
4.	**Operator Overloading:** Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions. **Inheritance & Polymorphism:** Introduction to inheritance, base and derived classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding.	8
	Total	30

Textbooks:

1. E Balagurusamy, “Programming with C++”, Tata McGraw Hill, 4th Edition,2019.
2. Herbert Schildt, “The Complete Reference C++”, McGraw-Hill, 5th Edition,2013.
3. Scott Meyers, “Effective Modern C++ “,O'Reilly Media,1st Edition,2014.

Reference Books:

1. Robert Lafore, “Object Oriented Programming in C++”, Sams Publishing, 4th Edition,2017
2. Parasons, “Object Oriented Programming with C++”, BPB Publication, 8th edition, 2020.
3. Bjarne Stroustrup ”The C++ Programming Language", Addison-Wesley,4th edition , 2013.

MOOC / NPTEL Courses:

1. NPTEL Course “Programming in C++”

https://nptel.ac.in/courses/106/105/106105151/

2**. Udemy course “Complete Modern C++ (C++11/14/17)”**

https://www.classcentral.com/course/udemy-beg-modern-cpp-23507

Program: B. Tech. (E&Tc)					**Semester :V**		
Course : Object Oriented Programming Lab					**Code : BET5510**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	--	2	1	25		25	50

Prior knowledge of:

1. Data Structures
2. C programming is essential.

is essential.

Course Objectives:

1. To Demonstrate the concept of OOP using C++.
2. To make students implement programs in C++ 11 and C++14.

Course Outcomes:

At the end of Laboratory work, the students will be able to:

1. Apply the concepts of classes and methods to write programs in C++.
2. Utilize the concepts of inheritance and polymorphism to write programs C++.
3. Implement the programs in C++11 and C++14.

General Guidelines: Any six Experiments from group A and Any 2 Experiments from group B are to be performed.

Expt. No.	**List of Experiments**
Group A:	
1.	Write a program in C++ to sort the numbers in an array using separate functions for read, display, sort and swap
2.	Write a C++ program that illustrates the concept of Function over loading.
3.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate.
4.	Write a program in C++ to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors.
5.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide. Use operator overloading for these operations.
6.	Write a program in C++ to Read and Display the information of Employee Using Multiple Inheritance. Use Basic Info and Department Info as a base classes of Employee class.
7.	Write a program in C++ to Read and Display the information of Employee Using Multilevel Inheritance Use Basic Info and Department Info as a base classes of Student class..
8.	Write a C++ program that illustrates run time polymorphism by using virtual functions.
Group B:	
9.	Write a C++ 11 program for Lamba Expressions of Lambda Functions.
10.	Write a C++ 14 program for Lamba Expressions of Lambda Functions.
11.	Write a C++ 11 program for Uniform Initialization.
12.	Write a C++ 14 program for Uniform Initialization

Reference Books:

1. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, 4th Edition,2017
2. Parasons, "Object Oriented Programming with C++", BPB Publication, 8th edition, 2020.
3. Bjarne Stroustrup , "The C++ Programming Language", Addison-Wesley,4th edition , 2013

MOOC / NPTEL Courses:

1. NPTEL Course "Programming in C++"

https://nptel.ac.in/courses/106/105/106105151/

2**. Udemy course "Complete Modern C++ (C++11/14/17)"**

https://www.classcentral.com/course/udemy-beg-modern-cpp-23507

Program Elective-II

Program: B. Tech.(E&TC)				**Semester:** V			
Course: Robotics and Automation				**Code:** BET5511			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**IE**	**MTE**	**ETE**	**Total**
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Basic engineering mathematics, Differential equations and Integration, Basic coordinate system, is essential

Course Objectives:

1. To introduce various types of Robots and the functional elements of Robotics
2. To impart knowledge of robot drive systems with Robo programming
3. To introduce students to different types of end effectors and actuators and programming logic as per robotic Applications

Course Outcomes:

After completion of this course students will be able to

1. To understand the basic classification of robots with specification
2. To apply the knowledge of robot drivers and vision systems to understand the programming of the robot
3. To select appropriate grippers, actuators, and driving motors for particular robotics applications
4. To apply programming logic to develop an industrial robotic system.

Detailed Syllabus:

Unit	**Description**	**Duration (Hrs.)**
I	**BASIC CONCEPTS IN ROBOTICS :**-Definition, Anatomy of the robot; Basic structure of robot; Specifications and Classification of the robot; Safety Measures in robotics; Industrial Applications of Robots	**6**
II	**Robot drivers Sensors and Vision Drives for robots :** Sensors in robotics, Principles and applications of the following types of sensors- Internal-External Contact-noncontact; position velocity force torque proximity and range. Introduction of Machine Vision in Robotics -Shape and Color identification using Machine Vision System, Optical Characteristics Recognition (OCR) using Machine Vision System, Drowsiness Detection Robot	**8**
III	**End Effectors and Actuators:** An overview of actuators; Electric hydraulic and pneumatic Actuators Power and torque, Acceleration and velocity; Specifications and characteristics of Stepper motors AC motors; DC motors and servomotors. Various process tools as end effectors; Robot end effectors interface, different types of grippers ;Mechanical, Magnetics, vacuum, Adhesive	**8**
IV	**Robot Kinematics and Programming Methods** Basic fundamentals of direct kinematics & inverse kinematics for industrial robots for position and orientation Simple programs on speed control, Direction control robot Line Following Algorithms based robot, Programming Humanoid Robot walking or similar application. Pick and Place application robot, Tracking Robot	**8**
	Total	30

Text Books:

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano and Lorenzo Sciavicco (latest edition: 3rd edition, published in 2020)
2. Introduction to Robotics: Mechanics and Control" by John Craig (latest edition: 4th edition, published in 2019)
3. Industrial Robotics: Technology, Programming, and Applications" by Mikell P. Groover and Mitchell Weiss (latest edition: 2nd edition, published in 2020)
4. Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee (latest edition: 1st edition, published in 2019)

Reference Books:

1. Robotics: State of the Art and Future Challenges" edited by Sukhan Lee and Bradley Hayes (latest edition: 2021)
2. Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee (latest edition: 1st edition, published in 2019)
3. Robotics and Control" by R.K. Mittal and I.J. Nagrath (latest edition: 1st edition, published in 2018)
4. Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee (latest edition: 1st edition, published in 2019)

NPTEL Courses Link

1. Robotics (IIT Kharagpur) : https://nptel.ac.in/courses/112105249
2. Robotics Automation (IIT Bombay): https://nptel.ac.in/courses/112101098
3. Introduction to robotics (IIT Madras): https://nptel.ac.in/courses/107106090

Program: B. Tech. (E&Tc)					**Semester: V**		
Course: Robotics and Automation Lab					**Code: BET5512**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	--	2	1	25	25		50

Prior knowledge of:

Sensors, Control Systems and basic programming

is essential.

Course Objectives:

1.To learn and understand the basics of fundamentals of robotics systems.
2.To be acquainted with a different configuration of the robotics system
3.To write program for robotic Application

Course Outcomes:

After completing the course, the students should be able to:

1. To understand the basic configuration of robots
2. To demonstration robot drivers and vision systems for particular robotics applications
3. To build programming logic to develop an industrial robotic system.

General Guidelines: Any 6 from first 7 Experiment and 8th experiment is compulsory.

Detailed Syllabus:

Exp. No.	**List of Experiments**
1	To Study of the configuration of robots and motion of robot manipulator
2	To arrange Industrial visit for Industrial robotic application
3	To demonstrate the Robot Tracking Program for the given path.
4	To demonstrate Shape and Color identification using Machine Vision System.
5	To demonstrate Optical Characteristics Recognition (OCR) using Machine Vision System.
6	To Program Robotics for Pick and Place application.
7	To Program and Demonstrate Robot Sorting System.
8	Robot development Project

Reference Books:

1. Robotics: A Project-Based Approach" by MJ. Dominique, 2nd Edition, 2021.
2. Robot Modeling and Control" by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, 3rd Edition, 2020
3. Introduction to Robotics: Mechanics and Control" by John J. Craig, 4th Edition, 2019.
4. Robotics, Vision and Control: Fundamental Algorithms in MATLAB" by Peter Corke, 2nd Edition, 2017.

Virtual Lab Links

1. Mechanisms & Robotics Lab
   http://vlabs.iitkgp.ernet.in/mr/
2. Robotics Application Lab

https://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525

3. Bio Inspired Robotics Virtual Lab.
   https://vlab.amrita.edu/?sub=3&brch=257

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Digital Design with VERILOG HDL			Code:	BET5513		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	--	2	2	20	30	50	100

Prior Knowledge of:
Digital Logic Design
Is essential

Course Objectives:

1. To introduce the concepts of modeling a digital system using Verilog hardware description Language.
2. To familiarize students with different levels of abstraction in Verilog.
3. To introduce concepts of logic synthesis and basics of verification.

Course Outcomes:

After completion of this course, students will be able to,

1. Understand evolution of CAD and HDL environment and Verilog basics.
2. Model combinational circuits Dataflow modelling style.
3. Model combinational and sequential circuits in Behavioral style.
4. Develop a test bench model for design under test.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction: Evolution of Cad and HDL environment.** Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis. Basics concepts: Lexical conventions, Datatypes, systems tasks and compiler directives. Module definition, Port declaration and connecting ports, hierarchical referencing	**7**
2.	**Gate Level Modeling:** Modelling of basic Verilog gate primitives, description of various gates, rise, fall and turn off delays, min, max and typical delays. **Data flow modelling:** continuous assignments, delay specifications, expressions, operator and operands.	**8**
3.	**Behavioral Modeling:** Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Design at Behavioral Level, Blocking and Non-Blocking Assignments, The 'Case' Statement, 'If' and 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, sequential and Parallel Blocks.	**8**
4.	**Test bench:** Test bench for sequential and combinational circuits, Test pattern generation, test bench with initial block. Introduction to score boards, verification model and verification environment.	**7**
	Total	30

Text Books:

1. Taraate, Vaibbhav. *Digital Logic Design Using Verilog*. Springer Singapore, Edition 1st . 2022.
2. J. Bhaskar, "A Verilog Primer'', BSP, 2nd edition 2003.

Reference Books:

1. Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition,2003.
2. Thomas and Moorby, "The Verilog Hardware Description Language", kluwer academic publishers, 5th edition, 2002
3. Stephen Brown and Zvonko Vranesic, "Fundamentals of Logic Design with Verilog", TMH publications, 2007.
4. Charles.H.Roth,Jr., Lizy Kurian John "Digital System Design using VHDL" , Thomson, 2nd Edition, 2008

Program: B. Tech. (E&Tc)				Semester : V		
Course : Digital Design with VERILOG HDL -Lab				Code: BET5514		
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	TW	OR	Total
2	--	2	1	25	25	50

Prior knowledge of

Digital Logic design **is essential**

Course Objectives:

1. To introduce to behaviour and RTL modelling of digital circuits using Verilog HDL, verifying and synthesizing RTL models to FPGAs.
2. To expose to practical experience by designing, modelling, implementing and verifying several digital circuits.

Course Outcomes:

After completion of this course, students will be able to,

1. Demonstrate the function of adder/subtractor circuits using Verilog.
2. Model and synthesize Multiplexers Decoders, Encoders circuits using Verilog.
3. Model and synthesize different Flip-flops and counters using Verilog and implement on FPGA.
4. Use FPGA/CPLD kits for down loading Verilog codes for shift registers and counters and check output.

General Guidelines: Any 8 assignments are compulsory.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Design and implement Adder – Full/half using Verilog in dataflow Modelling
2	Write a test bench for 4-bit ALU and Implement on PLD
3	Design and implement 4:1 Multiplexer and 1:8 Demux using verilog in behavioural modelling.
4	Write a test bench for 4:1 Multiplexer and 1:8 Demux and Implement on PLD
5	Design and implement D FF (active low-asynchronous reset) using verilog in behavioural modelling.
6	Write a test bench for D FF and Implement on PLD
7	Design and implement 4 bit Up-Down counter using verilog in behavioural modelling.
8	Write a test bench for 4 bit Up-Down counter and Implement on PLD
9	Write Verilog Description for sequence detector FSM to detect alternate 1's and 0's till 4 bits.
10	Write a test bench for 4 bit Up-Down counter and Implement on PLD
11	Write Verilog Description for sequence detector FSM to detect alternate 1's and 0's till 4 bits non overlapping.
12	Write a test bench for 4 bit Up-Down counter and Implement on PLD
	Case study: Write Verilog Description for Random Number Generator using linear feedback shift register. Write a test bench for Random Number Generator using linear feedback shift register. and Implement on PLD

	Total Hours	**30**

Reference Books:

1. Fundamentals of Digital Logic with Verilog Design - Stephen Brown,Zvonkoc Vranesic, TMH, 2nd Edition.2010
2. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.
3. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
4. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI,2009

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Digital Image Processing			Code:	BET5515		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	--	2	2	20	30	50	100

Prior Knowledge of: Basic Signals and Signal Processing is essential

Course Objectives:

1. To make students familiar with fundamental concepts of Digital Image Processing with basic relationship of pixels and mathematical operations on 2-D data.
2. To introduce design and integrate image enhancement.
3. To make students aware of the need for effective use of resources such as storage and bandwidth and ways to provide effective use of them by data compression techniques
4. To make student apprised of object segmentation and image analysis techniques

Course Outcomes:

After the completion of the course students will be able to

1. Develop basic mathematical operations on digital images.
2. Analyze image enhancement problems.
3. Apply 2-D data compression techniques for digital images.
4. Design image processing algorithms for object segmentation

Detailed Syllabus:

Unit	Description	Duration
1.	**Fundamentals of Image Processing**: Steps in Image processing, Human visual system, Sampling & quantization, Representing digital images, spatial and gray level resolution, Basic relationships between pixels, Distance Measures, Basic operations on images – image addition, subtraction, logical operations, scaling translation, rotation.	**7**
2.	**Image Enhancement** :Log transformation, Power law transformation, Piecewise linear transformation, Image histogram, histogram equalization, Mask processing of images, filtering operations- Image smoothing, image sharpening, frequency domains image enhancement: 2D DFT, smoothing and sharpening in frequency domain	**7**
3.	**Image Compression**: Types of redundancy, Fidelity criteria, Compression models - Information theoretic perspective – Fundamental coding theorem, Lossless Compression: Huffman Coding- Arithmetic coding. Introduction to DCT, Lossy compression: DCT based compression; Wavelet based compression	**7**
4.	**Image Segmentation**: Pixel classification, Bi-level thresholding, Multi-level thresholding, Adaptive thresholding, Otsu's method, Edge detection – First order derivative Prewitt and Sobel, Second order derivative – LoG, DoG, Canny. Edge linking, Hough transform, Region growing and region merging. Morphological operators: Dilation, Erosion, Opening, Closing, Hit or Miss transforms Boundary detection,	**9**
	Total	30

Text Books:

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education, 3rd edition 2008

2. Iain E. G. Richardson, ―H.264 and MPEG 2010

3. Video Compression: Video Coding for Next Generation Multimedia‖, John Wiley and Son's Publication, 3rd Edition.2011

Reference Books:

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. Pratt William K. "Digital Image Processing", John Wiley & sons 2009
3. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

Program: B. Tech. (E&Tc)						**Semester :V**	
Course : Digital Image Processing Lab						**Code : BET5516**	
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	--	2	1	25	25		50

Prior knowledge of:
Programming language
is essential.

Course Objectives:

1. To demonstrate Digital Image processing with basic relationship of pixels and mathematical operations on 2-D data.
2. To make aware the need for effective use of resources such as storage and bandwidth and ways to provide effective use of them by data compression techniques
3. To give an idea of object segmentation and image analysis techniques

Outcomes:
On completion of the course, student will be able to

1. Develop basic mathematical operations on digital images.
2. Analyze image enhancement problems.
3. Apply 2-D data compression techniques for digital images.
4. Design image processing Algorithms for object segmentation

General Guidelines: Any 10 Experiments is to be performed.

Detailed Syllabus:

Expt. No.	**List of Experiments**
1.	Perform basic operations on images.
2.	Perform histogram equalization.
3.	Perform image filtering in spatial domain.
4.	Perform image filtering in frequency domain.
5.	Perform image compression using DCT / Wavelet transform.
6.	Perform edge detection using various masks.
7.	Perform global and adaptive thresholding.
8.	Apply morphological operators on an image.
9.	Perform various thersholding operations on images
10.	Write a code & analyse for image region growing & region merging for segmentation

11.	Apply log transform,Power law transform & piece wise linear transform on gray level images
12.	Perform Canny edge detection for object segmentation

Reference Books:

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. Pratt William K. "Digital Image Processing", John Wiley & sons 2009
3. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

Program:B. Tech. (E&TC)					Semester: V		
Course: Antenna Theory					Code: 5517		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2		2	2	20	30	50	100

Prior knowledge of

1. Electromagnetics. Is essential

Objectives:

1. To make students apply concept and properties of electromagnetism to obtain parameters of antennas.
2. To make students aware of basic concepts and operating principles of antenna array.
3. To demonstrate knowledge about HF and VHF, UHF antennas.
4. To make students identify appropriate antenna for specific application.

Outcomes:

After completion of this course, students will be able to,

1. Compare antenna parameters and types of antennas.
2. Design and analyze antenna array with different parameters.
3. Design various types of antennas.
4. Analyze various types of antennas for specific applications.

Detailed Syllabus:

Unit	wave propagation mechanism	Duration
1	**Antenna Basics**: radiation mechanism, efficiency, directivity, beam efficiency, intensity, gain, power theorem and its application, radiation pattern, far field and near field, antenna aperture, effective height, bandwidth, VSWR, radio communication link, antenna impedance. Different types of antennas e.g., Microstrip patch antenna, Dipole antenna, array antenna, wire antenna etc	**07**
2	**Antenna array**: Concept of antenna arrays, Two element arrays and their directional characteristics, Principles of pattern multiplication & their application, Linear array analysis (uniform antenna array), Broadside and end fire arrays**.** **Array Antenna types:** Yagi-Uda antenna, Aperture array, Slotted wave guide array.	**08**
3	**Wire Antennas** - Dipole antenna, Short Dipole antenna, radiation resistance of short diploe antenna, folded dipole, Helix antenna, Loop antenna. Applications of all antennas. **Reflector Antenna**: Parabolic reflectors, Corner reflectors, Applications of all antennas. **Aperature Anenna**: Horn Antenna,Ultra-wideband antenna, MIMO antenna.	**07**

4	**Antenna for modern wireless communication:** Antennas for Biomedical applications, Wearable antenna, Antennas for Terrestrial communication - mobile handsets and base station, vehicle to vehicle communication.	08
	Total	**30**

Text Books:

1. C.A. Balanis, Antenna Theory - Analysis and Design, 3rd edition, Wiley & Sons, New York, USA. , 2016
2. K.D. Prasad ,"Antennas and Wave Propagation", Khanna or Satya Publications 2008

Reference Books:

1. R.K. Shevgaonkar, "Electromagnetic Waves", TMH, 2006
2. Peter S. Hall," Antennas and propagation for body centric wireless communication", Artech house.2012
3. Albert Sabban" Novel Wearable Antennas for Communication and Medical Systems", CRC press.2012
4. Albert Sabban, "Wideband RF Technologies and Antennas in Microwave Frequencies"Wiley, New York USA,2016

Program: B. Tech. (E&Tc)					Semester :V		
Course: Antenna Theory lab					Code: BET5518		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	--	2	1	25	25	--	50

Prior knowledge of:

1. Electromagnetics and uniform plane wave **is essential**.

Course Objectives:

1. To introduce to radiation pattern of different antennas
2. To introduce to VSWR at various conditions.
3. To introduce to simulation of antenna using antenna simulation tools.
4. To make to work in a team and learn modern tools

Course Outcomes:

After completion of this course, students will be able to,

1.Analyze radiation pattern of different antennas
2.Evaluate VSWR at various conditions
3.Learn modern tools.
4.Design and Simulate antenna using antenna simulation tools

General Guidelines: All experiments are compulsory.

Detailed Syllabus:

Expt. No.	List of Experiments
1	To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for Dipole Antenna.
2	To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for Folded Dipole Antenna.
3	To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for Yagi Uda Antenna.
4	To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for Horn Antenna.
5	To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for Parabolic Reflector Antenna.
6	Plot Standing Wave pattern and Measure SWR for open, short, and matched termination.
7	MATLAB simulation of Broad side linear array with uniform spacing and amplitude
8	MATLAB simulation of End fire linear array with uniform spacing and amplitude.
9	Design Of Rectangular Microstrip Patch Antenna Using Strip Line Feed.
10	Design Of Rectangular Microstrip Patch Antenna Using Coaxial Feed.

Reference Book:

1. R.K. Shevgaonkar, “Electromagnetic Waves”, TMH, 2006
2. Peter S. Hall,” Antennas and propagation for body centric wireless communication”, Artech house.2012
3. Albert Sabban” Novel Wearable Antennas for Communication and Medical Systems”, CRC press.2012
4. Albert Sabban, “Wideband RF Technologies and Antennas in Microwave Frequencies”Wiley, New York USA,2016

Program:	B. Tech. (E&TC)			Semester:	V		
Course:	Computational Tools for Data Analytics			Code:	BET5519		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Programming is **essential**

Course Objectives:

1.To make students apply the data analytics concepts using MATLAB and Python.
2. To demonstrate the applicability using statistical analysis of data analytics.
3. To make students aware of Graphical Analysis using Data Processing and Visualization.
4. To demonstrate the basics concept of Machine Learning.

Course Outcomes:

After completion of the course, student will be able to

1. **Demonstrate** the data analytics concepts using MATLAB and Python.
2. **Analyze** algorithms using statistical methods
3. **Make use** of the concept of graphical analysis for Data processing and Visualization.
4. **Apply** the concept of Regression, Classification and clustering algorithms.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to MATLAB & Python for Data analytics** Data Analytics Introduction, Understanding the data, accessing data set Introduction to MATLAB for Data analytics: MATLAB libraries for Data analytics, importing & exporting data in MATLAB Introduction to Python for Data analytics: Python packages for Data science, importing & exporting data in Python	**7**
2.	**Introduction to Statistical Methods** Overview of statistical analysis, Introduction to descriptive statistics and data distributions. Visualizing Data Sets, Measures of Centrality and Spread, Distributions, Fit line to data-Linear Regression, Evaluating Goodness of Fit, Interpolate values from a data set-Linear Interpolation.	**9**
3.	**Data Processing and Visualization** Overview of the content-Importing Hurricane Data, Getting Started with the Data, Preprocessing data- Importing data from multiple files -Read large data stored in multiple files using datastores - visualizing the multivariate data.	**6**
4.	**Introduction to Machine Learning** Introduction to Machine Learning example and its applications, Supervised Learning: Regression and Classification Unsupervised Learning: Clustering, Reinforcement Learning	**8**

	Total Hrs.	30

Text Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer 2009.
2. Wes McKinney and O'Reilly, "Python for Data Analysis", Second Edition, O'Reilly Media, Inc., 2017.

Reference Books:

1. Jake Vander Plas and O'Reilly, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media, Inc. 2019
2. Joel Grus and O'Reilly, "Data Science from Scratch: First Principles with Python", Shroff Publishers & Distributors Pvt. Ltd., Second Edition, 2019
3. Rajkumar Bansal, Ashok Kumar Goel, Manoj Kumar, "MATLAB and its Applications in Engineering: [based iôn MATLAB 7.5 (R2007b)]", Pearson, 2012.

1. Ethem Alpaydın, "Introduction to Machine Learning", Second Edition, MIT Press 2010.

NPTEL Courses Link

1. https://www.mathworks.com/academia/courseware/teaching-data-science-with-matlab.html
2. https://swayam.gov.in/nd1_noc20_cs46/
3. https://onlinecourses.nptel.ac.in/noc21_cs33/

Program: B. Tech. (E&Tc)				Semester:V			
Course: Computational Tools for Data Analytics Lab				Code:BET5520			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	--	2	1	25	25	--	50

Prior knowledge of:

1. Fundamentals of Programming

is essential.

Course Objectives:

1.To make students **apply** the data analytics concepts using MATLAB and Python.
2. To **demonstrate** the applicability using statistical analysis of data analytics.
3. To make students aware the **Graphical Analysis** using Data Processing and Visualization.
4. To **demonstrate** the basics concept of Machine Learning.

Course Outcomes:

After completion of the course, student will be able to

1. **Demonstrate** the data analytics concepts using MATLAB and Python.
2. **Analyze** algorithms using statistical methods
3. **Make use** of the concept of graphical analysis for Data processing and Visualization.
4. **Apply** the concept of Regression, Classification and clustering algorithms.

General Guidelines: Any 10 Experiments is to be performed in MATLAB or Python

Detailed Syllabus:

Expt. No.	List of Experiments
	Group A: Any 3 Experiments are Compulsory
1	Introduction to Python Programming
2	Perform different measures of central tendency on data set with Python
3	Implement data exploration and visualization with Python
4	Implement Linear regression analysis for housing prices dataset using Python
	Group B: Any 3 Experiments are Compulsory
5	Introduction to MATLAB Programming
6	Perform different measures of central tendency on data set with MATLAB
7	Implement data exploration and visualization with MATLAB
8	Implement Linear regression analysis for housing prices dataset using

	Group C: Any Two Experiments are Compulsory
9	Implement classification using Support Vector Machine (SVM) for binary class using Python or MATLAB
10	Implement Sensor data collection through smart phone and processing data with MATLAB
11	Implement temperature data capturing and prediction using curve fitting with MATLAB

Reference Books:

1. EthemAlpaydın ,"Introduction to Machine Learning", Second Edition, MIT Press 2010.
2. Jake Vander Plas and O'Reilly, "Python Data Science Handbook: Essential Tools for Working with Data"2010
3. Joel Grus and O'Reilly, "Data Science from Scratch: First Principles with Python".2012

Online courses

1. https://www.mathworks.com/academia/courseware/teaching-data-science-with-matlab.html
2. https://swayam.gov.in/nd1_noc20_cs46/
3. https://onlinecourses.nptel.ac.in/noc21_cs33/

Open Elective-II

Program	B. Tech. (Open Elective-2) - ASH			Semester :	V	
Course :	Statistical Data Analysis Using R			Code :	BAS5607	
Teaching Scheme				Evaluation Scheme		
Lecture	Practical	Tutorial	Credit	Internal Evaluation	MTE	ETE	Total
3	-	-	3	20	30*	50*	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 properties and **Identify** the R 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 (Hrs)
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.	7
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.	8
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)	8
IV	**Data Analysis** **Statistical Data Analysis:** Probability, Sampling & Sampling Distributions **Exploratory Data Analysis:** Central & Descriptive Statistics, Hypothesis Testing.	7
V	**Model Development** Linear regression and multiple linear regression, model evaluation using visualization, prediction and decision making	8

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/data https://www.kaggle.com/code/kailash068/crop-recommendation/data https://www.kaggle.com/datasets/debajyotipodder/co2-emission-by-vehicles https://www.kaggle.com/datasets/csafrit2/higher-education-students-performance- evaluation	**7**
	Total	**45**

Reference Books:

Montg**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. 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)
    1. https://www.youtube.com/watch?v=WbKiJe5OkUU&list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa- 6Gz (Descriptive statistics using R software)

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

Program:	B. Tech. (Civil Engineering)			Semester :	V		
Course :	Total Quality Management (OEC-2)			Code:	BCI5602A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Course Objectives: After Completing this course, student will have adequate background :

1. To understand the importance of Quality
2. To understand the need of Total Quality Management & 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. Describe Quality and Quality concepts
2. Apply different Quality control tools
3. Use cost of quality and ISO concepts and principles for quality assurance
4. Apply various techniques of TQM

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Concept of Quality** 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.	7
2.	**TQM & Six Sigma** a) TQM – Necessity, advantages , Quality Function Deployment(QFD). b) Six sigma – Importance, levels.	8
3.	**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	8
4.	**Techniques in TQM Implementation** a) Benchmarking in TQM, Kaizen in TQM, b) '5-S' techniques, Zero Defects.	8
5.	**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	7
6.	**Failure Mode Effect Analysis** a) FMEA problems, NPV b) Decision Tree problems	7
	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. (Civil Engineering)			Semester :	V		
Course :	Intelligent Transport System (OEC-2)			Code:	OEC: BCI5602B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Transportation and Traffic engineering
2. Transportation Planning and Designing

Course Objectives: After Completing this course, student will have adequate background :

1. To learn all the aspects related to intelligent transportation system and its application
2. To use the fundamental concepts of transportation system management.
3. To train the students 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 ITS and its background
2. Demonstrate the knowledge of telecommunication practices in ITS
3. Distinguish the physical architecture and hardware composition in the implementation of ITS
4. Implement the ITS concept in various domains
5. Explain the user needs and services in the context of implementing effective ITS
6. Identify and evaluate the practical constraints in the implementation of the technology and the grass root level.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**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	7
2.	**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	8
3.	**ITS architecture and Hardware:** Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection	8
4.	**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).	7
5.	**ITS User Needs and Services:** Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.	8

6.	**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	**7**
	Total	**45**

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
6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

Program:	B. Tech. (Computer)					Semester: V	
Course:	Data Structures Using Python (OEC-2)					Code: BCE5601	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
03	-	-	03	20	30	50	100

Prior knowledge of
Python Programming
is essential.

Course Objectives:

1. To understand Python Specific Data Structures.
2. To illustrate and demonstrate Stacks, Queues.
3. To understand how searching and sorting is performed in Python.
4. To understand how linear and non-linear data structures work.
5. To learn the fundamentals of writing Python scripts.
6. To learn the operations on tree and graph data structure.

Course Outcomes:

After learning the course, students will be able to:

1. Differentiate the type of data structure.
2. Create, run and manipulate Python Programs using core data structures like Lists.
3. Comprehend the searching & sorting algorithms.
4. Apply suitable data structures to solve the programming problems.
5. Use effective and efficient data structures in solving various Computer Engineering domain problems.
6. Comprehend nonlinear data structures such as tree and graph.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Data Structures** Introduction to Python programming, Data Structures – Definition, Linear Data Structures, on-Linear Data Structures, Python Specific Data Structures - List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, slicing. Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs. List.	**07**
II	**Searching and Sorting Techniques** Searching - Linear Search and Binary Search Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and Quick Sort.	**08**
III	**Linked List** Linked Lists – Introduction, Implementation of Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists	**07**
IV	**Stack & Queue** Stacks - Overview of Stack, Implementation of Stack, Applications of Stack, Queues- Overview of Queue, Implementation of Queue, Applications of Queues, Priority Queues.	**08**

V	**Tree** Trees - Overview of Trees, Tree Terminology, Binary Trees - Introduction, Implementation. Tree Traversals, Binary Search Trees - Introduction	**07**
VI	**Graph** Introduction, directed vs. Undirected Graphs, Weighted vs. Unweighted Graphs, Representations - Adjacency Matrix, Adjacency list, Graph Traversals - Breadth First Search, Depth First Search.	**08**
	Total	45

Text Books:

1. Data structures and algorithms in python by Michael T. Goodrich, ISBN-13: 978-1118290279, ISBN-10: 1118290275, Publisher: Wiley; 1st edition (March 18, 2013).
2. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum. ISBN-13: 978-1590282571, ISBN-10: 1590282574, Publisher: Franklin, Beedle & Associates; 2nd edition (August 22, 2011).

Reference Books:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka. ISBN: 9781788991933, 2018.
2. Core Python Programming -R. Nageswara Rao, ISBN-10: 9789351199427, ISBN-13: 978-9351199427, Willy; 1st edition (January 1, 2016).

Program:	B. Tech. (Computer)			Semester: V			
Course:	Programming with C++ (OEC-2)			Code: BCE5602			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
03	-	-	03	20	30	50	100

Prior knowledge of
Python Programming
is essential.

Course Objectives:

1. To explore the principles of Object-Oriented Programming (OOP).
2. To use the concept of inheritance and polymorphism.
3. To understand the use of exception handling in C++ programs.
4. To provide a foundation for advanced programming using File handling and STL.
5. To provide lifelong learning attitude towards problem solving.

Course Outcomes:

After learning the course, students will be able to:

1. Compare the strengths of object-oriented programming with respect to procedural programming.
2. Demonstrate working with primitive data types.
3. Understand and demonstrate dynamic memory management techniques.
4. Analyze and apply the concept of function overloading & operator overloading for real time problem solving.
5. Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming.
6. Demonstrate the use of various advanced object-oriented concepts with the help of programs.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction of OOPs Concepts** Overview of procedural programming and object-oriented programming, Syntax of variables declaration, Classes and objects, Member functions, memory management. **Case Study:** Write a program in c++ to create an employee class with appropriate features.	**07**
II	**Inheritance** Introduction, benefits, Access specifiers, Types of inheritance - single, multiple, multilevel, hybrid and hierarchical. **Case Study:**Write a program in c++ to derive class bicycle from class vehicle with appropriate syntax.	**08**
III	**Polymorphism** Introduction, Types of polymorphism: function and operator, Virtual functions, Pure virtual functions, Virtual base class, Overloading and overriding. **Case study:**Write a program in c++ to overload '+' and '-' operator.	**07**

IV	**Exception Handling** Introduction to exception, Benefits of exception handling, try, throw and catch blocks, pre-defined exceptions in c++, Re-throw. **Case Study:** Write a program in c++ to create a class student with name, age, roll no and telephone number as parameters. Program should throw an exception if telephone_number>10.	**08**
V	**File Handling** Classes for file stream operation, Opening and closing a file, File pointers and their manipulation, File operations on binary files – variables, class objects, sequential file organization, Direct access files. **Case Study:** Write a program in c++ to create a database for airline reservation system using file handling.	**07**
VI	**Templates** Introduction, Function templates, Class template with multiple parameters. **Introduction to STL: Introduction** of STL components, Sequential container,Algorithms, Iterators. **CaseStudy:**Write a program in c++ to create vector template using STL container.	**08**
	Total	45

Text Books:

1. E. Balagurusamy, "Object -Oriented Programming with C++", McGraw Hill Education, Eighth Edition, Sept. 2020, ISBN-13: 978-9389949186.
2. Ivor Horton, Peter Van Weert, "Beginning C++20", Novice Professional, Sixth Edition, 2020, ISBN-13: 978-1484258835 (ISBN-10: 1484258835)
3. Robert Lafore, "OOP in C++", Pearson Publishing, 4th Edition, 2001, ISBN:0672323087 (ISBN 13: 9780672323089).

Reference Books:

1. Bjarne Stroustrup, The C++ Programming language, Third edition, 2008, Pearson Education. ISBN 9780201889543.
2. Deitel, C++ How to Program, 4 th Edition, Pearson Education,2002, ISBN:81-297-0276-2.
3. Herbert Schildt, C++ the complete reference, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805.

MOOC Courses:

1. An Introduction to Programming Through C++, NPTEL, 12 weeks

Program: B. Tech. (IT)				Semester: V			
Course : Object Oriented Programming				Code : BIT5601			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	CE	MTE	ETE	Total
3	-	-	3	20	30	50	100

Prior Knowledge of:

1. C Programming

is essential.

Course Objectives:

1. To learn the fundamentals of object-oriented concepts and programming
2. To develop problem-solving skills using object oriented programming concepts
3. To apply the concepts of object-oriented paradigm
4. To develop programming skills using object oriented programming concept

Course Outcomes:

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

1. Demonstrate the key object oriented concepts.
2. Apply functions for given real life data
3. Apply operator overloading to develop programs
4. Design hierarchy of classes using inheritance.
5. Make use of polymorphism using virtual functions for solving real life problems.
6. Develop application which handles different types of exceptions

Detailed Syllabus

Unit	Description	Duration
1.	FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING :Object Oriented Paradigm, Features of Object-Oriented Programming: Objects and Classes, Data Abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Communication. Visibility/Access Control, Constructors and Destructors, Operators, Static data members and member functions, Arrays and reference variables.	**6**
2.	FUNCTIONS :Function prototypes, Default and Const arguments, Object as a function argument and returning object, Passing argument by reference, Returning a reference, Inline functions, Function overloading, Friend function.	**7**
3.	OPERATOR OVERLOADING :Rules of operator overloading, overloading the unary and binary operators using member and friend function, overloading relational and assignment operator.	**8**
4.	INHERITANCE : Need of inheritance, base and derived classes, member accessibility, types of inheritance, derived class constructor, constructors in multiple inheritance, overriding member functions, virtual base class.	**8**
5.	VIRTUAL FUNCTIONS : Pointers, Pointers to objects, 'this' pointer, Pointers to derived classes, virtual functions, Pure virtual functions, abstract class, virtual destructors.	**7**

6.	EXCEPTION HANDLING: Introduction, Exception handling mechanism: try, catch and throw, Multiple Exceptions, Exceptions with arguments	**9**
	Total	**45**

Text Books:

1. E. Balaguruswamy, "Object-oriented Programming with C++", Tata McGraw Hill, 7th edition.
2. Robert Lafore, "Object-Oriented Programming in C++", SAMS Techmedia

Reference Books:

1. Herbert Schildt, "C++: The Complete Reference", McGraw-Hill.
2. Kogent, "Object-Oriented Programming Methodology", Wiley, ISBN-9789351191841

Online References:

1. Coursera Course on C++ Basics:Selection and iteration offered by C- Codio, available online at https://www.coursera.org/learn/codio-cpp-basics
2. NPTEL Course Lecture Links on "Programming in C++" offered by IIT, Karagpur, available online at "https://nptel.ac.in/courses/106105151"

Program:	B. Tech. (Mechanical)					Semester: V	
Course:	Industry 4.0 (Open Elective-II)					Code: BME5602A	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Hours	Credit	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of:

a. Basic programming skills
b. Mathematical skills
are essential

Course Objectives:

1. To introduce revolutions of manufacturing industry
2. To introduce technological advancement in modern manufacturing industries
3. To introduce concepts of smart manufacturing, emphasizing Industry 4.0 in manufacturing industries

Course Outcomes:

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

1. Correlate the recent manufacturing trends and technological pillars of Industry 4.0.
2. Apply pillars of Industry 4.0 to the manufacturing industry.
3. Adapt the changes in existing manufacturing practices and relate the role of industrial robotics and sensors.
4. Identify applications of AR and VR in smart manufacturing.
5. Compare eco system of current manufacturing industry and Industry 4.0

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Industrial revolution and current state of industry:** Overview of industrial revolution, Introduction to Automation, hard automation, soft automation, classification of production system, adaptive control, overview of terminologies like CAD, CAM, CAE, CAPP etc.	9
2.	**Introduction to Industry 4.0:** Introduction to industry 4.0, need for Industry 4.0, Framework for Industry 4.0, technological pillars in industrial 4.0, applications, challenges and scope for industry 4.0	6
3.	**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.	8
4.	**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 Cyber-Physical Robotics	8
5.	**Simulation, Augmented Reality and Virtual Reality in Industry 4.0:** Introduction to simulation, methods for simulation of physical processes, interconnectivity using simulation softwares, 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	8
6.	**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	6
	Total	45

Text Books:

1. M. P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Pearson, 2015
2. Leong W., Nine pillars of technologies for Industry 4.0, IET publishers, 2020

3. Gilchrist A., Industry 4.0: The Industrial Internet of Things, Apress, 2017

Reference Books:

1. Alp Ustundag and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer, 2018
2. Bartodziej, Christoph Jan, The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics, Springer, 2016
3. Klaus Schwab, The Fourth Industrial Revolution, World Economic Forum, 2017
4. Christian Schröder, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, Friedrich-Ebert-Stiftung, 2016
5. Chua C K, Leong K F, Lim C S, Rapid Prototyping, World Scientific, 2012

Program:	B. Tech. (Mechanical)				Semester: V		
Course:	Safety, Health and Environment (Open Elective- II)				Code: BME5602B		
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
3	-	-	3	20	30	50	100

Prior knowledge of: None

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:

Upon successful completion of the course, the student 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)
1	**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.	7
2	**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.	8
3	**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.	8
4	**Fires and Explosions and concepts to prevent fires and explosions:** Fire triangle, Distinction between fires and explosions, Flammability characteristics of liquids and vapors, limiting oxygen concentration and inerting, Controlling static electricity, Explosion-proof equipment and instruments, Ventilation.	8

5	**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.	**7**
6	**Ergonomics at Work Place:** Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs.	**7**
	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.

HSMC

Program- B. Tech (All Branches)					Semester-V	
Course: Principles of Management					**Code: BHM5113**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE**	**MTE**	**ETE**	**Total**
2	**2**	**2**	**30**	**NA**	**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 (30 Hrs)
1	**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.	**7**
2	**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	**7**
3	**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)	**8**
4.	**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-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)	**8**

	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	

Professional Development Training (PDT)

** 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.**			**Semester:**		**V**	
Course :	**Professional Development Training-I**			**Code:**		BHM5917	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**Internal Evaluation**	**MTE**	**ETE**	**Total**
3	-	-	-	-	-	-	-

Course Objectives:

This course aims at enabling the students

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: Students will be able to

After learning the course, the students will be:

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 (Hrs)
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.	**6**
II	**Algebra** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	**6**
III	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics.**	**6**

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.	**6**
V	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	**6**
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.	**6**
	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 Agrawal, 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.

Proficiency Courses

Program:	B. Tech. (E&TC)			Semester: V/ VI			
Course:	Basics of LabVIEW			Code: BET5911/ BET6911			
Teaching Scheme				Evaluation Scheme			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	-	2	-	-	-	-

Prior knowledge of

1. Basics of programming
2. Basic Electronics

Is essential

Objectives:

1.To introduce students to the fundamental components of LabVIEW Virtual Instruments
2.To demonstrate features of LabVIEW with implementation of basic application.

Outcomes:

After completion of this course, the students will be able to,

1. Understand the applications of LabVIEW Virtual Instrument
2. Build basic Virtual Instrument for an application.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction** Features of Virtual Instrumentation with LabVIEW, LabVIEW Installation, LabVIEW Environment Basics, Fundamental Tools, Debugging tools, Graphical Programming, Execution Structures	10
2	**Programming Components in LabVIEW** Data Structures in LabVIEW, Passing Data Between Loop Iterations in LabVIEW Loops and Charts – For, While, Charts, Multiplots, Wiring Data into Charts Building LabVIEW VI application for parameter conversion.	10
3	**Introduction to Data Acquisition in VI** VI Application- Implementation of Data Acquisition System for Temperature measurement	10
	Total	30

Reference Books:

1. Jeffrey Travis, Jim Kring, “LabVIEW for Everyone”, Pearson Education, Third edition-2006
2. Gary W. Johnson, Richard Jennings, “LabVIEW Graphical Programming”, McGraw-Hill Education, Forth Edition-2006
3. Behzad Ehsani, “Data Acquisition using LabVIEW”, Packt Publishing, First edition- 2016
4. Marco Schwartz, Oliver Manickum, “Programming Arduino with LabVIEW”, Packt Publishing,First edition-2015

Program: B. Tech. (E&TC)					**Semester:** V/VI		
Course: MATLAB Scripting					**Code:** BET5912/ BET6912		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	-	2	-	-	-	-

Prior knowledge of:

1. Engineering Mathematics
2. Software operational skills

is essential.

Objectives:

1. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
2. To use MATLAB as a simulation tool.

Outcomes:

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

1. Learn the MATLAB interface and various methods
2. Build a program in MATLAB for implementing desired application or solving a mathematical equation.
3. Create a GUI application using MATLAB
4. Implement the given algorithm and simulate in MATLAB.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to MATLAB** The MATLAB Environment, MATLAB Basics – Variables, Data types, Operators, Expressions, Input and output, Vectors, Arrays – Matrices, MATLAB Functions, Built-in Functions, User defined Functions, Aabstraction and encapsulation	**07**
2.	**Programming with MATLAB** Conditional Statements, Loops, MATLAB Programs – Programming and Debugging, Profiling Tools and Report Generation, Applications of MATLAB Programming, GUI Development in MATLAB.	**08**
3	**Graphics with MATLAB** Files and File Management – Import/Export, Basic 2D, 3D plots, Graphic handling, parametric plots, contour lines and implicit plots, field plots, multiple graphics display function, multivariate data, data analysis	**08**
4	**Mathematical Computing with MATLAB** Polynomials, Curve fitting, Interpolation, solving algebraic equations, Differentiation, Integration, Basic Symbolic Calculus and Differential equations, Solving an ordinary differential equation, Numerical Techniques and Transforms.	**07**
	Total	**30**

Text Books:

1. S. J. Chapman. MATLAB Programming for Engineers. Thomson, 4th edition 2016.
2. C. F. Van Loan. Introduction to Scientific Computing. Prentice Hall, 2nd edition, 2000.

Reference Books:

1. C. B. Moler, Numerical Computing with MATLAB, Cengage Learning, Edition: 2012.
2. D. J. Higham and N. J. Higham. MATLAB Guide. Siam, 2nd edition, 2005.
3. K. R. Coombes, B. R. Hunt, R. L. Lipsman, J. E. Osborn, and G. J. Stuck. Differential Equations with MATLAB. John Wiley and Sons, 1st edition, 2000.
4. A. Gilat. MATLAB: An introduction with Applications. John Wiley and Sons, 6th edition, 2017

Program:	**B. Tech. (E&TC)**			**Semester:**	**V/VI**		
Course:	Embedded Product Design			**Code:**	BET5913/ BET6913		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	-	2	-	-	-	-

Prior knowledge of:

1. Basic electronics, Printed circuit board design.
2. System Programming and OS, Microcontroller programming,

is essential.

Objectives:

1. To make students aware of embedded product development process.
2. To impart knowledge and skills required for embedded product development.

Outcomes:

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

1. Learn the fundamentals of embedded product development.
2. Learn about the hardware elements of embedded product.
3. Acquire programming skills for software development of embedded product.
4. Design, test and debug embedded product.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**Fundamentals of Embedded Product development** Characteristics and quality attributes (Design Metric) of embedded system, Safety and reliability, ethical practice, real time system's requirements, real time issues.	**06**
2.	**Hardware Elements of Embedded Product** Core of the embedded system, Microcontroller, Memory, Sensors and Actuators, Communication Interface, Power-supply (Battery technology, Solar), PCB and Passive components.	**08**
3.	**Software Elements of Embedded Product** Program Modelling, Embedded C-programming concepts, Embedded firmware (RTOS, Device drivers, Application programs).	**08**
4	**System Integration, Testing and Debugging Methodology** Embedded Product Design Life Cycle (EDLC), Hardware Software Codesign Testing & Debugging, Blackbox testing, White Box testing, Hardware emulation, Logic analyzer.	**08**
	Total	**30**

Text Books:

1. Frank Vahid and Tony Givargis, ― Embedded System Design – A Unified hardware/ Software introduction, 3rd edition, Wiley, 2006.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3rd Edition 2009.
3. Parag H Dave, Himanshu. H. Dave, Embedded systems: Concepts, design and programming, Pearson India, 2015

Reference Books:

1. K.V. Shibu, "Introduction to Embedded Systems", McGraw Hill Education India Private Limited, 2nd Edition, 2017.
2. Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition, 2005.
3. Raj Kamal, ―Embedded Systems – Architecture, Programming and Design" 3rd edition, 2014

Program:	**B. Tech. (E&TC)**			**Semester:**	**V/VI**		
Course:	Model-Based Development using MATLAB			**Code:**	BET5914/BET6914		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	-	2	-	-	-	-

Prior knowledge of:

1. MATLAB environment
2. Control Systems
3. Embedded System Design

is essential.

Objectives:

1. To make students aware of Model Based Development.
2. To impart knowledge of MATLAB and Simulink

Outcomes:

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

1. Use Design of Experiment methods to create models of physical systems.
2. Apply basic control algorithms to a real physical system.
3. Connect component models together to model a larger more complex system.
4. Deploy a control algorithm on a real-time target.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**Automotive Control Systems** Analog and digital control methods, Modelling of linear systems, System responses, Introduction to Automotive Control Systems and Model Based Development.	**06**
2.	**Development in MATLAB environment** Introduction to MATLAB, Simulink and SIMSCAPE tool boxes, Model-Based Design for a small system: Motor Model, Generator Model, Controller Model.	**08**
2.	**Tuning and Refining Models** SimDriveline Introduction, Exploring the system response using different control methods, Tuning the system, exploring system limitations, Modelling and simulation of Automotive Systems with simple examples.	**08**
4	**Real time implementation of MBD** Real time simulations on a simple target (Arduino / Raspberry Pi etc), Plant on Real-Time Target like Freescale, Infineon, etc. Display Performance on Virtual Gauge Display.	**08**
	Total	**30**

Text Books:

1. Shailendra Jain, Modeling and Simulation using MATLAB - Simulink, 2editoin, 2015.
2. Agam Kumar Tyagi, Matlab and Simulink for Engg, Oxford, 2011.

Reference Books:

1. Eshkabilov Sulaymon L., Practical MATLAB Modeling with Simulink, APress,
2. Wu Wei, Model-Based Design for Effective Control System Development, IGI Global
3. Zander, Schieferdecker, Mosterman, Model-Based Testing for Embedded Systems, CRC Press, Inc., 2012.

rogram: B. Tech. (E&TC)				Semester: V/VI			
Course: PCB Designing Skills				Code: BET5915/BET6915			
Teaching Scheme				Evaluation Scheme			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	-	2	-	-	-	-

Prior knowledge of:

1. Basic understanding of electronic devices and circuits, Digital Electronics

is essential

Objectives:

1. To make students aware of various hardware and software tools used for circuit simulation, PCB design and fabrication.
2. To impart in-depth practical skills required for the development of PCB.

Outcomes:

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

1. Identify Electronic Components Symbols & Footprints
2. Construct Component libraries & use them effectively
3. Create a schematic of an analog and digital circuit
4. Simulate schematic and design a Printed circuit board for it.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to Electronic Circuit Simulation and PCB:** Basics of circuit simulation, Electrical rules, PCB design rules for various applications, various open source and commercial EDA tools for circuit design, simulation and PCB design	**06**
2.	**PCB Design software:** Schematic Entry, Netlist Creation, Component libraries, Design of Boards, Layout of Parts, Optimizing Parts Placements, Pads and Via, Manual and Auto Routing, Handling Multiple Layers, Gerber files.	**08**
3.	**Electromagnetic Interference.:** Overview of Electromagnetic Interference and Electromagnetic Compatibility, Reduction techniques for EMI, Line Impedance Stabilization Network (LISN), Conducted Noise, Common Mode Noises (CM), Differential Mode Noises (DM), EMI filter Design	**08**
4	**Understanding the manufacturing process of PCB**: Overview of various PCB manufacturing machines, post-processing methods, Study of soldering defect and rectification, Advanced technologies in Manufacturing, assembly and soldering.	**08**
	Total	**30**

Text Books:

1. Bossart, Printed Circuit Boards: Design and Technology, Tata McGraw Hill, 2002.
2. Farid N. Nazm, Circuit Simulation, Wiley-IEEE Press, 1st edition, 2010.

Reference Books:

1. Franco, Design with Operational Amplifiers & Analog Integrated Circuits, Tata McGraw Hill, 3rd Edition, 2002.
2. Horowitz & Hill, The Art of Electronics; Cambridge University Press, 3rd edition, 2015.
3. Mitzner.K, Complete PCB Design Using Orcad Capture and Layout. Elsevier Newnes, 1st edition, 2007.

Program: B. Tech. (E&TC)				Semester : V			
Course: **Synopsys EDA Tool Flow for Front-End Digital IC Design**				**Code: BET5916/ BET6916**			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
2	-	-	2	-	-	-	-

Prior Knowledge of:

1. Digital Integrated Circuits
2. Logic Design.

is essential

Course Objectives:

1. To make students understand Front end design flow in VLSI design.
2. **To make students aware about concepts of logic simulation and timing analysis.**

Course Outcomes:

After Completion of this course, the students will be able to,

1. study details of Front-End EDA Tools for digital IC design
2. Understand logic simulation to static timing analysis.

Detailed Syllabus

Unit	Description	Duration
1	**Topic 1.1 (4 hours) – Digital Design Flow** • Semiconductor chips usage. Phases of IC design. Design levels. Design flow concept. Types of design. Digital IC synthesis. Basics of digital IC design. Digital design flow. Specification. Design description. Logic simulation. Logic synthesis. Formal equivalence check. Static timing analysis (STA). Physical synthesis. Physical synthesis. Post-layout STA. Digital design toolchain. Summary. **Topic 1.2 (4 hours) – Logic Simulation** • Digital design toolchain. Inputs and outputs of logic simulator. Logic simulation goals. Logic simulation. VCS. VCS overview. Invoking VCS interactive mode. VCS features. DVE top-level window. Tracing the cause of failed assertion. RTL and gate signal comparison. Gate-level path schematic. User defined radixes.	8
2	**Topic 1.3 (8 hours) – Logic Synthesis** • Digital design toolchain. Logic synthesis. Specification. Design description. Operating conditions. Design constraints. Logic synthesis. Logic circuit. Logic synthesis. Logic synthesis steps. Constraint-driven synthesis. Synthesis and optimization. Main optimization trade-offs. Design constraints: Parameter trade-off. Path delay. Delay dependencies. Operating conditions. Path delay calculation. Constraint-driven synthesis. Parameter trade-off. Timing closure and constraints. Path types. Clocked environment.	6

	Constraining timing: setup/hold. Constraining timing: example. Constraining timing: modeling clock. Clock uncertainty modeling example. Modeling clock latency. Clock modeling summary. Combinational designs. Area constraints. Design compiler. Introduction to design compiler. DC and design flow. Basic synthesis flow. DC's input and output files. Setting up logic libraries. Logic synthesis: design analyzing. Analyzing the design. Logic synthesis: design elaborating. Elaborating the design. Translation. Commands. Design view after importing. Navigating in design. Hierarchy. Design mapping. Command compile. Design view. Writing the results.s. Physical synthesis steps. New Trends in Physical Design Cycle.	
3	**Topic 1.4 (8 hours) – Formal Verification** • Digital design toolchain. Synopsys formality. Formality: galaxy design platform. Capabilities of formality. Synopsys full-chip equivalence checking. Key concepts. ASIC verification flow using formality. Formal verification components. Logic cones and compare points. The matching cycle. The verification cycle. The debug cycle. Formality interfaces. Formality GUI – main window. Guided setup. Using the automated setup file. Loading designs. Formality read design process flow. Reading the reference design. Reading the implemented design. Reference and implemented designs ready for equivalence checking. Performing setup. Black boxes. Marking a design as a black box. Matching compare points. Matching compare points report. Exact-name matching. Name filtering matching. Topological equivalence and net names based matching. Signature analysis. Verify the design. Verification status messages. Debugging verification. Debugging flow chart. Gathering information. Determining failure cause by number of violations. Determining failure causes. Debugging. Isolate difference. Isolate difference: logic cone viewer. Isolate difference: pattern viewer. Fix the design.	8
4	**Topic 1.5 (8 hours) – Static Timing Analysis** • Digital design toolchain. Static timing analysis (STA). Simulation. STA. STA vs. simulation. Digital circuits timing goals. Timing closure problem. STA concepts. Timing paths. Path groups. Possible paths. False paths. Multi-cycle paths. Required time. Arrival time. Slack and critical path. Early and latest analysis. Path-based timing calculation. Representation of circuits. Given circuit with delays of components. Slack calculation. Path slack histogram. Timing checks. Setup timing check. Launch and capture flip-flops. Data and clock signals for setup timing check. Hold timing check. Data and clock signals for hold timing check. Hold checks and setup check cycles. Removal timing check. Variability. Process variation sources and types. Modeling variation. Process corners. Conventional corner-based analysis. Variation-aware timing analysis flow. Benefits of variation-aware analysis. Everything statistical. Distribution of propagation. SSTA approaches. Spatial correlations. PrimeTime. PrimeTime inputs and outputs. Physical synthesis flow using primetime. PrimeTime top-level GUI window. Execution script file. Executed script content. Timing analysis driver. Schematic view console. PathInspector console. SSTA tool inputs and outputs.	8

	Tota	**30**

Reference Books:

1. A. Reis, R. Drechsler. Advanced Logic Synthesis. Springer; 2017
2. R. Drechsler. Formal System Verification: State-of the-Art and Future Trends. Springer, 2017
3. C. Unsalan, B. Tar. Digital System Design with FPGA: Implementation Using Verilog and VHDL McGraw-Hill Education; 1 edition, 2017
4. J. Bhasker, R. Chadha. Static Timing Analysis for Nanometer Designs: A Practical Approach. Springer; 2013

Program: B. Tech. (E&TC)				Semester : VI			
Course : Synopsys EDA Tool Flow For Back -End Digital IC Design				Code: BET5917/ BET6917			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	-	2	-	-	-	-

Prior Knowledge Of:

1. Digital Integrated Circuits
2. Logic Design.

Is Essential

Course Objectives:

1. To Make Students Understand Back-End Digital IC Design Flow
2. To Make Students Aware About C Synopsys EDA Tools For Back-End Digital IC Design.

Course Outcomes:

After Completion Of This Course, The Students Will Be Able To,

1. Study Details Of Back -End EDA Tools For Digital IC Design
2. Understand Basics Of Physical Design Automation Processs In IC Design

Detailed Syllabus

Unit	Description	Duration
1	**Topic 1.1 (4 Hours) – Back End EDA Tools*** Introduction** Digital Design Flow. Back End Design Flow. Floorplanning. Placement. Clock Tree Synthesis (CTS). Routing. Physical Verification: Design Rule Check. Physical Verification: Layout Versus Schematic. Static Timing Analysis (STA). Parasitic Extraction. Back End EDA Tools.	1
2	**Topic 1.2 (8 Hours) – Floorplanning And Partitioning** Floorplanning. Floorplanning: Aspect Ratio, Area Utilization, Space For Power Rings, Pin Locations, I/O Placement, Creation Of Site Rows, Required Actions, Icc Dialog, Possibilities. Design Planning. Cell Types. I/O Cell Placement. Wire Bond. Flip-Chip. Wire Bond Placement. Flip Chip Placement. Flip-Chip Routed Example. Power Planning. Power Grid Planning. Top-Level Power Network. Block Level Power Network. Power Network Synthesis. Power Network Synthesis Flow. Logically Connect PG Nets. Logically Connecting Cells. Specifying PNS Constraints. Running PNS. PNS Preview And Final Commit. Preroute The PG Nets. Standard Cell PG Preroute. Verify The PG Nets. PNA IR-Drop Analysis. Committing Power Plan. Soft Macros. Layout Examples. Macros And Standard Cells Placement Challenges. Macros And Standard Cells. Macro Placement Constraints. Placement Blockages. Global Placement Blockages. Macro Keepout Margin (Padding). Routing Blockage (Route Guide). Placing And Optimizing The Design: Relative Macro Placement. Relative Placement Is Flexible. Controlling Space Between Macros. Relative Placement Of Ios. Placing Optimizing Physical Datapath (PD).	8

3	**Topic 1.3 (8 Hours) – Placement** Placement In IC Physical Design Flow. Placement Cost Components Functions. Placement Steps. Global And Detailed Placement. Global Routing (GR). Congestion Calculation. Routing Congestion. Routing Resources. Metal Routing Tracks. Partitioning-Based Placement. Global Placement. Detailed Placement: Coarse Placement. Placement Legalization. Standard Cell Placement. Placement Optimization. Timing-Driven Placement. Routing With Congestions. Congestion Optimization. Congestion Optimization Example. Congestion Vs. Timing-Driven Placement. Strategies To Fix Congestion. Floorplan For Low Congestion. Modifying Cell Density. Congestion Map. High Fanout Synthesis (HFS). HFS And Placement. Datapath Placement. Placing Optimizing Physical Datapath (PD). Relative Placement Design. Physical Datapath Support. Hierarchical Physical Datapath. Physical Datapath Tap Cell Support. Wirelength Reduction. Physical Datapath Tap Cell Support	8
	Topic 1.4 (6 Hours) – Clock-Tree Synthesis (CTS) Clock Tree General Concepts. Clock Skew Types: Global, Local, Useful. Extra Clock Skew: Variability. CTS In A Design Flow + Steps. CTS In A Real P&R Flow. CTS Goals. CTS Prerequisites. Clock Root Option. Clock Sinks: Stop, Float And Exclude Pins, Exclude Pins, Explicit Stop Pin, Explicit Float Pin. Clock Tree Buffer List. CTS Buffering: Starting Point, Build, Insertion Delay, Logical Hierarchy. Clock Tree Optimization. Effects Of Clock Tree Synthesis.	4
4	**Topic 1.4 (6 Hours) – Clock-Tree Synthesis (CTS)** Clock Tree General Concepts. Clock Skew Types: Global, Local, Useful. Extra Clock Skew: Variability. CTS In A Design Flow + Steps. CTS In A Real P&R Flow. CTS Goals. CTS Prerequisites. Clock Root Option. Clock Sinks: Stop, Float And Exclude Pins, Exclude Pins, Explicit Stop Pin, Explicit Float Pin. Clock Tree Buffer List. CTS Buffering: Starting Point, Build, Insertion Delay, Logical Hierarchy. Clock Tree Optimization. Effects Of Clock Tree Synthesis. **Topic 1.5 (4 Hours) – Routing** Routing. Routing Goals. Routing Input And Output. Routing Constraints. Routing Steps. Global Routing: Region Definition, Region Assignment, Pin Assignment. Track Assignment. Detailed Routing.	9
	Total	**30**

Reference Books:

1. Seongbo Shim, Youngsoo Shin. Physical Design And Mask Synthesis For Directed Self-Assembly Lithography. Springer. 2018
2. Thomas Dillinger. VLSI Design Methodology Development. Prentice Hall, 2019.
3. Joseph S. Valacich, Joey F. George , Jeff Hoffer. Essentials Of Systems Analysis And Design. Pearson, 2015
4. IC Compiler II User Guide. Synopsys. 2019
5. Prime Time User Guide. Synopsys. 2019
6. Star RC User Guide. Synopsys. 2019
7. IC Validator User Guide. Synopsys. 2019

Audit Course (Mandatory)

Program: B. Tech. (All branches)				Semester: IV			
Course : Constitution of India				Code :BHM9962			
Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	1	-	-	-	-

Prior knowledge: Nil

Course Objectives:

1. To enable the student to understand the importance of constitution
2. To identify individual role and ethical responsibility towards nation.
3. To understand human rights and its implications
4. To know about central and state government functionalities in India.

Course Outcomes:

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

1. Understand the functions of the Indian government and get acquainted with knowledge of Constitutional Amendments.
2. Identify and explore the basic features, modalities about Indian constitution and assessment of the Parliamentary System in India.
3. Differentiate and relate the functioning of Indian Political system at the Central and State level.
4. Comprehend the fundamental rights and abide the rules of the Indian constitution.

Detailed Syllabus:

Unit	Description	Duration (Hrs)
I.	**Introduction to Constitution:** Meaning of the constitution law and constitutionalism, making of constitution, Salient features and characteristics of the Constitution of India, Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties and it‘s legal status, Citizenship.	3
II.	**System of Government- Center & State level and local level** Structure and Function of Central Government, President, Vice President, Prime Minister, Cabinet, Parliament, Supreme Court of India, Judicial Review, Federal structure and distribution of legislative and financial powers between the Union and the States, local self-government	3
III.	**Judiciary:** Governor, Chief Minister, Cabinet, State Legislature Judicial System in States, High Courts and other Subordinate Courts, Parliamentary Form of Government in India.	3
IV.	**Constitution Functions:** Indian Federal System and it‘s characteristics, Center& State Relations, President‘s Rule, Constitutional Amendments and powers, Constitutional Functionaries, Emergency Provisions, Assessment of working of the Parliamentary System	3

	in India	
	Total	**12**

Text Books:

1. Durga Das Basu, ―Introduction to the Constitution of India ―, Prentice Hall of India, New Delhi,24th edition, 2020, ISBN-109388548868
2. Clarendon Press, Subhash C, Kashyap, ―Our Constitution: An Introduction to India‘s Constitution and constitutional Law‖, NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1. Maciver and Page, ―Society: An Introduction Analysis ―, Laxmi Publications, 4th edition, 2007, ISBN-100333916166
2. PM Bhakshi, ―The constitution of India‖, Universal Law Publishing - An imprint of Lexis Nexis, 14th edition, 2017, ISBN-108131262375

Course Syllabus

T.Y. B.Tech. Semester-VI

Program:	B. Tech. (E&TC)					Semester:	VI	
Course:	Electromagnetics					Code:	BET6418	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	TW	Total
2	1	3	3	10	15	50	25	100

Prior Knowledge of:

1. Vector algebra is essential

Course Objectives:

1. To introduce the concepts of electrostatics, electric potential, energy density and their applications.
2. To expose to concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
3. To make students familiar with electrodynamic fields.
4. To apply the concepts of time varying fields to electromagnetic wave propagation.

Course Outcomes:

After completion of this course, students will be able to,

1. Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions.
2. Apply the principles of magnetostatics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions.
3. Interpret the concepts of time varying fields using Maxwell‘s equations and Poynting Theorem
4. Employ Maxwell‘s equations to solutions of problems relating to uniform plane wave propagation.

Detailed Syllabus:

Unit	Description	Duration
1.	**Electrostatics** Review of vector algebra, Review of cartesian, Cylindrical and spherical coordinate systems, Introduction to del ∇ (operator, Use of del operator as gradient, divergence, curl). Coulomb‘s Law, Electric field intensity, Field due to discrete and continuous charges(Point charge,line charge,surface charge), Gauss‘s law and applications(point and line charge). Electric potential, Relation Between E and V. Electric field in free space, conductors, dielectrics, Dielectric polarization, Dielectric strength, Electric field in multiple dielectrics, Boundary conditions (Dielectric-Dielectric, conductor-dielectric), significance of Poisson‘s and Laplace‘s equations, Capacitance, Parallel plate, Co-axial and Spherical capacitors, Illustrative Problems.	**9**
2.	**Magnetostatics** Lorentz force, magnetic field intensity (H) , Biot–Savart‘s Law, Ampere‘s Circuit Law, H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B), B in free space, conductor, magnetic materials, Boundary conditions, scalar and vector potential, Poisson‘s Equation, Magnetic force, Torque, Inductance, Energy density, Applications.Conditions at a boundary Surface: Dielectric -dielectric, dielectric- conductor Interfaces, Illustrative Problems.	**5**

3.	Time-Varying Fields Faradays law and Lenz's law, Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: for static fields, for time varying fields, for free space, for good conductors, for harmonically varying fields. Wave equations for free space, Wave equations for conductors. Poynting theorem: Energy stored and radiated power, Complex poynting vector,	**4**
4.	Plane-Wave Propagation Introduction, Uniform plane wave propagation: Transverse nature of uniform plane waves, Perpendicular relation between E and H, EM waves in charge free, Current free dielectric.Polarization, Reflection and Refraction for plane wave. Plane wave in lossy dielectric, wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance, Transmission Lines: Types, Primary and secondary Parameters, Standing waves.	**6**
	Total	30

Text Books:

1. Matthew N. O. Sadiku , Elements of Electromagnetics, 4rd edition, Oxford University Press, New Delhi,2008.
2. William H. Hayt Jr. , John A. Buck , *Engineering Electromagentics*, 7th edition, Tata McGraw Hill, India,2006

Reference Books:

1. Kraus, J.D., Electromagnetics, McGraw–Hill (2006)
2. Paramanik, A, Electromagnetism: Theory and Applications, Prentice–Hall of India (2006)
3. N. Narayana Rao, Elements of Engineering Electromagnetics, (6/e), Pearson, 2006.
4. Jordan, E.C. and Balmain K.G., Electromagnetic Waves and Radiating Systems, Prentice Hall of India (2008).

List of Tutorials

1. Vector analysis, Electric field Intensity(E): Due to Q,ρ_L,ρ_S
2. Gauss's Law, Electric flux Density(D) & Electrical Potential (V) : Due to Q Q,ρ_L,ρ_S
3. Electrostatic Boundary Conditions: dielectric-dielectric, conductor –dielectric
4. Poisson's and Laplace's Equation: Capacitance, Energy density.
5. Magnetic field Intensity (H)- Biot-Savart: Due to IdL,KdS,JdV, and Ampere's circuital law
6. Magnetic Boundary Conditions, Inductance, Force, Torque, Energy density.
7. Faradays Law, Maxwell's Equations
8. Poynting Theorem, Retarded Magnetic Potential
9. Uniform Plane Waves: Wave parameters, Incidence/Reflection /transmission of UPW.
10. All-important derivations
11. Case Study of EMF Applications to real life and wireless communication

Program:B. Tech. (E&TC)				Semester: VI			
Course: Digital Signal Processing				Code: BET6419			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of
Analog & Digital signals, Signal Transforms, Mathematics
is essential.

Course Objectives:

1. To provide background and fundamentals for the analysis and processing of digital signals.
2. To make students familiar with DFT and the computations of FFT algorithms.
3. To describe the design procedure and types of realization of digital filters to the students.
4. To explain the necessity of Digital Signal Processors, their architectures and applications

Course Outcomes:

After completion of this course, students will be able to,

1. Explicate various stages of Digital Signal Processing
2. Select proper tools to evaluate system response using frequency transformation techniques like DFT, FFT
3. Design the FIR digital filters for given specifications
4. Realize the IIR digital filters using different structures
5. Explain applications of digital signal processing algorithms to various areas like medical, speech, image
6. Illustrate various architectures and features of digital signal processors

Detailed Syllabus:

Unit	Description	Duration
1	**DSP Introduction:** Basic Elements of DSP and its requirements, Sampling and Reconstruction, Advantages & Disadvantages, Mapping between analog frequencies to Digital frequencies, System Stability and Correlation	**06**
2	**Transforms:** Definition of DTFT ,DFT,Properties of DFT, FFT algorithms: DIT,DIF	**08**
3	**FIR Filter Design:** Introduction, Basics of group delay & phase delay concepts, Comparison between Analog and Digital Filters, Characteristics of FIR filter, FIR filter design using Windowing methods, Filter Structures.	**08**
4	**IIR Filter Design:** IIR Filter Design by: impulse invariance method, bilinear transformation method,warping effect, Design of Butterworth low pass and high pass filter, Filter Structures.	**08**
5	**DSP Applications:** Medical, Speech, Image, Radar applications block diagrams, any one Case Study in detail	**07**

6	**Digital Signal Processor Architecture, GPU architecture:** Features of DSP architecture, Instruction set of Processor, Architecture, Protocols & standards used, Fixed and Floating-point formats, Basics of GPU/CUDA architecture	**08**
	Total Hrs.	**45**

Text Books:

1. Proakis & Manolakis, "Digital Signal Processing- Principles, Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007.
2. A. Nagoor Kani," Digital Signal Processing". Tata McGraw-Hill, Second edition, 2012
3. Venkataramani.B, Bhaskar.M, "Digital Signal Processors, Architecture, Programming and Application", Tata McGraw Hill, New Delhi, 2003.
4. S.Salivahanan, A.Vallavaraj and C.Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill, First edition 2009.

Reference Books:

1. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition. McGraw Hill Education, 2013
2. Avtar Singh, S. Srinivasan, "DSP Implementation using DSP microprocessor with Examples from TMS32C54XX", Cengage Learning India Pvt. Ltd. 2004.
3. Rulph Chassaing, Donald Relay, "Digital Signal Processing and Applications with TMS3206713 and TMS320C6416 DSK", 2nd Edition, Wiley-IEEE press, 2011
4. P. Ramesh Babu, "Digital Signal Processing" Scitech Publications Pvt. Ltd. 4th edition, 2006

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://www.classcentral.com/course/youtube-electrical-digital-signal-processing-47650/classroom
3. .https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/
1.

Program: B. Tech. (E&Tc)				Semester : VI			
Course : Digital Signal Processing Lab				Code : BET6420			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	--	2	1	-	--	25	25

Prior knowledge of:
Basic Signal Transforms, 1D signals mathematics is essential

Course Objectives:

1.To inculcate mathematical skills to solve problems involving convolution and sampling
2. To demonstrate the representation of signals in the frequency domain.
3. To make students aware of different types of filters and their implementations
4. To familiarize the students with various applications of DSP.

Course Outcomes:

After completing the course, the students should be able to:

1. Demonstrate open-source programming for engineering problems in the DSP domain.
2. Evaluate system response using frequency transformation techniques, DFT, FFT.
3. Design IIR & FIR Filters for real world signals.

General Guidelines: Any 10 Experiments is to be performed.

Mode of Evaluation: Continuous Assessment Test, Final Assessment Test

Detailed Syllabus:

Expt. No.	List of Experiments
1	Generation of continuous time (CT) and Discrete time (DT) signals using MATLAB. x4[n]=square wave with frequency 8 Hz, duty cycle 50%, x5[n]=Sawtooth wave with frequency 3Hz and peak is halfway through the period
2	Verification of Sampling Theorem.
3	Write a MATLAB program to find the linear and circular convolution of two sequences. a) Without using the MATLAB convolution function. b) Using MATLAB convolution function
4	Frequency domain analysis of the signal: Analyze how the signal's energy is distributed over a range of frequencies, Magnitude/Phase spectrum, Apply FFT to filtering applications
5	To study the effect of different windows on FIR filter (LPF,BPF) response. map it with any one application
6	To study the effect of different windows on FIR filter (HPF, BSF) response. map it with any one application
7	Design Butterworth filter using Bilinear transformation method for LPF and write a program to draw the frequency response of the filter. map it with any one application
8	Design Butterworth filter using Bilinear transformation method for HPF and write a program to draw the frequency response of the filter, map it with any one application

9	Analysis of speech signal: Read the speech signal, add noise above 3kHz and then remove; Interference Suppression using 400 Hz Tone. Also convert the signal into discrete domain, observe the effect of quantization on speech signal Fix number of quantization levels [2 4 8 16].
10	Identify the type of interface used to get a digital signal into a PC and use software to view the data on PC.
11	Signal processing on hardware to do projects with audio/speech signals (any one of the following) IDE of digital signal processor, Texas Code Composer Studio, Analog Devices VisualDSP++, Microchip MPLAB, ARM Keil MDK, Cadence, Tensilica, Eclipse IDE
12	**Typical Projects** 1. Consider an audio song with instrumental music and design a filter circuit to separate the voice signal and the instrument signal 2. Design and implement an encryption and decryption algorithm for audio signals which can be used for secured communication. 3. Design a Hardware system to control a DC motor speed by using voice signal as an input and apply this concept for Robotics applications 4. Develop a Voice controlled Home automation system for controlling the Home appliances in terms of switch on, switch off etc. 5. Develop a Speaker Verification system for biometric Security Applications. This project should be designed like fingerprint or Face recognition 6. Design the following modules for Analog to Digital conversion a. Sampling; b. Quantization; c. Encoding 7. Develop a system for noise cancellation. This system has to separate/filter the noise and the original signal. 8. Analyze an ECG signal for medical diagnosis applications. 9. Design and implement a DTMF signaling scheme for various controlling applications. 10. Design a motion detector circuit for intruder alarm, home automation system etc. 11. Develop an algorithm for audio watermarking and implement the same in MATLAB 12. Develop an algorithm for speech signal Denoising and compression method for Communication. 13. Design a stress measurement system using strain gage. The output of the system should be 8 bits digital output

Reference Books:

1. S Esakkirajan,t Veerakumar,Badri Narayan Subudhi Digital Signal Processing McGraw Hill 2021
2. Avtar Singh, S. Srinivasan, “DSP Implementation using DSP microprocessor with Examples from TMS32C54XX”, Cengage Learning India Pvt. Ltd. 2004.
3. S.Salivahanan, A.Vallavaraj and C.Gnanapriya, “Digital Signal Processing”, Tata McGraw-Hill, First edition 2009.
4. Rulph Chassaing, Donald Relay, “Digital Signal Processing and Applications with TMS3206713 and TMS320C6416 DSK”, 2nd Edition, Wiley-IEEE press, 2011
5. https://bmsp-coep.vlabs.ac.in/
6. https://cse19-iiith.vlabs.ac.in/List%20of%20experiments.html
7. https://ssp-iiith.vlabs.ac.in/exp/basics-of-dsp/

Program: B. Tech. (E&Tc)					**Semester : VI**		
Course : Project Based Learning -VI					**Code : BET6421**		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	--	2	1	25	--	--	25

Prior knowledge of:

Electronics components , hardware and programming

is essential

Course Objectives:

1. To make the students aware of basics of prototype design and its importance
2. To encourage the students to develop a prototype of the proposed idea.

Course Outcomes:

After completion of the course, students will be able to:

1. Compare the prototype design techniques.
2. Design a prototype model using suitable prototype design tools.

General Guidelines:

1. Create groups of maximum 3 students.
2. The students plan, manage and complete a task/project/activity which addresses the stated problem in the hardware/ software domain.
3. The selected topic should exhibit the various steps followed for prototype design.
4. The assessment for term work will be done at least two times at the department level by giving a presentation to panel members which consist of at least two members as examiners (including the project guide/mentor).
5. At the end of the semester, every group has to submit a report/ research article on their implementation which summarizes the results

Detailed Syllabus:

List of Activities

1. To Understand the difference between prototype design and product.
2. To Understand Prototype design techniques, Design optimization.
3. To do the literature survey and finalize the topic.
4. Finalization of the implementation algorithm and design steps.
5. Testing and validation of prototype design, Proof of concept.
6. Introduction to 3D printing.
7. Development of idea into prototype using design techniques-Paper design/ model design.
8. Apply process algorithms for part development.
9. Implementation of the algorithm.
10. Develop a prototype/end use product.
11. Submit the final report/ research article on the implementation.
12. Demonstration and Team presentation.

	Total	**30**

Reference Books:

1. Kathryn McElroy “Prototyping for Designers” O'Reilly Media, first edition 2017.
2. Bjarki Hallgrimssn “Prototyping and Model making for Product Design” Laurence King Publishing, 2012.

Online Courses:

1. Prototype Design”
https://www.coursera.org/learn/prototyping-design#about.

Program Electives-III

Program:	B.Tech.(E&TC)	Semester:	VI
Course:	Energy harvesting and Management	Code:	BET6501

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of

Physics, Power Electronics, Basics of electronics and electrical is essential

Course Objectives:

1. To provide an understanding of energy harvesting materials.
2. To make the student aware of the concepts of solar power management.
3. To provide the management aspects of energy.
4. To make the student aware of the concept and design of electrochemical batteries.

Course Outcomes:

After completion of this course, students will be able to,

1. Describe the importance of energy harvesting and its use.
2. Summarize the need of solar power management and analyze the Maximum power point tracking (MPPT) algorithms.
3. Elaborate the concept of energy management.
4. Analyze the various types of rechargeable batteries.

Detailed Syllabus:

Unit	Description	Duration
1.	**Energy Harvesting:** Piezoelectric, Pyroelectric and Thermo-electrics, Electrostatic (capacitive) Energy Harvesting, energy from Magnetic Induction, Metamaterial, energy from atmospheric pressure changes, electroactive polymers (EAPs), nanogenerators, Ambient radiation sources and nanoantenna, energy from noise.	8
2.	**Solar Power Management:** Power conditioning and maximum power point tracking (MPPT) algorithms based on buck- and boost-converter topologies, Maximum power point tracking (MPPT) algorithms, Inverter topologies for stand-alone and grid-connected operation. Analysis of inverter at fundamental frequency and at switching frequency.	8
3.	**Power Management:** Electricity Act 2003, Relevant aspects, Central Electricity Authority, Central electricity regulatory Commission, India energy exchange, Open Access Power	6

4.	**Rechargeable Batteries:** Primary and secondary batteries, battery potential, charge figure of merit, energy, and power in the battery, battery architecture, and design guidelines, Lead–acid battery, Nickel–cadmium battery (NiCd), Nickel–metal hydride battery (NiMH), Lithium-ion battery, Lithium-ion polymer battery. Energy density, power density, price, and market. Battery Management Systems and System Performance	**8**
	Total	**30**

Text Books:

1. Solar Energy, by S P Sukhatme & J K Nayak, Mc Graw Hill Publishers
2. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
3. Advanced Energy Materials, Ashutosh Tiwari & Sergiy Valyukh, J. Wiley & Sons
4. Solanki S. Chetan. Solar Photovoltaics: Fundamentals, Technologies and Applications, New Delhi, PHI, 2012.
5. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion," John Wiley and Sons, 2012.
6. M D Singh, K B Khanchandani," Power Electronics," Tata McGraw-Hill Education,2017

Reference Books:

1. Materials and Energy (Book Series), Leonard C Feldman (Ed. In Chief), World Scientific
2. Photovoltaics: Engineering and Technology for Solar Power, Catherine Waltz, Syrawood Publishing House
3. Thomos Reddy," Linden's Handbook of Batteries," Fourth Edition, McGraw-Hill Education.
4. Doughty Liaw, Narayan, and Srinivasan, "Batteries for Renewable Energy Storage," The Electrochemical Society, New Jersy,2010.
5. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters Applications and Design, John Willey & Sons, Singapore, 2nd Edition Oxford University Press, New Delhi, 2005.
6. Research papers on energy harvesting.
7. NPTEL course on energy harvesting and Energy storage devices

Program: B.Tech.(E&Tc)				Semester: VI			
Course: Energy harvesting and management Lab				Code:BET6502			
Teaching Scheme				Evaluation Scheme			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	-	2	1	-	-	25	25

Prior knowledge of:
Basic electronics and electrical Engineering and Network Analysis

is essential

CourseObjectives:

1. To develop the students simulation skill in PV cell modeling
2. To introduce the DC-DC converter topology and its uses
3. To introduce the need of maximum power point tracking algorithm in exacting power from the photovoltaic module.
4. To introduce students the basics of batteries and its parameter

CourseOutcomes:
After completion of this course, students will be able to,

1. Analyze the performance of PV cell/ module .
2. Summarize the need of DC-DC converter topology
3. Analyze the maximum power point tracking algorithm
4. Calculate the various parameters of battery.

General Guidelines :Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Generate the V-I and P-V curve of PacBell /module using MATLAB Simulink tool
2	StudytheperformanceofPVmoduleandobservetheimpactoftemperatureandsolarirradiationon it.
3	Study the impact of partialshadingconditiononthePVmodule
4	DesignandsimulateanyMaximumpowerpointtrackingalgorithmusingMATLABSimulinktool
5	Design and simulate Buck and Boost converter of any specification.
5	Design and simulate a Boost converter of any specification.
6	Study the basic parameters of battery and measure the charging voltage and current of given battery
7	Simulate battery model of given battery using any simulation tool.
8	Study the process of battery testing.
9	Visit to any industry/Research laboratory related to battery.
10	Case study on energy management.

Reference Books:

1. Materials and Energy (Book Series), Leonard C Feldman (Ed. In Chief), World Scientific
2. Power generation Operation & Control, Allen J. Wood and Bruce Woollen berg, John Wiley
3. Photovoltaics: Engineering and Technology for Solar Power, Catherine Waltz, Syrawood Publishing House
4. D.LindenandT.S.Reddy,"HandbookofBatteries,"3rdEdition,McGraw-Hill,2002.
5. DoughtyLiaw,NarayanandSrinivasan,"BatteriesforRenewableEnergyStorage", The ElectrochemicalSociety,NewJersy,2010.

Online course:

1. https://cea.nic.in
2. https://cercind.gov.in
3. bhttps://www.iexindia.com

Program:	B. Tech. (E&TC)				Semester:		VI
Course:	Embedded System Design & RTOS				Code:		BET6503
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	CE	MTE	ETE	Total
02	--	2	2	20	30	50	100

Prior Knowledge of
Microcontrollers and Embedded C programming
Is essential

Course Objectives:

1. To explain the basics of Embedded systems design.
2. To discuss design and implementation of a real time system using RTOS.
3. To elaborate application specific system design.

Course Outcomes:

After completion of this course, students will be able to,

1. Understand the embedded system architecture and development toolchain.
2. Acquire a basic knowledge about fundamentals of RTOS.
3. Design multiple tasks using ucos-II RTOS for specific embedded applications.
4. Design Device drivers with embedded Linux development systems.

Detailed Syllabus:

Unit	Description	Duration
1.	**Embedded System Overview** Embedded System Introduction, Hardware and software architectures of ES, Design metrics (technical and techno- economical), Prototyping models, Development tool chain insights (GNU), embedded system design challenges.	**6**
2.	**Real time systems and RTOS** Introduction to Real time system, types, design approaches and considerations, Usage of Shared resources and related issues, Concept of RTOS, Types of RTOS, differences from GPOS, commercial RTOS, survey of RTOS	**8**
3.	**µcos-II –RTOS** Introduction to µCOS-II RTOS, µcos-II features, study of kernel structure of µCOS-II, Synchronization in µCOS-II, Inter-task communication in µCOS-II, Memory management in µCOS-II, porting of RTOS on ARM-v7 (emulation) board, Application developments using µCOS-II.	**8**
4.	**Embedded Linux** Linux for embedded systems, embedded Linux development system, kernel architecture and configuration, file systems, porting Linux on ARM architecture, boot loaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample character device driver.	**8**
	Total	30

Text Books:

1. Rajkamal, Embedded Systems: Architecture, Programming and Design, Tata McGraw-Hill Education, 2nd edition, 2011.
2. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, **CRC Press** 1st Edition , 2003
3. Jean Labrosse, MicroC OS II: The Real Time Kernel, CRC Press, 2nd edition, 2002
4. Christopher Hallinan, Embedded Linux Primer: A Practical Real-World Approach, 2nd edition,2010

Reference Books:

1. Di Jasio, Programming 32-bit microcontrollers in C, Elsevier, 1st Edition, 2008.
2. Tammy Noergaard, Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Newnes, 2nd Edition, 2010.
3. K. Curtis, Embedded multitasking, 1st edition, Newnes, 2011.

4. Chris Simmonds, Master the techniques needed to build great, efficient embedded devices on Linux, Packt, 2nd Edition, 2017
5. Brian Amos, Hands-On RTOS with Microcontrollers, Packt Publishing, 1st Edition, 2020

NPTEL Online Courses / MOOCs

1. Embedded Systems, IIT Delhi, Prof. Santanu Chaudhary https://nptel.ac.in/courses/108102045
2. Embedded System Design with ARM, IIT Kharagpur, Prof. Indranil Sengupta, Prof. Kamalika Datta https://nptel.ac.in/courses/106105193
3. Introduction to Embedded System Design, IIT Jammu, Prof.Dhananjay V. Gadre, Prof. Badri N Subudhi https://nptel.ac.in/courses/108102169
4. Microcontroller Embedded C Programming: Absolute Beginners, Udemy.com https://www.udemy.com/course/microcontroller-embedded-c-programming/
5. Embedded Linux Step by Step Using Beaglebone Black, Udemy.com
6. https://www.udemy.com/course/embedded-linux-step-by-step-using-beaglebone/

Program: B. Tech. (E&Tc)					Semester: VI		
Course: Embedded System Design & RTOS Lab					Code: BET6504		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
02	--	2	01			25	25

Prior knowledge of
Microcontrollers and Embedded C programming
is essential

Course Objectives:

1.To enable the students to understand embedded-system development process 2. To impart knowledge of various embedded hardware and software tools
3.To educate on implementation of RTOS based embedded systems.

Course Outcomes:

After completion of this course, students will be able to,

1. Develop programming skills in embedded systems for various applications
2. Write an ARM microcontroller based programs to perform various tasks using RTOS.
3. Implement microcontroller based embedded systems using open source RTOS.

General Guidelines: Any 10 Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Porting of ucos-II on ARM7 controller
2	Implementation/Verification of multitasking (minimum 03 tasks) with ucos-II on ARM7 controller
3	Implementation of semaphore with ucos-II service ARM7 controller for resource management and synchronization
4	Implementation of interprocess communication with ucos-II mailbox service on ARM7 controller
5	Implementation of interprocess communication with ucos-II message queue service on ARM7 controller
6	Exercise on Porting of Linux on ARM9 board
7	Writing simple application using embedded Linux on ARM9
8	Writing a device Driver. Loading into & removing from Kernel on ARM9 board.
9	Implementation/Verification of multitasking defining two task for LCD and Keypad with ucos-II on ARM7 controller..
10	Writing and Implementing RTC using embedded Linux on ARM9
11	Implementation of inter-process communication with ucos-II using MUTEX on ARM7 controller

Reference Books:

1. Christopher Hallinan, Embedded Linux Primer: A Practical Real-World Approach, 2nd edition, 2010
2. UM10139 LPC214x User manual, NXP Semiconductor, https://www.nxp.com
3. Jean J. Labrosse (Author), Freddy Torres uC/OS-III: The Real-Time Kernel and the NXP LPC1700, Micrium, 1st Edition, 2010.

Program:	B. Tech. (E&TC)					Semester: VI	
Course:	Audio and Speech Processing					Code: BET6505	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Signal and Systems
2. Digital Signal Processing is essential

Course Objectives:

1. To familiarize students the basic mechanism of speech production, different speech sounds and parameters.
2. To formulate speech and audio processing methods in time and frequency domain.

Course Outcomes:

After completion of this course, students will be able to,

1. Understand basic concepts of speech production and Categorize different types speech sounds different pitch and formants of speech.
2. Employ time domain speech analysis.
3. Employ frequency domain analysis.
4. Develop and analyze system for different applications of speech processing.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction:** Anatomy and physiology of speech production, categorization of speech sounds, Parameters of Speech: Pitch and Formants, audio perception	**7**
2.	**Speech Analysis:** Short-Time Speech Analysis, Time domain analysis :Short time energy(STE), short time zero crossing Rate, ACF**,** Methods for extracting the parameters :energy, Average Magnitude – Zero crossing Rate (ZCR) – Silence Discrimination using ZCR and energy	**7**
3.	**Frequency domain analysis:** Filter Banks, Short-Time Fourier Transform (STFT), Spectrogram, Cepstral Analysis, MFCC, Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain	**7**
4.	**LPC Analysis:** Linear Predictive Coding Model, The autocorrelation method **Applications**: Speaker Recognition: Spectral Features required for Speaker Recognition, Speech Recognition: Spectral Features required for Speech Recognition, Music Analysis, Speech Enhancement	**9**
	Total	30

Text Books:

1. Douglas O'Shaughnessy, Speech Communications: Human & Machine, IEEE Press, Hardcover 2/e, 1999; ISBN: 0780334493.
2. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, , John Wiley & Sons, ISBN: 0471351547, July 1999
3. T.F. Quartieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall,2008

Reference Books:

1. Rabiner and Juang, Fundamentals of Speech Recognition, Prentice Hall, 1994.
2. Rabiner and Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978

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Online Course:

NPTEL Course Digital Speech Processing https://onlinecourses.nptel.ac.in/noc22_ee117/preview

Program: B. Tech. (E&Tc)						**Semester :VI**	
Course : Audio and Speech Processing Lab						**Code :** BET6506	
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	-	2	1	-	-	25	25

Prior knowledge of: digital signal processing, MATLAB/Python is essential.

Course Objectives:

1. To familiarize students various domain representations of audio and speech signals.
2. To introduce students about various applications of audio and speech signals.

Course Outcomes:

After completion of this course, students will be able to,

1. Comprehend time and frequency domain representation of audio and speech signal processing.
2. Characterize various speech parameters for representation of audio and speech signals.
3. Design, implement and analyze application of speech and audio processing.

General Guidelines: Any Eight Experiments is to be performed.

Detailed Syllabus

Expt. No.	**List of Experiments**
1	Analysis and Synthesis of audio and speech signals
2	Identification of voiced speech, unvoiced speech, silence
3	Short time domain analysis of audio and speech Signals
4	Frequency domain analysis of audio and speech Signals
5	Linear Predictive analysis of Speech
6	Pitch Estimation
7	Formant Estimation
8	Enhancement of audio and speech signal
9	Speech Recognition
10	Speaker Recognition
11	Design and Implementation of audio or speech processing based case study.

Reference Books:

1. T. Dutoit, F. Marqués, L.R. Rabiner, Applied signal processing: a MATLAB-based Proof of Concept, Springer 2010
2. Ian Vince Mcloughlin. Speech and Audio Processing: A MATLAB-based Approach, Cambridge University Press 2016

Program:	B. Tech. (E&TC)				Semester:	VI	
Course:	Mobile Communication and Networks				Code:	BET6507	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Analog and Digital communication systems is essential

Course Objectives:

1. Students will be exposed to fundamental issues in mobile communication and mobile channel modeling.
2. Students will learn importance of diversity in mobile communication.
3. Students will learn contemporary issues in wireless networks along with existing networks.

Course Outcomes:

After completion of this course, students will be able to,

1. Apply the cellular concepts in RF planning of mobile network.-
2. Choose an appropriate path loss model in planning of mobile network.
3. Compare diversity techniques in mobile communication.
4. Analyze the various contemporary mobile networks and recent trends.

Detailed Syllabus:

Unit	Description	Duration (Hours)
1.	**Cellular Communication Fundamentals:** Introduction to 1G, 2G,3G,4G,5G and comparison. CDMA, GSM and GPRS basics. Frequency reuse, frequency management and channel assignment, handover concepts, co-channel and adjacent channel interference, trunking and grade of service (GoS), coverage and capacity improvement in cellular system, power control.	**7**
2.	**Mobile Radio Propagation:** Large scale fading: free space propagation model, reflection, ground reflection (two-ray) model, diffraction, scattering, Okumura, Hata model, PCS-Hata model. Small scale fading: parameters of multipath channels, types of small scale fading, time delay spread; flat, frequency selective, Doppler spread; fast and slow fading. Rayleigh and Rician fading,Link budget analysis.	**8**
3.	**Diversity Techniques:** Types of diversity, Diversity combining techniques: selection, feedback, maximal ratio combining and equal gain combining, rake receiver.	**7**
4.	**Contemporary issues and wireless networks:** OFDM basics, bit error rate performance for fading channel. Introduction to MIMO Wireless Communications, MIMO System Model and MIMO-OFDM.Vertical Handover, Case Studies of Cellular standards:LTE,VoLTE,5G. Introduction to NFV, SDN, Network slicing	**8**
	Total	30

Text Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
2. Jagannatham, A. K., "Principles of Modern Wireless Communication Systems", McGraw-Hill Education,1st Edition,2015.

Reference Books:

1. W.C.Y. Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
2. E. Dahlman, J. Skold, and S. Parkvall, "4G, LTE-Advanced Pro and The Road to 5G", Academic Press, 3rd Edition.
3. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.

MOOC / NPTEL Courses:

1. NPTEL Course "Introduction to Wireless & Cellular Communications"
Link of the Course: **https://nptel.ac.in/courses/106/106/106106167/**

2. NPTEL Course "Advanced 3G and 4G Wireless Mobile Communications"
Link of the Course: **https://nptel.ac.in/courses/117/104/117104099/**

Program: B. Tech. (E&Tc)				**Semester :VI**			
Course : Mobile Communication and Networks Lab				**Code : BET6508**			
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**OR**	**PR**	**Total**
2	-	1	2			25	25

Prior knowledge of:

1.Analog and Digital communication,
2. Software tools like MATLAB,GNU radio is essential.

Course Objectives:

1.Students will learn the concepts of mobile communication by experimentation, simulation and field visit.

Course Outcomes:
At the end of Laboratory work, the students will be able to:

1. Analyze the various aspects related to mobile communication like frequency reuse and path loss calculations.
2. Simulate the performance of mobile systems for diverse environment.
3. Experiment with the hardware components for mobile systems.

General Guidelines: Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	**List of Experiments**
1	To analyze the cellular frequency reuse concept fulfilling the following objectives: Finding the co-channel cells for a particular cell. Finding the cell clusters within certain geographic area.(Virtual Lab.IIT)
2	To apply the path loss prediction formula with the objectives: 1. Calculation of received signal strength as a function of distance of separation, antenna height and carrier frequency. 2.To understand the impact of :-Transmitter Power, Path loss exponent, Carrier frequency, Receiver antenna height, Transmitter antenna height. (Virtual Lab.IIT)
3	To simulate Hata model for urban, sub-urban and city environment and analyze the impact of frequency and distance on received signal strength.
4	To Simulate BER performance over a Rayleigh fading wireless channel with BPSK/QPSK transmission for SNR:0 to 50 dB.
5	To simulate BER performance over a Rayleigh fading wireless channel with OFDM for SNR: 0 to 60 dB.
6	To simulate a Link Budget for a mobile network in your area.
7	To design OFDM transmitter in GNU radio.
8	To design OFDM receiver in GNU radio.
9	To study of Mobile phone trainer and AT commands

10	To study of 3G Mobile trainer Kit and observe various waveforms.
11	Field visit to nearby MTSO/Base station and prepare a report.
12	To present a recent paper in the area of mobile/wireless communication.

Reference Books:

1. Theodore S Rappaport, "Wireless Communications Principles & Practice" Second Edition, Pearson Education,2010.
2. Jagannatham, A. K., "Principles of Modern Wireless Communication Systems", McGraw-Hill Education,1st Edition,2015.
3. https://in.mathworks.com/help/comm/
4. https://www.gnuradio.org/

Program:	B. Tech. (E&TC)	Semester:	VI
Course:	JAVA PROGRAMMING	Code:	BET6509

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	--	2	2	20	30	50	100

Prior Knowledge of:
1. Data Structures and Algorithms
2. Object Oriented Programming concept

is essential.

Course Objectives:

1. To make students familiar with fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
2. To introduce principles of object-oriented programming paradigm including abstraction encapsulation, inheritance and polymorphism and basics of java programming
3. To acquaint students with concepts of inheritance and polymorphism
4. To comprehensively explain the concepts of Multithreading , exceptions and file handling.

Course Outcomes:

After completion of this course, students will be able to,

1. Explain the syntax and semantics of java programming language and basic concepts of OOP
2. Apply the concepts of classes and objects in java.
3. Write the java program based on inheritance, polymorphism, interfaces and packages.
4. Apply Multithreading and Exception handling concepts to develop efficient and error free codes..

Detailed Syllabus:

Unit	Description	Duration
1.	**JAVA BASICS:** Review of Objectoriented concepts, History of Java, Evolution of Java, Comparison of Java with other programming languages, Java features, Java Run Time Environment. JVM architecture, Java Program Structure, Simple Java Program. Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions.Control statements- Decision making & looping.	**6**
2.	**Classes & Objects:** Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class.Abstract Methods and classes, Strings,One dimensional and two dimensional arrays , wrapper classes, enumerated types, Command line arguments.	**8**

3.	**Inheritance & Polymorphism:** Inheritance: Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch. Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface Packages: Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes	**8**
4.	**Multithreading & Exception Handling:** Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Managing input/output files: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.	**8**
	Total	**30**

Text Books:

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition. 2012
2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.2010

Reference Books:

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.2008
2. Y. Daniel Liang, "Introduction to Java programming", Pearson Education, India, 7th Edition. (2010)
3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.2012

NPTEL Online Courses/MOOCs:

1. Programming In Java By Prof. DebasisSamanta https://onlinecourses.nptel.ac.in/noc23_cs74/preview

Java Programming Masterclass updated to Java 17 by Tim Buchalka https://www.udemy.com/course/java-the-complete-java-developer-course/

Program : B. Tech. (E&Tc)				Semester :VI			
Course : Java Programming Lab				Code :BET6510			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	--	2	1			25	25

Prior knowledge of:
1. Data Structures and Algorithms
2. Object Oriented Programming concept
is essential

Course Objectives:

1. To demonstrate basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methods etc.
2. To implement the principles of inheritance, packages and interfaces in java
3. To demonstrate skills in writing programs using multithreading, exception & file handling techniques.

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

1. Apply the concepts of classes and objects to write programs in Java
2. Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
3. Demonstrate efficient and error free codes using concepts of Multithreading and Exception handling .

General Guidelines: Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Write some simple programs in Java such as: To find the factorial of a number. To display the first 50 prime numbers. To find sum and average of N numbers
2	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and color is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display "Matching Rectangles", otherwise display " Non-matching Rectangle"
3	Write a program in JAVA to demonstrate the method and constructor overloading.
4	Write a program in Java to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.
5	Write a Java program which imports user defined packages and uses members of the classes contained in the package.
6	Write a Java program which implements interface.
7	Write a java program which uses try and catch for exception handling.

8	Write a program to create multiple threads and demonstrate how two threads communicate with each other.
9	Write a java program in which data is read from one file and should be written in another file line by line
10	A Mini project in Java: A group of 4 students can develop a small application in Java

Reference Books:

1. T. Budd, “Understanding OOP with Java”, Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), “Introduction to Java programming”, Pearson Education, India, 7 th Edition.

Program Elective-IV

Program:	B. Tech. (E&TC)					Semester:	VI
Course:	Battery Management System					Code:	BET6511
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	CE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior knowledge of

1. Basics of Electronics Engineering, Basic Electrical & Electronics Engg, (or equivalent subject),
2. Control System, Network Analysis,
3. Chemistry, Physics is essential

Course Objectives:

1. To introduce learners to basics of batteries and its parameters.
2. To introduce learners to modelling and charging requirements of battery.
3. To introduce battery management algorithms for batteries

Course Outcomes:

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

1. Interpret the role of battery management system
2. Identify the requirements of Battery Management System.
3. Interpret the concept associated with battery charging / discharging process
4. Calculate the various parameters of battery and battery pack and design the model of battery pack.

Detailed Syllabus:

Unit	Description	Duration (Hrs)
1	**Unit I: Introduction** Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical, and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging	07
2	**Unit II: Battery Management System Requirement:** Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power,	08
3	**Unit III: Battery State of Charge and State of Health Estimation, Cell Balancing:** Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing	07
4	**Unit IV: Modelling, Simulation & Design:** Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, Simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs, Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.	08
	Total	30

Text Books:

1. Joey Jung, Lei Zhang and Jiujun Zhang, "LEAD-ACID BTTERY TECHNOLOGIES", Fundamentals, Material and Applications, CRC Press, Taylor & Francis Group
2. Sandeep Dhaneja, "ELECTRIC VEHICLE BATTERY SYSTEMS" Newines, ELSEVIER

Reference Books:

1. Plett, Gregory L., "Battery management systems", Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L., "Battery management systems", Volume II: Equivalent-circuit methods. Artech House, 2015.
3. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L, "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
4. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
5. Pop, Valer, et al., "Battery management systems: Accurate state-of-charge indication for battery-powered applications". Vol. 9. Springer Science & Business Media, 2008.

NPTEL Courses on "Battery Management Systems:

Program:	**B. Tech. (E&TC)**			**Semester:**	**VI**		
Course:	**Battery Management System Lab**			**Code:** **BET6512**			
Teaching Scheme (Hours)				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
02	-	2	1	25	-		25

Should have Prior knowledge of,

1. Basics of Electronics Engineering, Basic Electrical & Electronics Engg, (or equivalent subject),
2. Control System, Network Analysis,
3. Chemistry, Physics is essential.

Objectives:

The objectives of this course are:

1. To introduce learners to basics of batteries and its parameters.
2. To introduce learners to modelling and charging requirements of battery.
3. The course will help learner to develop battery management algorithms for batteries

Outcomes:

After Successfully completing the course, the learner will be able to:

1. Interpret the role of battery management system
2. Identify the requirements of Battery Management System.
3. Interpret the concept associated with battery charging / discharging process
4. Calculate the various parameters of battery and battery pack.
5. Design the model of battery pack.

Detailed Syllabus: Any 10

Sr. No	**List of Experiments**	
1	To model a lead-acid battery cell using the Simscape™	
2	Observe the charging and discharging process, and plot graph of charging/load current, SOC, temperature, DOC, and terminal voltage- Part A	
3	Observe the charging and discharging process, and plot graph of charging/load current, SOC, temperature, DOC, and terminal voltage Part B	
4	To analyze the effect of temperature on the performance of a Lithium-Ion battery model	
5	To simulate and plot the result of temperature, SOC for the HV Battery Charge/Discharge using realistic DC-link current profile, which originates from a dynamic driving cycle-PartA	
6	To simulate and plot the result of current, and terminal voltage for the HV Battery Charge/Discharge using realistic DC-link current profile, which originates from a dynamic driving cycle- PartB	
7	To study Lithium Battery Cell - One RC-Branch Equivalent Circuit and it's simulation	
8	To simulate Ni-MH Battery Model with the DC machine and show the charging and discharging process using DC machine.	
9	To simulate Lithium-Ion (LiFePO4) Battery and analyze the effect of DOD and discharge rate on battery ageing considering 1000 h simulation time	
10	Compare of-the-self BMS functions .	
11	Case study on different batteries used for Electric Vehicles	

Textbooks:

1. Joey Jung, Lei Zhang and Jiujun Zhang, "LEAD-ACID BTTERY TECHNOLOGIES", Fundamentals, Material and Applications, CRC Press, Taylor & Francis Group
2. Sandeep Dhaneja, "ELECTRIC VEHICLE BATTERY SYSTEMS" Newines, ELSEVIER

Reference Books:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.
3. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
4. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
5. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008.

Program:	B. Tech. (E&TC)					Semester:	VI
Course:	FPGA Architectures & Programming					Code:	BET6513
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Digital design fundamentals.
2. VHDL/Verilog knowledge is essential

Course Objectives:

1. To introduce students to advanced design methodologies using FPGA
2. To explain practical design approaches using Verilog for high-performance FPGA applications.
3. To demonstrate VLSI design flow and development of applications using Advance FPGA

Course Outcomes:

After completion of this course, students will be able to,

1. Comprehend programmable logic devices and FPGA architectures
2. Explain VLSI design flow with simulation and implementation
3. Evaluate the FPGA based application with the emerging multicore architectures from the perspectives of price/performance.

Detailed Syllabus:

Unit	Description	Duration
1.	**FPGA Architecture:** Programmable Logic Devices (PLD), Evolution of PLDs, Programmable Logic Block Architectures, Routing Architecture. Programmable Interconnections, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs. FPGA based SoC Design-Case study.	**8**
2.	**Introduction to EDA:** Overview of VLSI Design flow and levels of abstraction in IC design, Basics of design automation at the logic level. Design methodology HDL and top-down design methodology; describe and synthesis approach. Introduction to Two-level logic synthesis: multi-level logic synthesis, high level synthesis. logic level synthesis and technology mapping.	**7**
3.	**FPGA Design and Programing:** The VERILOG Process, Concurrent and Sequential Statements, Understanding the Flip-Flop, Synchronous Design Methodology, RTL styles that are popular with FPGA, JTAG, Programming through JTAG, Boundary Scan Testing, Finite State Machine (FSM).	**7**
4.	**High Level Synthesis and PYNQ Architecture:** and Introduction to Vitis HLS, high-level synthesis flow, FPGA-based Programming using C/C++, Architecture of PYNQ (Zynq 7000), PYNQ Development Flow, Basic GPIO interfacing with PYNQ FPGA, Image Processing with PYNQ, using PYNQ libraries as sci_pi, OpenCV, Installing TensorFlow on PYNQ, Machine Learning with PYNQ, Neural Network Implementation on PYNQ, Creating Custom PYNQ, Overlay on Xilinx VIVADO, Machine Learning on Xilinx FPGAs.	**8**
	Total	30

Text Books:

1. Stephen M. Trimberger, “Field Programmable Gate Array Technology”, Springer International Edition.2012
2. FPGA Programming for Beginners: Bring Your Ideas to Life by Creating Hardware Designs and Electronic Circuits with SystemVerilog 2010

Reference Books:

1. Kilts, Steve. *Advanced FPGA design: architecture, implementation, and optimization.* John Wiley & Sons, 2007.

Online Course

1. https://nptel.ac.in/courses/117108040
2. https://www.udemy.com/course/pynq-fpga-development-with-python-programming/

Program: B. Tech. (E&TC)					**Semester:** VI		
Course: FPGA Architectures & Programming Lab					**Code:** BET6514		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	-	2	1	25	-		25

Prior knowledge of:
Digital design fundamentals.
VHDL/Verilog knowledge is essential

Course Objectives:

1. To explain design and simulation of combinational and sequential circuits
2. To describe FPGA programming using advanced FPGA boards.

Course Outcomes:

After completion of this course, students will be able to,

1. Design the applications using latest FPGA development boards.
2. Demonstrate FPGA implementations using Python for certain applications

General Guidelines: All Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Vivado/Vitis HLS Design Flow
2	FPGA Implementation of 4-bit Adder/Subtractor using VHDL/Verilog.
3	FPGA Implementation of 4-bit UP/DOWN using VHDL/Verilog.
4	FPGA implementation of LFSR.
5	Modelling of Adder in structural and behavioral styles.
6	Modelling of FSM using Verilog (Sequence Detector)
7	Verifying Adder Code with C Simulation to understand HLS
8	Verifying FIFO code with C simulation to understand HLS
9	Getting Started with PYNQ Z2 board.
10	Using Python Overlays to Experiment switching of LEDs on PYNQ
11	Using Python Overlays to Experiment chasing of LEDs on PYNQ

Reference Books:

1. Kilts, Steve. Advanced FPGA design: architecture, implementation, and optimization. John Wiley & Sons, 2007.

Online Course

1. https://nptel.ac.in/courses/117108040
2. https://www.udemy.com/course/pynq-fpga-development-with-python-programming/

Program	B. Tech. (E&TC)	Semester	VI
Course	Introduction to Statistical signal Processing	Code	BET6515

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	CE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Probability and random theory
2. Linear algebra
3. Fundamentals of digital Signal Processing **are essential**.

Course Objectives:

1. To understand the fundamental concepts of statistical signal processing.
2. To have a good knowledge on estimating different signal parameters in signal processing applications.
3. To Learn and understand various Bayesian estimators such as MSE, MMSE, MAE and Maximum a Posteriori (MAP)
4. To have a good foundation in Non-parametric and parametric spectrum estimation.

Course Outcomes:

After completion of this course, students will be able to,

1. Understand the fundamentals of statistical signal processing techniques.
2. Illustrate the underlying principle of different classical estimator techniques
3. Describe the various Bayesian estimators to model based signal processing problems.
4. Explain the underlying principle of different spectrum estimation techniques.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction/Fundamentals:** Random Variables: Definition, Ensemble averages, jointly distributed random variables, Independent, uncorrelated and orthogonal random variables, Gaussian random Variables, Probability density function , Random Processes: Gaussian and stationary processes, auto-covariance and Auto Correlation Matrices, Ergodicity, White noise, The Power Spectrum Stochastic Models: Autoregressive Model (AR) , Moving Average ,(MA) model and Autoregressive Moving Average(ARMA) model.	**10**
2.	**Parameter Estimation I** Estimation in Signal Processing, Mathematical estimation Problem, assessing estimator performanceClassical Estimators: Minimum variance unbiased estimator (MVUE) , Maximum likelihood estimation and its properties	**5**
3.	**Parameter Estimation II** Bayesian estimation: MSE, MMSE, MAE and Maximum a Posteriori (MAP) estimation, Adaptive filtering: The LMS algorithm; Introduction to Kalman filter	**7**
4	**Spectrum Estimation** Minimum variance spectrum estimation, Maximum entropy method Nonparametric Methods: The Periodogram, Performance of Periodogram, The modified Periodogram, Welch's method Parametric Methods: Autoregressive spectrum estimation, moving average spectrum estimation	**8**
	Total	30

Text Books:

1. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, 2002
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation theory, volume 1, Pearson Education India
3. Gray, R. M. and Davisson L. D., An Introduction to Statistical Signal Processing. Cambridge University Press, 2004

Reference Books:

1. H. V. Poor, An Introduction to Signal Detection and Estimation, 2nd edition, Springer, 1994
2. Dimitris Manolakis, Vinay Ingle, Stephen Kogon, Statistical and Adaptive Signal Processing, Tata McGraw Hill. 2012

NPTEL Course:

1. NPTEL Course "Statistical Signal Processing" Link of the Course: https://nptel.ac.in/courses/108103158

MathsWork Course:

2. Introduction to Statistical Methods with MATLAB:Link of the Course: https://matlabacademy.mathworks.com/details/introduction-to-statistical-methods-with-matlab/stats?s_tid=course_stats_start

Program: B. Tech. (E&Tc)					Semester :VI		
Course : Introduction to Statistical signal Processing -Lab					Code : BET6516		
Teaching Scheme				Evaluation Scheme			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	-	2	1	25			25

Prior knowledge of:

1. Probability theory
2. Fundamentals of MATLAB programming **is essential.**

Objectives:

1. Study and Implement various algorithms in statistical signal processing using MATAB

Outcomes:

After completion of this course, students will be able to,

1. Apply the fundamentals of statistical signal processing techniques for real life applications
2. Implement the different algorithms and models for signal processing.

General Guidelines:

Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Perform statistical measurements on an input data. Compute the signal statistics minimum, maximum, mean, variance and peak-to-RMS and the signal power spectrum density and plot them.
2	Implement Autoregressive Moving Average (ARMA) model in MATLAB
3	Demonstrate Minimum variance unbiased estimator (MVUE) algorithm.
4	Implement basic functions of Matlab Toolbox for Bayesian Estimation
5	Find MMSE estimate of variable and its variance using Bayesian estimation theory
6	Realizes an adaptive FIR filter using the Least Mean Squares (LMS) algorithm
7	Demonstrate Maximum likelihood estimates using MATLAB
8	Periodogram of a signal containing two Sinusoidal components corrupted with White noise using MATLAB
9	Power Spectrum estimate of a random signal using Welch Method.
10	Implements the multiple signal classification (MUSIC) algorithm

Reference Books:

1. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons, Inc., 2002.
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall, 1993.
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive Signal Processing, McGraw Hill, 2000.

Program:	**B. Tech. (E&TC)**				**Semester:**	**VI**	
Course:	**Fiber optic communication**				**Code:**	BET**6517**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**IE**	**MTE**	**ETE**	**Total**
2	--	2	2	20	30	50	100

Prior Knowledge of:
Refraction , Total Internal Reflection Basics of communication , Basics of electronics and modern physics Is essential

Course Objectives:

1. To introduce students to basic elements of optical fiber transmission link, fibers, modes, types and essential parameters.
2. To make students to learn various optical sources and detectors and their characteristics.
3. To expose the students to link budget, WDM, passive components like isolators, circulators etc.

Course Outcomes:

After completion of this course, students will be able to,

1. Apply the concept of optics to optical fiber characterization.
2. Compare optical sources and detectors.
3. Design the optical link for link power and rise time..
4. Explore optical amplifiers, multichannel and WDM systems.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**Overview of optical fiber communication and Networks** Elements of an optical fiber transmission link ; Basic principles of optical fiber Communication, Step Index and Graded Index fiber structure, Snell's Law, Critical Angle, Numerical aperture . Fiber Modes and Configurations, Single mode and Multimode fibers, Types of Attenuation and Dispersion.	**9**
2.	**Optical Sources and Detectors :** Light Emitting Diodes (LEDS), Types , Construction and Operation of LED's and LASERS, Characteristics of LED'S and LASERS, Optical Detectors: Construction and working principle of Photo Detectors, Types of Photo Detectors . Performance characteristics: Noise , Quantum Efficiency.	**9**
3.	**Optical Link Design :** Digital links: Point-to-Point links-System consideration-Link power budget-Rise time budget, Direct and Coherent Link comparison	**6**
4.	**WDM Systems and Components**: Operational principles of WDM-Passive optical coupler. MZI Multiplexers , Isolators and Circulators – Fiber Bragg Grating-FBG Applications, Fiber amplifier basics and applications in current optical networks.	**6**
	Total	30

Text Books:

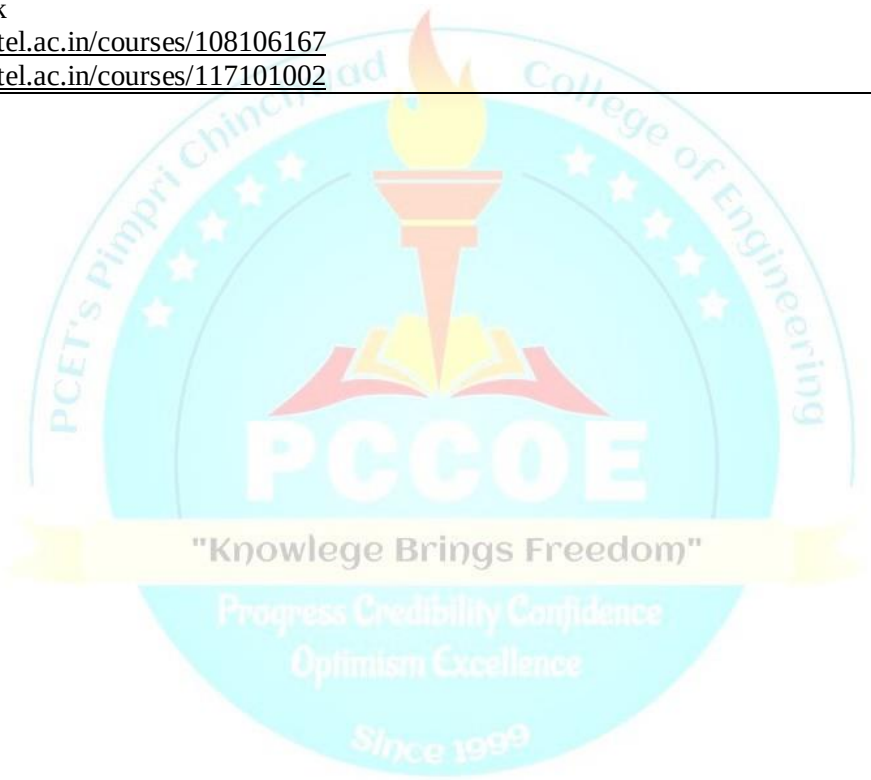
1. Gerd Keiser, Optical Fiber Communications, McGraw Hill, 5th Edition 2013
2. J. M. Senior, Optical Fiber Communications: Principles and Practice, 2011, Pearson

Reference Books:

1. G.P Agrawal, Fiber Optic Communication Systems, Wiley, 2011, 2nd Edition
2. B.Mukerjee, Optical WDM Networks (Optical Networks), 2006, Springer edition

NPTEL Link

1. https://nptel.ac.in/courses/108106167
2. https://nptel.ac.in/courses/117101002



Program: B. Tech. (E&Tc)					Semester : VI		
Course : Fiber optic communication Lab					Code : BET6518		
Teaching Scheme				Evaluation Scheme			
Practical	**Tutorial**	**Hours**	**Credit**	**T W**	**OR**	**PR**	**Total**
2	--	2	1	25	------	------	25

Prior knowledge of:
Basics of communication **is essential**

Course Objectives:

1. To acquaint the students with the key parameters of an optical fiber.
2. To make the students set analog and digital links and measure system losses.
3. To introduce the students to source and detector characteristics.

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

1. Analyze the optical fiber parameters like Numerical Aperture, attenuation constant, loss etc.
2. Analyze the characteristics of sources and detectors.
3. Simulate the link budget and WDM system.
4. Operate field instruments such as optical power meter, OTDR, splicing machine etc.

General Guidelines: Any Eight Experiments is to be performed.

Detailed Syllabus:

Expt. No.	List of Experiments
1	Numerical aperture for a plastic fiber
2	V-I and P-I characteristics of LED/LASER and Compare with Semiconductor diodes
3	V-I and P-I characteristics of photodiode
4	Measurement of attenuation coefficient and bending losses in optical fibers by establishing Analog/Digital Link.
5	Simulate optical power budget and rise time budget analysis of optical fiber systems.
6	Eye pattern measurement
7	Establish voice link using optical fiber.
8	PAM signal transmission and reception.
9	Simulation of WDM using a suitable simulator.
10	Field visit to study optical sources, detectors, fibers for telecommunication, mux demux, filters, isolators, circulators, couplers, connectors, optical amplifiers etc and the field instruments such as optical power meter, OTDR, splicing machine etc.(Prepare a short report)

11	Tutorial on Optical power budget & rise time budget analysis of existing system and its viability.

Reference Books:

1. Wolf, Helmut F.,"Optical Waveguides", Handbook of Fiber Optics.H. F. Wolf, Ed., Garland STPM Press, New York, 1979
2. Sandbank, C. P , Editor, Optical Fibre Communication Systems,John Wiley and Sons, Chichester2010
3. Virtual LAB Links:http://vlabs.iitb.ac.in/vlabs-dev/labs/physics-basics/labs/numerical-aperture-measurement- iitk/index.html

Program:	B. Tech. (E&TC)			Semester:	VI		
Course:	Artificial Intelligence & Machine Learning			Code:	BET6519		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	IE	MTE	ETE	Total
2		2	2	20	30	50	100

Prior Knowledge of:

1. Basics of mathematics and fundamental knowledge of programming **is essential**

Course Objectives:

1.To make students aware of the basics concept of Artificial Intelligence and Machine Learning.
2. To illustrate different Supervised and Unsupervised Learning algorithms.
3. To introduce students to the concept and applications of Artificial Neural Networks.

Course Outcomes:

After completion of this course students will be able to

1. **Apply** the concept of Artificial Intelligence and Machine Learning.
2. **Analyze** Supervised Learning algorithms with various performance measures.
3. **Discriminate** Unsupervised Learning algorithms with various performance measures.
4. **Demonstrate** the applicability of Artificial Neural Networks.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to Artificial Intelligence (AI) & Machine Learning (ML)** **Introduction to AI**: Intelligent Agents, Agents and environments, Good behavior, The nature of environments, structure of agents, Problem Solving, problem solving agents, example problems, Searching for solutions, uninformed search strategies **Introduction to ML**: Why Machine learning. Types of machine learning, basic concepts in machine learning like parametric and non-parametric modeling, linear and nonlinear regression, over fitting.	**9**
2.	**Regression & Classification Techniques** **Regression Techniques:** Basic concepts and applications of Regression, Simple Linear & Multiple Regression, Gradient Descent, Hyper-parameters tuning, Evaluation Measures for Regression Techniques **Classification Techniques:** Naïve Bayes Classification, K-Nearest Neighbors, Classification, Trees, Support Vector Machines, Evaluation Measures for Classification Techniques.	**7**
3.	**Clustering& Dimensionality Reduction** **Clustering:** k-Means Clustering, Anomaly detection, Mixtures of Gaussian **Dimensionality Reduction:** Principal Components Analysis, Linear Discriminant Analysis	**6**
4.	**Introduction to ANN (6 hours)** Biological Neurons and Biological Neural Networks, McCulloch-Pitts (MP) neuron model, Perceptron Learning, Activation Functions, Multilayer Perceptron, Back-propagation Neural Networks, Convolution Neural Network	**8**
	Total	30

Text Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence, A Modern Approach”, Fourth Edition, Prentice Hall of India, 2021.
2. Ethem Alpaydın, “Introduction to Machine Learning", Fourth Edition, The MIT Press 2020.
3. Christopher Bishop, “Pattern Recognition and Machine Learning", Springer, 2016.
4. Phil Kim, “MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",

APress, 2017.

Reference Books:

1. Parag Kulkarni, Prachi Joshi, "Artificial Intelligence-Building Intelligent Systems", PHI Publications, 2016.
2. Deepak Khemani,"A First Course in Artificial Intelligence", First Edition, Tata McGraw-Hill, 2013.
3. Simon Haykin," Neural Networks and Learning Machines", Third Edition, Prentice Hall International Inc., 2009.
4. S. N. Sivanandam, S.Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill, 2005.
5. Laurene Fausett,"Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education, Inc, 2008.

Program: B. Tech. (E&Tc)							**Semester:VI**
Course: AI and ML Lab							**Code: BET6520**
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	**--**	**2**	**1**	**25**			**25**

Prior knowledge of:

1. Basics of mathematics and fundamental knowledge of programming **is essential**

Objectives:

1.To make students aware of the basics concept of Artificial Intelligence and Machine Learning.
2. To illustrate different Supervised and unsupervised Learning algorithms.
3. To introduce students to the concept and applications of Artificial Neural Networks.

Outcomes:

After completing the course, the students should be able to:

1. **Apply** the concept of Artificial Intelligence and Machine Learning.
2. **Analyze** Supervised Learning algorithms with various performance measures.
3. **Discriminate** Unsupervised Learning algorithms with various performance measures.
4. **Demonstrate** the applicability of Artificial Neural Networks.

General Guidelines: Any Eight Experiments is to be performed using MATLAB and or Python

Group A: Any Eight Experiments are Compulsory&Group B: Two Experiments are Compulsory

Expt. No.	**List of Experiments**
Group A: AnyEight Experiments are Compulsory	
1	Implement Linear and Non-Linear Regression Analysis using Python/MATLAB
2	Human activity classification using machine learning algorithm using Python
3	Implement Principal Component Analysis using Python
4	Implement K-means clustering using Python and MATLAB
5	Implement simple logic gates using McCulloch-Pitts (MP) neuron model using MATLAB
6	Image based classification using Convolutional Neural Network using MATLAB
7	Defective identification: To implement a defect identification system using audio data with MATLAB or Python
8	Character Recognition: To implement character recognition using CNN with MATLAB or Python
Group B: Two Experiments are Compulsory	
9	Interoperability of MATLAB and Python
10	Installation of MATLAB using Raspberry Pi
11	Hardware deployment using Raspberry Pi

12	Application of AI algorithm using Raspberry Pi

Text Books:

1. Christopher Bishop, “Pattern Recognition and Machine Learning", Springer, 2007.
2. EthemAlpaydın ,"Introduction to Machine Learning", Second Edition The MIT Press 2010.

Reference Books:

3. S. N. Sivanandam , S.Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill, 2006.
4. Phil Kim, "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", a Press 2017.

Open Elective III

Program:	B.Tech.(All branches)			Semester: VI			
Course:	Multivariate Data Analysis using R (OEC-3)			Code: BAS6608			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	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 should 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. using different 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 (Hrs)
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.	7
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 Correlations for Multivariate Data, The multivariate normal density function.	8
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	8

IV	**Dependent Analysis** Multiple linear regression, Conjoint Analysis, Multiple Discriminant Analysis, Linear Probability Analysis, Multivariate analysis of variance (MANOVA), Canonical Correlation Analysis, Structural Equation Modeling	**7**
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	**7**
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.	**8**
	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 Applied Multivariate 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 MTE and ETE; Examination will be conducted using R software in the laboratory through proper invigilation.**

Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Remote Sensing and GIS (OEC-3)			Code:	BCI6603A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Surveying and GPS

Course Objectives: After Completing this course, student will have adequate background :

1. To comprehend fundamentals and principles of RS and GIS techniques.
2. To enhance students' capacity to interpret images and extract information of earth surface from multi-resolution imagery at multi-scale level.
3. To develop skills of Image processing and GIS
4. To utilize RS and GIS techniques in Engineering Geology and civil engineering.
5. To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
6. To learn buffering and layer analysis for civil 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)
1.	**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	7
2.	**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	8
3.	**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 navigation	7

4.	**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.	**8**
5.	**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.	**7**
6.	**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:	**8**
	Total	**45**

Textbooks:

1. Principles of Remote Sensing, Panda B C, Viva Books Private Limited
2. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad.

Reference Books:

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

Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Building Services and Maintenance (OEC-3)			Code :	BCI6603B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Pre-requisite:
Building Planning, and Construction Materials

Objectives:
After Completing this course, student will have adequate background to understand and solve the problem involving :

1.To develop concepts of management of building services provisions
2. To learn the synchronization of construction activities with installation of building services
3. To study the suitable electrical and mechanical services, fire protection, acoustic and sound Insulations

Outcomes:
After learning the course, the students should be able to:

1. Apply building services provisions
2. Execute the construction activities with installation of building services.
3. Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.
4. Design the Fire Protection, Acoustic and Sound Insulations.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Introduction to Building Services:** Definitions, Objective and uses of services, Applications of services for different types building considering, Classification of building services, Types of services and selection of appropriate services for given project.	7
2	**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.	8
3	**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 Conditioning Air Distribution system, Cleaners,	8
4	**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.	8
5	**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 systems in housing	7
6	**Building Maintenance :** Role of maintenance in durability and serviceability of buildings Economic aspects of maintenance. Different types of maintenance	7
	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

List of Software/Learning Websites

1. www.academia.edu
2. www.nptel.iitm.ac.in
3."http://en.wikipedia.org/w/index.php?title=Dumbwaiter_(elevator)&oldid=621761813" Categories: www.bis.org.in/sf/nbc.htm
4. cpwd.gov.in/Units/handbook.pdf
5.http://www.civilengineeringnews.tk/2014/07/methods-of-demolition-of-building.html thecontractor.org

Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Smart Cities & Building Automations (OEC-4)			Code:	BCI6604A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Physics
2. Mathematics
3. Programming Language

Course Objectives:

After Completing this course, student will have adequate background :

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

Course Outcomes:

After learning the course, the students will be able:

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

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Smart cities** Introduction to city planning, Concept, Principle stakeholders, key trends in smart cities developments	7
2.	**Smart Cities Regulations** Understanding smart cities, Global Standards and performance benchmarks, Practice codes for smart city development	7
3.	**Smart Cities Planning and Development** Smart city planning and development, Dimension of smart cities, Financing smart cities development, Governance of smart cities	7
4.	**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.	8
5.	Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino for smart city applications	8
6.	**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	8
	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 Villey Valtokari, 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. (Civil Engineering)	Semester :	VI
Course :	Mechanical Electrical Plumbing (MEP) Systems (OEC-4)	Code:	BCI6604B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Basics of air conditioning
2. Basics of Electrical Engineering
3. Basics of Mechanical Engineering

Course Objectives:

After Completing this course, student will have adequate background :

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)
1.	**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.	7
2.	**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.	8
3.	**Electrical Analysis and Design** Major electrical loads used in the installation, Electrical design calculations, Various design stages & Sequence of electrical design procedure.	7
4.	**Plumbing** Plumbing Systems, Design of Domestic Water Supply and Distribution System, Design of Sanitary Drainage System, Drawings – Plumbing Layouts.	8
5.	**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.	7

6.	**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.	**8**
	Total	**45**

Text Books:

7. Design of Mechanical & Electrical Systems. Trost, Pearson Publishing, ISBN 978-0-13097235-4 .
8. MEP Planning Manual: Become a Professional Construction Engineer: 1 (Arabmep H), ISBN-10 : 1677068930, ISBN-13 : 978-1677068937.
9. MEP Databook (Construction Databooks) Hardcover – 16 August 2000 by Sidney Levy, McGraw-Hill Education.
10. Electrical and Mechanical Services in High Rise Building (English, Paperback, Mittal A.K.), CBS Publisher and Distrubutor Pvt.Ltd.

Reference Books

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

e-Reference

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)			Semester: VI			
Course:	Information Security (OEC-3)			Code: BCE6603			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
3	-	-	3	20	30	50	100

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 should 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. Propose the security Services and Mechanisms for preventing the different security attacks.
3. Use Symmetric key Cryptographic Techniques to encrypt and decrypt the massages.
4. Use Asymmetric key Cryptographic Techniques to encrypt and decrypt the massages.
5. Use different Hash Techniques to provide the Authentication and to check the Integrity of messages in transit.
6. Use Message Authentication Code to provide Authentication.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Security Basics** **Computer Security Concepts** - Need, Security Vs Privacy, Confidentiality, Integrity & Availability (CIA), additional Security considerations, The challenges of Security, Threats, Attacks and Assets, Operational Model of Security; **Case Study: Study of Campus Network and identification of possible Threats, Attacks and Assets**	7
II	**Encryption Techniques** **Basics:** Symmetric & Asymmetric Cipher Model; Cryptography; Cryptanalysis and Brute-Force Attack **Classical Encryption Techniques** - Substitution Techniques: Caesar Cipher, Mono-alphabetic Ciphers, Poly-alphabetic Ciphers, Playfair Cipher; Transposition Techniques: Rail Fense Technique	7
III	**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; **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)	8

IV	**Asymmetric Cipher** **Public-Key Cryptosystems:** Secrecy, authentication, secrecy & authentication; applications, requirements; **The RSA Algorithm:** Algorithm, Example, The security of RSA; **Diffie-Hellman Key Exchange:** The Algorithm, Key Exchange Protocol, Man-in-the-middle attack;	**8**
V	**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**	**7**
VI	**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	**8**
	Total	**45**

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, SunitBelapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1

Program:	B. Tech. (Computer)					Semester: VI	
Course:	Principles of Software Engineering (OEC-3)					Code: BCE6604	
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
3	-	-	3	20	30	50	100

Course Objectives:

The course is aiming to impart conceptual clarity among students about.

1. The fundamental phases of the Software Development Life-cycle (SDLC).
2. Selection of an appropriate process model for specific software project development.
3. Comprehension of methods for capturing, specifying, and analyzing software requirements.
4. Applying Design principles to software project development.
5. Comprehension of UML Diagrams for software project development.
6. The fundamental understanding of agile process model.

Course Outcomes:

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

1. Comprehend the fundamental phases of the Software Development Life-cycle (SDLC).
2. Compare and select an appropriate process model for specific software project development.
3. Comprehend methods for capturing, specifying, and analyzing software requirements.
4. Apply Design principles to software project development.
5. Comprehend UML Diagrams for software project development.
6. Relate the basics of agile process model for the development of software projects.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction To Software Engineering** Definition of Software, Software Application Domains, Software engineering layers, Software engineering practice, The Essence of Practice, General Principles, Software development myths, Management myths, Customer myths, Practitioner's myths, Software Development Life-cycle.	7
II	**The Software Process** A Generic Process Model, Defining a Framework Activity, Perspective Process Model, Waterfall Model, V Model, Incremental Process Model, Evolutionary Process Models-Prototyping, The Spiral Model, Unified Process, Phases of the Unified Process	8
III	**Requirements Analysis** Requirement Engineering, Requirements engineering tasks, Establishing the Groundwork-Eliciting Requirements, Collaborative Requirements Gathering, Quality Function Deployment, Usage Scenarios, Elicitation Work Products, Developing use cases.	7

IV	**Design Concepts** The design Process, Abstraction, Architecture, Separation of Concerns, Modularity, Information Hiding, Refinement, The design Model, Data Design Elements, Architectural Design Elements, Interface Design Elements.	**8**
V	**Modeling with UML** Modeling Concepts and Diagrams, Introduction to UML, Use Case Diagrams, Class Diagrams, State chart Diagrams, Activity Diagrams, Package Diagram, Component Diagrams, Deployment Diagrams.	**7**
8VI	**Agile development Process** Agile Process- Extreme Programming in agile development, Agile software development process Models, SCRUM – process flow, scrum roles, scrum cycle description, product backlog, sprint planning meeting, sprint backlog, sprint execution, daily scrum meeting.	**8**
	Total	**45**

Text Books:

1. Roger S Pressman, "Software Engineering – A Practitioner's Approach", Pearson Education, 7th Edition, ISBN 0073655783, 2010.
2. Ian sommerville, "Software Engineering", 9th edition, ISBN-13: 978-0-13-703515-1, 2010.
3. Unified Modeling Language User Guide, The (2nd Edition) (Addison-Wesley Object Technology Series), ISBN:978-0-321-26797-9, May 2005.

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 10: 0133056996, 2002.
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 13: 978-8120348981, 2014.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715, 2010.

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Program:	B. Tech. (Computer)						Semester: VI
Course:	Fundamentals of Machine Learning (OEC-4)						Code: BCE6605
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
3	-	-	3	20	30	50	100

Prior knowledge of
Engineering Mathematics
is essential.

Course Objectives:

1. To introduce different machine learning primitives.
2. To introduce different preprocessing 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 use classification algorithms to solve classification problems.
6. To introduce metrics and methods for Evaluating Classifier Performance

Course Outcomes:

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

1. Distinguish different machine learning primitives.
2. Use different data preprocessing techniques to prepare training and testing data set.
3. Apply data similarity and dissimilarity measures for statistical analysis.
4. Apply Association Rule Mining algorithms for market basket analysis.
5. Solve real world problems using regression techniques.
6. Apply classification algorithms to solve real world problems.

Detailed Syllabus

Note: Case studies mentioned in Unit IV, Unit V and VI are just to get understanding to students, and will not be considered for evaluation.

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, Error measures, Creating training and testing datasets	7
II	**Data Pre-Processing** Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes; Data Pre-processing: Data Cleaning, Data integration, Data transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction, Data Discretization, Binning techniques for smoothing noise.	8

III	**Measuring Data Similarity and Dissimilarity** Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data: Euclidean distance and Manhattan distance; Cosine Similarity	**7**
IV	**Unsupervised Learning** **Association Rules Mining-** Market Basket Analysis, Frequent item set, Association Rules, Apriori Algorithm, Generating Association Rules from Frequent Item sets; **Clustering-** K-means: Finding optimal number of clusters **Case study of ML application:** Shopping mall application for Market Basket Analysis.	**8**
V	**Supervised Learning- Regression** **Linear Regression**- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Regularization-Ridge, Lasso **Logistic regression-**Linear classification, Logistic regression **Case study of ML applications:** Applications for house price prediction, Share Market	**7**
VI	**Supervised Learning- Classification** Naïve Bayes Classifier, Decision Tree Classification, K-Nearest Neighbor Classifier, Metrics for Evaluating Classifier Performance, Confusion Matrix, Evaluating the Accuracy of a Classifier: Holdout Method and Cross-Validation, ROC Curve **Case study of ML applications:** Applications in Agriculture sector, Health care domain using analytical tools such as WEKA/KNIME/R/SK-Learn	**8**
	Total	**45**

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. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt Publishing Limited 2017, ISBN-10: 1785889621, ISBN-13: 978-1785889622.

Reference Books:

1. EthemAlpaydin, “Introduction to Machine Learning”, PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, Cambridge University Press, Edition 2012, ISBN-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell “Machine Learning” McGraw Hill Publication 1997, ISBN: 0070428077 9780070428072
4. AurélienGéron, “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. 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. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
3. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/DataMining/Witten_and_Frank_DataMining_Weka_2nd_Ed_2005.pdf
4. http://scikit-learn.org/stable/datasets/
5. https://scikit-learn.org/stable/modules/model_evaluation.html
6. https://www.kaggle.com/datasets

Program:	B. Tech. (Computer)						Semester: VI
Course:	JAVA Programming (OEC-4)						Code: BCE6606
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
3	-	-	3	20	30	50	100

Prior knowledge of

Decision control structures, loop control structures, arrays, Functions, pointers, structure and union, searching and sorting techniques

is essential.

Course Objectives:

1. To understand various data types, conditional and looping constructs in Java.
2. To understand concepts of Java classes, various types of constructors in Java.
3. To use inheritance and polymorphism to solve real life problems.
4. To apply multi-threading concepts and collection framework.
5. Exemplify the usage of packages and implement the concepts of Applets and JavaFX.

Course Outcomes:

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

1. To comprehend basic Java concepts and JVM architecture.
2. To use Object-oriented programming concepts to solve real time problems.
3. To apply error handling mechanism using Exceptions in Java.
4. To use concepts of multithreading for synchronization in Java.
5. To use the string collection framework for various string operations.
6. To apply Java UI components for designing windows-based applications.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Java programming** what is JAVA, History of JAVA, Java Virtual Machine, difference between JDK, JRE & JVM, Variables and data types, Control statements	**07**
II	**Object-oriented programming concepts I** JAVA OOPs Concepts**,** Fields and Methods, Constructors, copy constructor, method overloading, method overriding, static keyword, this keyword	**08**
III	**Object-oriented programming concepts II** Inheritance, Aggregation, Polymorphism, super keyword, final keyword, Abstract class, Interface, **Exceptions**: types of exception with examples, Try, catch, throw and throws in JAVA, flow control in try catch finally in JAVA	**07**

IV	**Java Multithreading** life cycle and states of thread, thread scheduler, creating thread, creating multiple threads, thread priorities, synchronization Enumerations fundamentals and example, type Wrappers **Collection Framework:** collection Interfaces, collection classes, working with Maps, Arrays, Legacy classes and Interfaces	**08**
V	**Applet** Basics, architecture, applet skeleton, simple Applet Display method **SWING (JFC):** Introduction, Difference between AWT and SWING, Components hierarchy, Panes, Individual Swings components J Label, JButton, JTextField, JTextAres.	**07**
VI	**JavaFX** JavaFX Architecture, JavaFX Program Structure, Shapes, Effects, Layout Components, Properties and Bindings, Basic UI Controls, Graphics and Animation. **Case Study:** To develop real-time application using java concepts.	**08**
	Total	**45**

Text Books:

1. Herbert Schildt,"Java - The Complete Reference", The McGraw-Hill Education,11th Edition,2018, 978-1260440232.
2. E. Balagurusamy, "Programming with Java" McGraw Hill Education India, 6th Edition, 2019, 9789353162344

Reference Books:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press India Pvt. Ltd., Paperback, 2015, 9789351197584.
2. Ken Arnold, James Gosling and David Holmes, "The Java Programming Language", Addison-Wesley, 4th Edition, 2005, 0321349806

Web references:

1. https://www.w3schools.com/java
2. https://www.javatpoint.com/java-tutorial
3. www.spoken-tutorial.com : Free Online course of JAVA

Program: B. Tech. (IT)				Semester:VI			
Course : Web Technology				Code:BIT6601			
Teaching Scheme				Evaluation Scheme			
Lecture	**Practical**	**Tutorial**	**Credit**	**CE**	**MTE**	**ETE**	**Total**
3	-	-	3	20	30	50	100

Prior knowledge of

1. Computer Fundamentals
2. Any one computer Language

is essential.

Course Objectives:

1. To write a valid standards-conformant HTML document involving a variety of element types, including hyperlinks, images, lists, tables, and forms
2. To use CSS to implement a variety of presentation effects in HTML and XML documents, including explicit positioning of elements
3. To demonstrate techniques for improving the accessibility of an HTML document
4. To learn the concepts commonly used in dynamic language programming, such as introspection, higher-order functions, and closures.

Course Outcomes:

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

1. Develop Static and Dynamic websites using technologies like HTML, CSS, Bootstrap.
2. Test and debug JavaScript web applications.
3. Develop a mobile website using JQuery Mobile.
4. Develop web applications with Front End & Back End Technologies.
5. Demonstrate the use of web scripting languages.
6. Build Responsive Web application using Angular Typescript

Detailed Syllabus

Unit	Description	Duration
1.	HTML: Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links, Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements. CSS: Types of CSS, How to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.	6
2.	BOOTSTRAP: , CSS over Bootstrap, How to Use Bootstrap, Bootstrap Grid System, Bootstrap Responsive, Bootstrap Classes, Bootstrap Components (i.e., Button, Table, List, etc.),Bootstrap as a Cross Platform. W3C: What is W3C , How W3C handles/Supports Web Technologies.	6
3.	JavaScript: Introduction to Scripting languages, Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events. Advanced JavaScript: JSON - JSON Create, Key-Value Pair, JSON Access, JSON Array, JS Arrow Functions, JS Callback Functions, JS Promises, JS Async-Await Functions, JS Error Handling	7
4.	AJAX: Why AJAX, Call HTTP Methods Using AJAX, Data Sending, Data Receiving, AJAX Error Handling. JQUERY :Why JQuery, How to Use, DOM Manipulation with JQuery, Dynamic Content Change with JQuery, UI Design Using JQuery.	10

5.	Front-End Frameworks: Web Framework Types. MVC: What is MVC, MVC Architecture, MVC in Practical, MVC in Web Frameworks. TypeScript: Introduction to TypeScript (TS), Variables and Constants, Modules in TS.	6
6.	ReactJS: Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux- Architecture, Hooks- Basic hooks, useState() hook, useEffect() hook, useContext() hook	10
	Total	**45**

Text Books:

1. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13: 978812653867
2. Jeremy McPeak& Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937

Reference Books:

1. Steven Holzner,"HTML Black Book", Dremtech press.
2. Web Technologies, Black Book, Dreamtech Press
3. Web Applications: Concepts and Real World Design, Knuckles, Wiley-India
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson.

Program: B. Tech. (IT)				Semester:VI			
Course : Mobile Application Development				Code : BIT6602			
Teaching Scheme				Evaluation Scheme			
Lecture	**Practical**	**Tutorial**	**Credit**	**CE**	**MTE**	**ETE**	**Total**
3	-	-	3	20	30	50	100

Prior knowledge of
Java programming language
is essential.

Course Objectives:

1. To learn a new mobile application development environment.
2. To develop problem solving skills with mobile applications.
3. To develop competency for the design, coding and debugging for mobile app development.
4. To build the programming skills using 'Android Programming Language.

Course Outcomes:

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

1. Explore the android environment for mobile application development.
2. Apply event handling skills for problem solving in real life applications.
3. Analyze different notification interfaces and apply the most appropriate one for solving problems.
4. Identify file handling mechanism in android environment.
5. Develop database and database control programming logical constructs of Android language for problem solving.
6. Describe significant android services and their usage in solving real life problems.

Detailed Syllabus

Unit	Description	Duration
1.	Unit-1 Introduction to Android Operating System Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools. Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application, Activities, Activity lifecycle,	8
2.	Unit-2 Android User Interface Measurements – Device and pixel density independent measuring units, Layouts – Linear, Relative, Grid and Table Layouts etc. User Interface (UI) Components – Editable and non-editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers etc Event Handling – Handling clicks or changes of various UI components.Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.	8
3.	Unit-3 Intents and Broadcasts Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts	8

4.	Unit-4 Persistent Storage Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference	**5**
5.	Unit-5 Database Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)	8
6.	Unit 6 Android services Introduction of android services and its lifecycle. Location Services,Types of Services, Best practices- Performance, Testing,Privacy, Security etc. Deployment of Application.	8
	Total	45

Text Books:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

Reference Books:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013
2. Android Application Development Black Book Pradeep Kothari, KLSI,Dreamtech Press

Reference URL:

https://www.javatpoint.com/android-service-tutorial
https://developer.android.com/guide/components/services

Program:	B. Tech (Mechanical)					Semester : VI	
Course :	3D Printing and Modeling (Open Elective-III)					Code: BME6603A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of basics of

a. Materials Engineering is essential
b. CAD/CAM

Objectives:

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

Outcomes:

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)
1.	**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.	8
2.	**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.	7
3.	**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.	7
4.	**Powder Based Systems:** Selective laser sintering (SLS): Specifications, process, parameters, working principle, applications, advantages and disadvantages. Three dimensional printing (3DP): Specification, parameters, process, working principle, applications, advantages and disadvantages.	8
5.	**Modelling in 3D printing:** Preparation of CAD models by using software, STL File Format, Creating STL Files from a CAD System, AM process simulations using Finite element analysis.	8
6.	**Applications of 3D Printing**: Prototyping and manufacturing, Medical applications, Automotive applications, Aerospace & Defence applications, Constructions applications. Art and Jewellery applications.	7
	Total	45

Text Books:

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

Reference books:

Henrique Amorim Almeida and Paulo Jorge da Silva Bártolo, Mathematical Modeling of 3D Tissue Engineering Constructs, Springer International Publishing AG 2017.

Program:	B Tech. (Mechanical)			Semester : VI			
Course :	Material Informatics (Open Elective-III)			Code: BME6603B			
Teaching Scheme/week				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of :

a. Data Science
b. Machine Learning
c. Pyton/R programming

are essential

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.

Outcomes:

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)
1.	**Introduction to materials:** Classification of materials, structure of materials **:**Atomic structure, crystal structure and microstructure, material properties: Physical, Mechanical, Electrical, Magnetic etc.	7
2.	**Materials Information:** Structure property relationship**,** Applications and selection of materials, Analysis and synthesis of materials.	8
3.	**Statistics and Materials:** Basic probability and statistics, basic R/ Python , Inaccurcacies and error and its propagation, Descriptive data analysis, Probability distributions, Probability distributions using R/Python, Fitting functions to data: regression, testing significance of fit.	7
4.	**Experimental data**: Processing of experimental data using R/Python, R/Python for graphical handling of data and fitting.	8
5.	**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.	7
6.	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.	8
	Total	45

Text Books:

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

Reference books:

1. Materials Informatics: Methods, Tools, and Applications, Wiley VCH
2. Informatics for Materials Science and Engineering, Elsevier
3. Emerging Trends and Applications of Machine Learning, Solanki, Kumar, Nayyar, IGI Global, 2018.

Program	B. Tech. (Mechanical)						Semester VI		
Course	Model Based System Engineering (Open Elective IV)						Code : BME6604A		
Teaching Scheme/week					Evaluation Scheme				
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	TW	OR	Total
3	-	3	3	20	30	50	-	-	100

Prior knowledge of : – Not Required

Objectives:

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.

Outcomes:

After completion of this course, 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)
1.	**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.	**8**
2.	**Fundamentals of MBSE :** Introduction, Systems, subsystems and levels, Concrete and abstract objects, Properties, States, event, process, behavior and fact, Systems of interest.	**8**
3.	**Three Pillars of MBSE :** Modelling methods, Modelling tools and Modelling language	**7**
4.	**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	**8**
5.	**Process Modelling with MBSE** Approach, The Process Modelling Framework, Using the process modelling framework	**7**
6.	**Requirements Modelling with MBSE** Introduction, The Requirements modelling Framework, Using the Requirements modelling Framework (ACRE Process)	**7**
	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. (Mechanical)					Semester : VI			
Course :	Electronics Cooling (Open Elective-IV)					Code : BME6604B			
Teaching Scheme				Evaluation Scheme					
Lecture	Practical	Tutorial	Credit	IE	MTE	TW	PR	ETE	Total
3	-	-	3	20	30	-	-	50	100

Prior knowledge:

a) Engineering Physics
b) Electronics Components and its mountings
c) Electronics Packaging

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.

Outcomes:

After learning the course, students should 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 applications.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to Thermal Management:** Electronics Component Packaging Trends, Sources of heat generation, Electronic component failure analysis, Need of Thermal Management, modes of heat dissipation	7
2.	**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	7
3.	**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	8
4.	**Electronics Cooling Methods in Industry:** Thermal interface and phase change materials, Passive and novel air cooling approaches, micro channel, jet impingement, Thermoelectric Cooling, Immersion Cooling, Vapor Chambers, Cooling Techniques for High Density Electronics.	8
5.	**Evaluating Cooling Requirement:** Conduction cooling for chassis and circuit boards, Concentrated heat sources, distributed heat sources, Circuit boards with Aluminum Heat Sink, heat transfer across interfaces by conduction and convection	8
6.	**Electronics Cooling Applications:** Avionics, Data Centers, Mobile, High-Performance Computing, Automotive	7
	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

HSMC

Program:	B. Tech (All Branches)				Semester: VI
Course:	Project Management				Code: BHM6114
Teaching Scheme			Evaluation Scheme		
Lecture	Hours	Credit	IE	MTE	ETE	Total
2	2	2	30	NA	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, the 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. **Analyze** the risk associated with various project

Unit	Description	Duration (30 Hrs)
1	**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	7
2	**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.	7
3	**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	8
4.	**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	8

	Techniques and Tools Used in Project Management. Case Studies	
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. 1.https://www.youtube.com/watch?v=RjOA7AxOVj8&list=PLLy_2iUCG87AUusGVo2wsXvRZ4zlbbKUu
2. 2.https://www.youtube.com/watch?v=W2EdffbwgcM&list=PL3MO67NH2XxIRneBXA3yA1RacZQIuX7Yl

3.https://www.youtube.com/watch?v=RQNZWCl6eXI&list=PLBd76GK9sWTwVXm9FlVHOTXXbGY2vZR8z

Program:	B Tech (All Branches)			Semester: VI			
Course:	Financial Management (HSMC-VI)			Code: BHM6115			
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
2	-	-	2	30	-	20	50

Prior knowledge of
a. Basic Financial Literacy is essential.

Course Objectives:
This course aims at enabling students
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, the 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. **Analyse** financial statements and read documents and books of accounts.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**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.	7
2.	**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.	7
3.	**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	8
4.	**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.	8
Total		**30**

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

ReferenceBooks:
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 (All Branches)					Semester: VI	
Course: Entrepreneurship Development					Code: BHM6116	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE	MTE	ETE	Total
2	2	2	30	NA	20	50

Prior Knowledge of

a. Basic Financial Literacy **is essential.**

Course Objectives: This course aims at enabling students:

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 : **(Changed)**

After learning the course, the 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 plans.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1	**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 Entrepreneur, 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.	7
2	**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.	7
3	**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 Centers, Support from Incubation Centers	8

4.	**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?	**8**
	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 3. 2005 4. 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/	

Professional Development Training (PDT)

Program:	B. Tech.			Semester:	VI		
Course :	Professional Development Training-II			Code:	BHM6918		
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	Internal Evaluation	MTE	ETE	Total
3	-	-	-	-	-	-	-

Course Objectives:

This course aims at enabling the students

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: Students will be able to

After learning the course, the students will be:

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 (Hrs)
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.	6
II	**Algebra** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	6
III	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics.**	6
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.	6
V	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	6

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.	**6**
	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.

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AUDIT COURCES (AC)

Program: B. Tech. (All branches)				**Semester: IV**			
Course : Emotional Intelligence				**Code :BHM9963**			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	1	-	-	-	-

Prior knowledge: Nil

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 behaviour
4. To know and utilize the difference between reaction and considered response

Course Outcomes:

After completion of this course, the 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.	**3**
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	**3**
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	**3**

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	**3**
	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. (All branches)				Semester :IV			
Course: Entrepreneurship Development				**Code :BHM9964**			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	1	-	-	-	-

Prior knowledge : Nil

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 analyze 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 (Hrs)
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	**3**
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	**3**
III.	**Business Plan Preparation:** Sources of product for business: Feasible study, Ownership, capital, budgeting, Marketing plan for the new venture, steps in preparing	**3**

	marketing plan, Business Model Canvas (BMC), Financial plan- proforma income statements, Ratio Analysis.	
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 opportunities for Start-ups in India, Crowd funding, Angel investing	**3**
	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. (All branches)				Semester: IV			
Course: Research Article Writing				Code: BHM9965			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
1	-	-	1	-	-	-	-

Prior knowledge: Nil

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 completion of this course, the 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 analyze a research reports
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 (Hrs)
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.	3
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	3

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.	**3**
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	**3**
	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. 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