Course Structure for B. Tech. ECE-AI
Third Year

Fifth Semester				
Code	**Subject**	**L-T-P**	**Credits**	**Category**
BEC-303	Control Systems	3-0-2	4	DCC
BEC-311	Digital Signal Processing	3-0-2	4	DCC
BAI-301	Machine Learning	3-0-2	4	DCC
BAI-307	Computer Networks	3-0-2	4	DCC
HMC-301	Professional Ethics and Human Values	3-0-0	3	HMC
BEC-353	Industrial Training/Internship	-	1	DCC
GEC-301	Generic Open Elective	0-2-0 0-0-4 2-0-0	2	GEC
		Total	**22**	

Sixth Semester				
Code	**Subject**	**L-T-P**	**Credits**	**Category**
BEC-306	VLSI Design	3-0-2	4	DCC
BEC-308	Microprocessors & Microcontrollers	3-0-2	4	DCC
BEC-318	Digital Image Processing	3-0-2	4	DCC
DEC-3xx	Departmental Elective Course- I	3-0-2	4	DEC
DEC-3xx	Departmental Elective Course – II	3-0-2	4	DEC
HMC-302 HMC-304 HMC-306 HMC-308	Principles of Management Marketing Management Financial Management Human Resource Management	2-0-0 2-0-0 2-0-0 2-0-0	2	HMC
		Total	**22**	

List of Departmental Elective Courses

Category	Course Code	Subject	L-T-P	Credits
Departmental Elective Course -I	BEC-312	Antenna Design	3-0-2	4
	BEC-314	FPGA & Verification	3-0-2	4
	BAI-302	Natural Language Processing	3-0-2	4
	BAI-308	Cloud Computing	3-0-2	4
	BAI-310	Blockchain Technologies	3-0-2	4
	BAI-312	Quantum Computing	3-0-2	4
Departmental Elective Course -II	BEC-304	Information Theory & Coding	3-0-2	4
	BEC-316	Power Electronics	3-0-2	4
	BAI-314	Information Retrieval	3-0-2	4
	BAI-316	Recommender Systems	3-0-2	4
	BAI-318	Semantic Web	3-0-2	4

Control Systems	
Course Code: BEC-303 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 5

Introduction: The course will introduce fundamental principles of open loop and closed loop control system. The course provides sufficient basic knowledge for the undergraduate to understand the feedback control system, frequency response analysis, stability analysis, basics of state space analysis, transducers, circuits of control system and their applications as well asthe design of feedback control system.

Course Objective:

- To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
- To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system
- Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

Pre-requisite:

- Linear Differential Equations, Laplace Transform
- Rotational Motion
- Network Theory

Course Outcome: After completion of the course, student will be able to:

- Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
- Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.
- Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
- Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.
- Formulate different types of analysis in frequency domain to explain the nature of stability of the system.
- Identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
Definitions of Control Systems, Closed Loop and Open Loop Control, Examples of Control Systems, Laplace Transformation and Solution of Differential Equations, Concept of Mathematical model, Linear and Non-Linear Systems, Transfer Function with Simple Examples, Transfer function of physical systems (Mechanical Translational Systems), Armature controlled and field controlled DC servomotors, AC servomotors and deriving their transfer functions, Block Diagram representation, Block Diagram Reduction Technique.	
UNIT-II	**10 Hours**
Signal Flow graph, Mason gain formula, Basic Control Actions, Proportional, integral and Derivative controllers, effect of feedback on control system, Transient and steady state response of first order system, Second order system, Transient, Static error coefficients, position, velocity and acceleration error coefficients.	
UNIT-III	**10 Hours**
Stability of Control System, Routh's Stability criterion, relative stability analysis, Root Locus Techniques, Bode Plot, Determination of Transfer function from Bode Plot, Polar Plots, Nyquist Stability Criterion.	
UNIT-IV	**10 Hours**
Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties, Z transform and solution of difference equation, Transducers, Stepper Motor, Rotating Amplifiers and Magnetic Amplifiers	
Text Books	
1	I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International, 6th Edition 2018/latest edition.
2	K. Ogata, "Modern Control Engineering", 5thEdition, 2015/latest edition.
Reference Books	
1	K. Kuo, "Automatic Control Systems", PHI, 7th Edition, 2013/latest edition.
2	N. K. Jain, "Automatic Control System Engineering", Dhanpat Rai, 2nd Edition, 2011/latest edition.

DIGITAL SIGNAL PROCESSING	
Course Code: BEC-311 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:**5

Introduction: The course is designed to introduce fundamental principles of Digital Signal Processing. The course provides sufficient understanding of the analysis and representation of discrete-time signal systems, including DFT, DTFT, z-transform and design of digital filters.

Course Objective:

- Understand the fundamental concepts and techniques used in digital signal processing.
- Understand the design and analysis of FIR and IIR filters.

Pre-requisite:

- Basics of signals and systems.
- Student should have the prior knowledge of frequency domain analysis.

Course Outcome: After completion of the course, student will be able to:

- Understand DFT, DTFT and FFT.
- Understand design and operation of digital filters.
- Understand multirate signal processing

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
DFT and its properties, Relation between DTFT, Z transform with DFT, Overlap-add and savemethods, FFT computations using Decimation in time (DIT) and Decimation in frequency (DIF)algorithms for radix 2 and composite number.	
UNIT-II	**10 Hours**
Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain, Design of IIR digital filters using impulse invariance technique, Design of digital filters using bilinear transform, pre warping, Realization using direct, cascade, parallel, state space and lattice form.	
UNIT-III	**10 Hours**
Symmetric and Antisymmetric FIR filters, Linear phase FIR filters, Design using Hamming, Hanning Rectangular, Blackmann and Bartlett Windows, Frequency sampling method,Realization using direct, cascade, and lattice form.	
UNIT-IV	**10 Hours**
Fixed point and floating point number representations, Comparison, Truncation and Rounding errors, Quantization noise, derivation for quantization noise power, coefficient quantizationerror, Product quantization error, Overflow error, limit cycle oscillations due to product roundoffand overflow errors, Introduction to Multirate signal processing, Decimation-Interpolation,rational sampling rate conversion, Applications of Multirate signal processing.	
Text Books	

1	J. G Proakis, D. G Manolakis, “Digital Signal Processing Principles, Algorithms and Application”, PHI, 3rdEdition, 2000/latest edition.
2	A. V. Oppenheim, R. W. Schafer, J. R Back, “Discrete Time Signal Processing”, PHI, 3rdEdition, 2010/latest edition.
Reference Books	
1	J.R. Johnson, “Introduction to Digital Signal Processing”, Learning Private Limited, 2011/latest edition.
2	S.K. Mitra, "Digital Signal Processing - A Computer based approach", Tata McGraw-Hill, 4th Edition, 2013/latest edition.

Machine Learning	
Course Code: BAI 301 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 5

Introduction:

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. This course will cover the standard and most popular supervised learning algorithms along with the basic clustering algorithms. The course will be accompanied by hands-on problem solving with programming sessions.

Course Objective:

1. To understand the problems and difficulties in machine learning.
2. To study the strengths and weaknesses of machine learning techniques.
3. To gain insights of the supervised and unsupervised learning.
4. To apply machine learning approaches for solving real world problems.

Prerequisites: Calculus, Linear algebra, Probability and statistical concepts, Coding and comfort with data manipulation.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Interpret the underlying problems and difficulties that machine learning faces, such as data, model selection, complexity of the model, etc.

CO2: Discuss the strengths and weaknesses of many popular machine learning approaches.

CO3: Analyse the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.

CO4: Design and implement various machine learning algorithms in a range of real-world applications.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will beadopted.

CONTENTS

UNIT I	10 hours
Introduction: Goals and applications of machine learning, Types of Machine Learning: Supervised Learning, Unsupervised Learning, Machine Learning Cycle: Train-Test Split, Validation Data, K-Fold Cross Validation, Evaluation Metrics. Data Exploration and Pre-processing: Data Objects and Attributes; Statistical Measures, Visualization, Data Cleaning and Integration. Feature Extraction and Reduction.	
UNIT II	**10 hours**
Supervised Learning Regression: Least Mean Square Regression; Ridge Regression and LASSO regression; Logistic Regression, Support Vector Machines, Kernels for learning non-linear functions, K-nearest-neighbor, Bayesian and Naïve Bayes Classifier, Decision Tree Learning.	
UNIT III	**10 hours**
Unsupervised Learning Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering, k-means partitional clustering, Hierarchical, and Density-based Clustering, Expectation maximization (EM) for soft clustering. Dimensionality Reduction: Linear Discriminant Analysis; Principal Component Analysis;	
UNIT IV	**10 hours**
Advanced Topics Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing, Ensemble Learning: Bagging, boosting, and stacking, Random Forests, Ensemble Classification including Adaboost, Active learning with ensembles.	
Text Books	
1	Han, J., Pei, J. and Tong, H., 2022. Data mining: concepts and techniques. Morgan kaufmann
2	Daumé, H. III, "A Course in Machine Learning", 2015 (freely available online).
3	Mitchell, T. "Machine Learning", 1997 (freely available online)
Reference Books	
1	Shai Shalev-Shwartz and Shai Ben-David. "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014
2	Marsland, S., 2011. Machine learning: an algorithmic perspective. Chapman and Hall/CRC.

Computer Networks	
Course Code: BAI 307 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 5

Introduction: The course introduces main concepts of computer networking, application areas, classification, reference models, transmission environment, technologies, routing algorithms, IP, UDP and TCP protocols; reliable data transferring methods, application protocols and perspectives of communication networks.

Course Objectives:

1. To equip the students with a general overview of the concepts and fundamentals ofcomputer networks.
2. Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers

Prerequisite: NIL

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Comprehend the basic computer network technology and functions of each layer in theOSI and TCP/ IP reference model.
CO2: Explain various protocols of the data link layer to handle design issues.
CO3: Discuss the algorithms of the network layer to perform subnetting and routingmechanisms.
CO4: Identify and analyse different elements of transport and application layer for securenetworking.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to makethe classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

Unit I	10 Hours
Evolution of Computer Networking-Types of Network- networks topologies-Protocols & standards-Network Devices-The OSI reference model- TCP/IP Reference Model. Physical Layer: transmission media, twisted pairs, coaxial cable, fiber optics, Wireless transmission.	
Unit II	**12 Hours**
Data Link Layer Design Issues-Services provided to the Network Layer-Framing-Error Control-Flow Control- Error Detection and Correction- Elementary Data Link Protocols-Sliding Window Protocols, A one-bit sliding window protocol, A protocol using Go-Back-N,A protocol using Selective Repeat, Example data link protocols. Medium Access sub layer:The channel allocation problem, Multiple access protocols: ALOHA, Carrier sense multipleaccess protocols, collision free protocols. Wireless LANs, Data link layer switching, Multiple Access Protocols-An overview of IEEE Standard for LANs, MAC Address.	

Unit III	10 Hours
Introduction to Network Layer – Services – Circuit Switching Vs Packet Switching-Packet Switched Networks-Types of Routing-routing algorithms- congestion control algorithms,Hierarchical routing, Broadcast, Multicast, distance vector routing -Network Protocols-IP-IPV4, IPV6, Subnets, Gateways- Congestion Avoidance in Network Layer, Quality of Service, Internetworking, The Network layer in the internet	
Unit IV	**10 Hours**
The Transport Services – Services provided to the upper layers –Elements of transport Protocols –Internet Transport Protocols- Congestion Controls in Transport Layer Principles of Network Applications-Web and HTTP-Electronic mail-DNS Application Layer –Domain name system, SNMP, Electronic Mail; the World WEB, HTTP, Streaming audio and video Overview of Network Security	
Text Books	
1	Andrew S. Tanenbaum, Computer Networks, Pearson Education India, 5th Edition.
2	William Stalllings, Data and Computer Communications , Pearson Education India,10th Edition.
3	Schaum's Outline Of Computer Networking, McGraw Hill, 2020
Reference Books	
1	Behrouz A Forouzan, Data Communications and Networking, McGraw Hill Higher Education, Special Indian Edition, 4th or Latest Edition, 2017.
2	Keith W. Ross, James F. kurose, Computer Networking: A Top-Down Approach, Pearson, 6th Edition, 2017

PROFESSIONAL ETHICS AND HUMAN VALUES	
Course Code: HMC-301 Contact Hours: L-3 T-0 P-0 Course Category: HMC	Credits: 3 Semester: 5

Introduction: Values and Ethics are very relevant in today's environment of conflicts and stress in every profession, with obligations to be met by one person in many directions. A formal study will certainly improve one's ability and judgment and refine one's behaviour, decisions, and actions in performing the duty to the family, organization, and to the society.

Course Objectives:
To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way. To inculcate Ethics and Human Values into the young minds and develop moral responsibility and mould them as best professional which will create ethical vision and achieve harmony in life.

Pre-requisite: Basic ethics knowledge

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

- Develop the capability of shaping themselves into outstanding personalities, through a value based life.
- Students turn themselves into champions of their lives.
- Students take things positively, convert everything into happiness and contribute for the happiness of others.
- Students become potential sources for contributing to the development of the society around them and institutions / organizations they work in.
- Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	10 Hours
Human Values Morals, Values and Ethics, Integrity, Work Ethic, Respect for Others, Living Peacefully, Caring, Sharing, Honesty, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Character, Spirituality. Indian values (on the conceptual framework of Vedas): Purusharth, Niskama karma, Religion and Human Values, Towards a World Religion, Ethical Living and Harmony in Life.	
UNIT-II	11 Hours
Profession and Professionalism, Ethical Theories: Kohlberg's Theory, Gilligan's Theory, Feminist Consequentialism, Moral Dilemmas, Types of Enquiry, Uses of Ethical Theories, Engineering	

Profession, Engineering Professionals- Training, Skill Set, Life Skills, Engineering Ethics: Making Senses and Issues, Ethical Obligations of Engineers, Ethical Codes for Engineers.	
UNIT-III	10 Hours
Engineering as a Social Experimentation, Safety Responsibility and Rights: Engineering as experimentation, Engineers as responsible Experimenters, Concept of Safety and Risk, Engineer's Responsibility for Safety, Risk – Benefit Analysis, Case Studies: The challenger case study, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy. Disaster Management, Professional Rights, Employee Rights, Intellectual Property Rights (IPRs), Human Rights and Human Responsibilities. Major Ethical Issues.	
UNIT IV	11 Hours
Ethics and Global Issues: Ethics in Global Scenario, Multinational corporations, Environmental ethics, computer ethics, Business Ethics. Corporate Social responsibility, Weapons Development, Research Ethics.	
Text Books	
1	M. Govindarajan, S. Natarajan, V.S. Senthil, "Engineering Ethics", Prentice Hall, New Delhi, 2004/latest edition.
2	R. Subramaniam, "Professional Ethics", Oxford University Press, New Delhi, 2013/latest edition.
Reference Books	
1	B.P. Banerjee, "Foundation of Ethics and Management", (2nd ed.) Excel Books, 2005/latest edition.
2	C. Fleddermann, "Engineering Ethics", 4th Edition, Pearson Education. 2004/latest edition.
3	C. Harris et al., "Engineering Ethics- Concepts and Cases", 4th Edition, Thompson Learning, 2008/latest edition.
4	J.R. Boatright, "Ethics and the Conduct of Business", 8th Edition, Pearson Education, New Delhi, 2018/latest edition.

Industrial Training/ Internship	
Course Code: BEC-353 Contact Hours: L-1 T-0 P-0 Course Category: DCC	Credits: 1 Semester: 5

Course Objectives: Students will carry on the industrial training for six weeks making them capable of handling the implementation of their theoretical knowledge in the practical field. To facilitate the development of a holistic perspective among students towards life, industry experts teach advanced technologies. Through Industrial training, students get familiarize with the environment of an organization and a company. Students get a certificate which validates their skills and helps them in getting a job quickly.

General Elective Course	
Course Code: GEC-301 Contact Hours: L-0 T-0 P-4 Course Category: GEC	Credits: 2 Semester: 5

Introduction:

A Generic Elective (GE) course is an inter-disciplinary course provided to the students chosen generally from an unrelated discipline/subject and allowing them a chance at comprehensive education. Generic Electives (GE) are introduced as part of the CBCS. The students can choose their preference from a pool of papers from various disciplines/subjects. Elective courses do much more than filling in the gaps to fulfill the high school graduation requirements. It gives a chance to explore new options, allowing students to study more about the subject they are passionate about, and enables them to 'test drive' new activities. They provide students with the necessary skills to improve creativity that they might not find in the classroom. The main purpose of the Elective course is to seek exposure to a new discipline/subject and to provide the students with an alternative option for desired fields.

Course objective:

- Students will have exposure to a new discipline/subject.
- Prepare students to look for inter-disciplinary research.
- GE can fulfill the limitation to pursue master's study in desired field.
- Help discover new things that never existed and might change the course of student's life.

Pre-requisite: Basic knowledge of the selected domain of elective course

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

- To investigate future careers.
- Allow diligent students to improve their knowledge and area of weakness.
- Help students build a strong resume that shows students willingness and curiosities to the officials and employers.
- Electives take students into the real world that doesn't require academic papers or research. They not only learn to work independently, but they attain self-motivation, discipline, and confidence to achieve their goals.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

VLSI Design	
Course Code: BEC-306 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:**6

Introduction: The course will introduce fundamental principles of analog and digital electronics. The course provides sufficient basic knowledge for the undergraduate to understand the design of diodes and transistor based circuits, op-amps and their applications as well as the design of digital circuits.

Course Objective:

- Study the fundamentals of MOSFET circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits using MOSFET.

Pre-requisite:

- Basic concept of transistor and logic
- Student should have the prior knowledge of semiconductor electronics

Course Outcome: After completion of the course, student will be able to:

- Understand basics of MOSFET family devices
- Understand various applications of MOSFET
- Analyse logic processes and implement logical operations using MOS/CMOS combinational logic circuits
- Design circuits for VLSI projects

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
Evolution of VLSI technology trends in VLSI, MOS transistor theory, MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances, transconductance, figure of merit. MOSFE Transistors SPICE MODEL, Level 1, 2 and 3. Fabrication of MOSFET, CMOS fabrication process steps, isolation, latchup, twin well process, triple well process.	
UNIT-II	**10 Hours**
MOS inverter, resistive and active load, CMOS inverter design, DC characteristics, switching characteristics, rise time, fall time delays, noise margin, CMOS Inverter design with delay constraints, Interconnect parasitics and Delay, static & dynamic power dissipation in CMOS inverters. Combinational MOS/CMOS logic implementation, pass transistor and transmission gate designs, tristate buffers, cascaded inverters and super buffers.	
UNIT-III	**10 Hours**
Sequential MOS/CMOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop, dynamic logic circuits; basic principle, synchronous dynamic circuit techniques, shift register, domino CMOS logic, high performance dynamic CMOS circuits, clocking issues, clock distribution. Introduction to Semiconductor memories.	
UNIT-IV	**10 Hours**

Introduction to BiCMOS Logic circuits, Static Behavior, Switching in BiCMOS Logic Circuits, BiCMOS Applications.CMOS chip design, design strategies, design flow, design Hierarchy, concept of regularity, modularity & locality, Chip design using programmable logic, testing. Introduction to Layout and design rules. CMOS and SOI Technology.	
Text Books	
1	S. M. Kang, Y. Lebiebici, “CMOS digital integrated circuits analysis & design” Tata McGraw Hill 4th Edition, 2019/latest edition.
2	N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective - 4th Edition", Pearson Education, India, 2011/latest edition.
3	P.A. Douglas, E. Kamran, “Basic VLSI Design”, PHI Learning Pvt. Limited,2013/latest edition.
Reference Books	
1	K. Martin, “Digital Integrated Circuit Design”, Oxford University Press, Indian Edition 2014/latest edition.
2	J. M. Rabaey, “Digital Integrated Circuits” PHI Learning Pvt Limited, India, 2nd Edition 2016/latest edition.
3	J. P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc., New York, NY, 2010/latest edition.

Microprocessors & Microcontrollers	
Course Code:BEC-308 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DCC	**Credits:** 4 **Semester:** 6

Introduction: Microprocessors are used extensively in the design of any computing facility. It contains units to carry out arithmetic and logic calculations, fast storage in terms of registers and associated control logic to get instructions from memory and execute them. A number of devices can be interfaced with them to develop a complete system application. On the other hand, microcontrollers are single chip computers, integrating processor, memory and other peripheral modules into a single System-on-Chip (SoC). Apart from input-output ports, the peripherals often include timers, data converters, communication modules, and so on. The single chip solution makes the footprint of the computational element small in the overall system package, eliminating the necessity of additional chips on board. However, there exists a large range of such products. This course will also introduce advanced microcontrollers and advanced microprocessors.

Course Objective:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the architecture of 8051 microcontroller as well as advance processors.
- To design a microcontroller based system

Pre-requisite:

- Basic concept Digital design.
- Digital Logic.

Course Outcome: After completion of the course, student will be able to:

- Understand and execute programs based on 8086 microprocessor.
- Design Memory Interfacing circuits.
- Design and interface I/O circuits.
- Design and implement 8051 microcontroller based systems.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	10 Hours
Introduction to microprocessor, Basic of 8-bit microprocessor (8085): Architecture, Instruction set, Addressing modes. Introduction to 8086 Microprocessor and its architecture, **8086 System Bus Architecture,** memory organization.	
UNIT-II	**10 Hours**
Addressing modes, Instruction set and assembler directives, Interrupts and interrupt service routines, Byte and String Manipulation, System design using 8086, I/O programming. Introduction to Multiprogramming, System Bus Structure, Multiprocessor configurations, Coprocessor, Closely coupled and loosely Coupled configurations.	
UNIT-III	**12 Hours**
Introduction to 8051, Addressing Modes, Instruction Set, Assembly Language Programming and C Programming, Peripheral devices: Parallel Peripheral Interface (8255), A/D & D/A Interface, Timer / Counter (8253), Keyboard and Display Controller (8279), Serial data transfer (USART 8251), Interrupt Controller (8259), DMA Controller (8237), DAC and ADC interfacing and applications, Alphanumeric displays, LCD, Graphic Displays, Communication Bus protocols: RS 232, RS 485.	
UNIT-IV	**10 Hours**
Introduction to 80186/80286, Introduction to Advanced microcontrollers: High performance CISC architecture: Pentium CPU architecture. High Performance RISC architecture: ARMCore & Architectures. PIC microcontroller: CPU Architecture, Interrupts, Timers, I2C Interfacing.	
Text Books	
1	R. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Prentice Hall, 2014/latest edition.
2	M.A. Mazidi, R.D. McKinlay, J.G. Mazidi, "The 8051 Microcontroller: A Systems Approach", Pearson, 2013/latest edition.
Reference Books	
1	M.Bates, "PIC Microcontrollers", Newnes, 2011/latest edition.
2	W.A. Smith, "ARM Microcontroller Interfacing: Hardware and Software, Eketor, 2010/latest edition.
3	B. B. Brey, "The Intel Microprocessor 8086/8088. 80186, 80286, 80386 and 80486 Architecture Programming and Interfacing", PHI 2009/latest edition.

Digital Image Processing	
Course Code: BEC-318 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 6

Introduction: The course will introduce fundamental principles of digital image processing. The course provides sufficient basic knowledge for the undergraduate to understand the design of digital image processing techniques such as image enhancement, restoration, segmentation, and morphological filtering.

Course Objective:

- To introduce the concepts of image processing and basic analytical methods to be used in image processing.
- To familiarize students with image enhancement and restoration techniques,
- To explain different image compression techniques.
- To introduce segmentation and morphological processing techniques.

Pre-requisite: Basics of engineering mathematics and signal and systems

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Explain the fundamentals of digital image and its processing

CO2: Describe image enhancement techniques in spatial and frequency domain.

CO3: Define the mathematical modeling of image restoration and compression

CO4: Apply the concept of image segmentation, state object detection and recognitiontechniques.

Pedagogy: The teaching-learning of the course would be organized through lectures, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based sources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction and Digital Image Fundamentals: The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations. Image Enhancement in the Spatial Domain: Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothing and Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	
UNIT- II	**11 Hours**
Filtering in the Frequency Domain: Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters. Image Restoration: A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.	
UNIT-III	**11 Hours**
Color Image Processing, Color fundamentals, Color Models, Pseudo color Image processing, Color Transforms, Smoothing and Sharpening, Color Segmentation Image Compression: fundamentals of compression, coding redundancy, Lossy and lossless compression, Spatial and temporal redundancy, Image compression models. Some basic compression methods. Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Region Oriented Segmentation, Motion based segmentation.	
UNIT- IV	**10 Hours**
Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms. Object Recognition: Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.	

Text Books	
1	Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 4th edition, Pearson, 2017.
2	A.K. Jain, "Fundamental of Digital Image Processing", 1st Edition, Pearson, 2015.
Reference Books	
1	B. Chanda and D. Dutta Majumder, "Digital Image Processing and Analysis," PHI, 2nd Edition, 2013.
2	Chris Solomon and Toby Breckon, "Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab," Wiley Blackwell, 1st Edition, 2010.
3	Maria Petrou, and Costas Petrou, "Image Processing: The Fundamentals," Wiley Publications, 2nd Edition, 2010.

ANTENNA DESIGN	
Course Code:BEC-312 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:**6

Introduction: The course will introduce the basic essentials of antenna and apply them in the analysis and design basics of antennas. Starting from the basic antenna parameters, the course will discuss various types of antennas such as array antennas, loop antenna, horn antenna and Micro strip Antennas etc. It also covers the fundamentals of wave propagation.

Course Objective:

- To familiarize with the fundamental principles of antenna theory
- To develop understanding of antenna concepts and practical antenna design for various applications
- To develop underlying concepts of wave propagation

Pre-requisite:

- Basic concepts of electromagnetic field theory
- Knowledge of differential and integral calculus

Course Outcome: After completion of the course, student will be able to:

- Understand antenna fundamentals and basic concepts of radiation mechanism of an antenna
- Design different types of basic antennas
- Analyze the concept of wave propagation mechanism

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
Antenna fundamental: Introduction, field & power pattern, Near field and far field radiation pattern, beam area, radiation intensity, beam efficiency, directivity and gain, antenna aperture, effective height, radiation resistance, antenna impedance, antenna temperature, signal to noise ratio, from oscillating dipole, Far Field due to an alternating current element, Power radiated by a current element	
UNIT-II	**10 Hours**
Antenna Design: Point Source, Power Theorem and its Application to an Isotropic Source, Electric dipoles, The short electric dipole, Fields of a short dipole, Radiation resistance of short electric dipole, Thin linear antenna, Radiation resistance of $\lambda/2$ antenna, Half wave dipole, quarter wave monopole, Array Antenna, Array of two driven $\lambda/2$ elements: Broadside case and end-fire case	
UNIT-III	**10 Hours**
Yagi-Uda antenna design: Design and its Characteristic Properties, Applications, Field pattern Loop Antennas: Design and its Characteristic Properties, Applications, Horn Antennas, Helical Antennas, The Log-Periodic Antenna, Micro strip Antennas, Long wire antennas, Folded dipole antennas.	
UNIT-IV	**10 Hours**

Wave Propagation Ground Wave Propagation:Plane Earth Reflection, Space Wave and Surface WaveSpace Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth Sky wave Propagation: Introduction structural details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation	
Text Books	
1	J. D. Kraus, R. J Marhefka, A. S. Khan, “Antennas and Wave Propagation”, Vth Edition, Tata McGraw Hill, 2019/latest edition.
2	C. A. Balanis, "Antenna Theory Analysis and Design", IVth Edition, John Wiley, 2016/latest edition.
Reference Books	
1	M. Sadiku, “Elements of Electromagnetic’, VIIth Edition, Oxford University Press, 2020/latest edition.
2	W.H. Hayt, J.A. Buck and M.Jaleel Akhtar, “Engineering Electromagnetic”, IXth Edition, McGraw- Hill Education, 2013/latest edition.
3	A. R. Harish, M. Sachidananda, “Antennas and Wave Propagation”, Oxford University Press, 2007/latest edition.
4	R.L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi, 2018/latest edition.
5	K.D. Prasad, “Antennas and Wave Propagation”, Satya Prakashan, Tech India Publications, New Delhi-2019/latest edition.

FPGA & VERIFICATION	
Course Code: BEC-314 Contact Hours:L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester:6

Introduction: This course covers the systematic design of advanced digital systems using Field-Programmable Gate Arrays (FPGAs). The emphasis is on top-down design starting with a software application, and translating it to high-level models using a hardware description language (such as VHDL or Verilog). The course will focus on design for high-performance computing applications using streaming architectures. The basic building blocks of FPGA programming are discussed followed by review of architecture, design methodologies, best design practices, and optimization techniques for performance (frequency, latency, area, power, etc). Finally, simulation for bit-true design verification, SoC Design Flow and demonstration of hardware by different acceleration and emulation techniques has been covered.

Course Objective:

- To know FPGA architecture, technologies and FPGA's implementation methodologies.
- To understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA.
- To utilize techniques and technology for efficient circuit verification.
- To introduce the concepts of Verification techniques, UML and considerations
- To demonstrate the hardware acceleration and emulation techniques

Pre-requisite:

- Concepts of digital system design and behaviour modelling of a system.
- Basics of Verilog and VHDL.
- FPGA architecture and its technologies.
- Knowledge of sequential and combinational circuits.

Course Outcome: After completion of the course, student will be able to:

- Demonstrate VLSI tool-flow and appreciate FPGA architecture
- Understand the basics of system on chip and on chip communication architectures.
- Understand the issues involved in ASIC design, including technology choice, design management, tool flow.
- Able to verify digital circuits for design errors.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
FPGA Design Environment: Introduction, Scripting Environment, Interaction with Version Control Software, A Regression Test System, Common Tools in the FPGA Design Environment, Challenges that FPGAs Create for Board Design, Engineering Roles and Responsibilities, FPGA Engineers, Design Flows for Creating the FPGA Pinout, Board Design Check List for a Successful FPGA Pin-Out. Power Analysis and RTL Design: Introduction, Power Basic, Key Factors in Accurate Power Estimation, Power Estimation Early in the Design Cycle, Simulation Based Power Estimation, Best Practices for Power Estimation, Recommendations for Engineers with an ASIC Design Background, Writing Effective HDL, Analyzing the RTL Design.	
UNIT-II	**10 Hours**
Design and Verification Languages: Introduction, History, Design Languages, Verification	

Languages. Digital Simulation: Introduction, Event vs Process-Oriented Simulation, Logic Simulation Methods and Algorithms, Impact of Languages on Logic simulation, Logic Simulation Techniques, Impact of HVLs on simulation, Summary.	
UNIT-III	**10 Hours**
Using Transactional-Level Models in a SoC Design Flow: Introduction, Overview of the System-to-RTL Design Flow, TLM —View for the Design Flow, TLM Modeling Application Programming Interface, Example of a Multimedia Platform, Design Flow Automation, Conclusion.	
UNIT-IV	**10 Hours**
Hardware Acceleration and Emulation: Introduction, Emulator Architecture Overview, Design Modeling, Debugging, Use Models, The Value of In-Circuit Emulation, Considerations for Successful Emulation	
Text Books	
1.	D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, "Embedded System Design: Modeling, Synthesis and Verification", Springer, 2009/latest edition.
2.	G. De Micheli, "Synthesis and Optimization of Digital Circuits", McGraw Inc latest edition.
Reference Books	
1.	L.Scheffer, L.Lavagno, G. Martin, "EDA for IC System Design, Verification, and Testing", Taylor & Francis, 2006/latest edition.
2.	E. Seligman, T. Schubert, "Formal Verification: An Essential Toolkit for Modern VLSI Design", Elsevier Inc., 2015/latest edition.
3.	M. Fujita, I. Ghosh, and M. Prasad, and Morgan Kaufman, "Verification Tec/latest edition.hniques for System-Level Design", Published in The Morgan Kaufmann series, 2008

Natural Language Processing	
Course Code: BAI- 302 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 6

Introduction: Natural language processing (NLP) refers to the branch of computer science and more specifically, the branch of artificial intelligence or AI—concerned with giving computers the ability to understand text and spoken words in much the same way human beingscan. NLP combines computational linguistics—rule-based modelling of human language withstatistical, machine learning, and deep learning models. Together, these technologies enable computers to process human language in the form of text or voice data and to 'understand' itsfull meaning, complete with the speaker or writer's intent and sentiment.

Course Objectives:

- To learn the fundamentals of Natural language Processing and its algorithm.
- To understand machine translation and applications of NLP.
- Basic understanding of deep learning models for NLP.

Pre-requisite: Artificial Intelligence, Data structures and algorithms, programming languages

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Learn the fundamentals of Natural language Processing and its algorithm.

CO2: Understand machine translation and applications of NLP.
CO3: Provide basic understanding of deep learning models for NLP.
CO4: Apply the concept of NLP in the real domain.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for betterunderstanding. Use of ICT, web-based resources as well as flipped class room teaching will beadopted.

CONTENTS

UNIT -I	10 Hours
Introduction to NLP: Characteristics of Natural Language, Language structure, Sentence Structure, Language analyzer, Lexicon, word formation, Morphology, syntax analysis (parsing), semantics, ambiguity, pragmatics and discourse.	
UNIT- II	**11 Hours**
NLP Algorithms: Understanding Corpus and data attributes, Corpus Formats CSV, JSON, XML, LibSVM, Operations on Text Corpus, Tokenisation, stop words, Term Frequency Inverse Document Frequency (TF-IDF), Text Analysis and word embedding using word2vec, doc2vec, GLoVe, Bag-of-words (BoW).	

UNIT-III		11 Hours
Machine Translation and Applications of NLP: Introduction to Machine Translation (MT), Approaches, Structure of Anusaraka: an Interlingua based MT system, Example/Analogy based MT, Word/phrase based MT, Neural MT. Applications of NLP: Sentiment analysis, chatbots, conversational models (Question Answering system) for Digital Assistants		
UNIT- IV		**10 Hours**
Deep learning models for NLP: Neural Net based NLP models: Study of Convolutional Neural Network(CNN), Recurrent Neural Network(RNN), Long Short-Term Memory (LSTM) and Gated Recurrent Unit(GRU) using Natural Language Toolkit (NLTK)		
Text Books		
1	Daniel Jurafsky, James H. Martin,"Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech, Pearson Publication, 2014.	
2	Thanaki, Jalaj, "Python natural language processing". Packet Publishing Ltd, 2017.	
Reference Books		
1	Lawrence Rabiner And Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.	
2	Samuel Burns, "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK" Independently Published, 2019	
3	Bird, Steven, Ewan Klein, and Edward Loper. "Natural language processing with Python: analyzing text with the natural language toolkit." O'Reilly Media, Inc.", 2009.	

Cloud computing	
Course Code: BAI-308 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: This course gives an insight into Cloud Computing and other related emerging Computing Technologies. It teaches various Cloud Computing Models and services and their current uses from industry perspective

Course Objective: To familiarize with the evolution, concept and deployment models of cloud computing, and to familiarize different services of cloud computing

Pre-requisite: Database systems.

Course Outcomes: Upon successful completion of the course, students will be able to:
CO1: Learn the fundamentals of cloud computing, its evolution and deployment models.
CO2: Demonstrate the use cases and applications of Cloud Computing

CO3: Describe the concept of Virtualization and its need in cloud computing.

CO4: Apply the Cloud Services in different aspects of a project

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction: Trends in Computing, Concept and Evolution of Cloud Computing Paradigm. Introduction to Cloud Computing, Benefits and challenges of cloud computing. Cloud Deployment Models: Public clouds, Private clouds, Community clouds, Hybrid clouds, Advantages of Cloud computing.	
UNIT- II	**11 Hours**
Cloud Architecture- Layers and Models Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Advantages of Cloud computing Case studies on cloud service providers – Amazon EC2, Google App Engine, Microsoft Azure	
UNIT-III	**11 Hours**
Virtualization: Virtualization Concept, Need of virtualization, Types of Virtualization. Storage virtualization, Compute/Processor virtualization, Network virtualization. Software Defined Networks, Network Function Virtualization.	
UNIT- IV	**10 Hours**

Best Practices and Similar Upcoming Technologies: Analysis of Case Studies when deciding to adopt cloud computing architecture, Cloud Security, Block chain, Containerization and Docker. Recent research in computing.	
Text Books	
1	Barrie Sosinky, “Cloud Computing”. Wiley Publishing House, 2011.
2	Michael J. Kavis, “Architecting the Cloud: Design Decision for Cloud Computing”. JohnWiley & Sons, 2014.
3	Rajkumar Buyya &James Broberg ,”Cloud Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing)”, Wiley-Blackwell, 2011.
Reference Books	
1	Anthony T.Velte, Toby J. Velte Robert Elsenpeter, “Cloud computing a practical approach”, McGraw-Hill Osborne, 2009.
2	Thomas Erl, Ricardo Puttini, “Cloud Computing: Architecture”, Prentice Hall, Pearson Publications, 2013. Concepts, Technology & Architecture”, Prentice Hall, Pearson Publications, 2013.
4	G. Coulouris, J. Dollimore, T. and Kindberg, Distributed Systems: Concepts and DesignEdition 5, Pearson Education , 2017

Blockchain Technologies	
Course Code: BAI-310 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: Blockchain technology is a structure that stores transactional records, also known as the block, of the public in several databases, known as the "chain," in a network connected through peer-to-peer nodes.

Course Objectives:

- To understand the history, types and applications of Blockchain.
- To acquire knowledge about cryptography and consensus algorithms.
- To deploy projects using blockchain technology.

Pre-requisite: Distributed systems.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Discuss the overview of Blockchain and its different categories.

CO2: Analyse the need of Blockchain in various domains.

CO3: Define cryptography and Consensus algorithms.

CO4: Design and build an Initial Coin Offerings (ICO) on Ethereum

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction to Blockchain: Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.	
UNIT- II	**11 Hours**
Blockchain Architecture: Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)	
UNIT-III	**11 Hours**
Blockchains in Business and creating ICO: Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain-as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts-Contract security and testing the code.	
UNIT- IV	**10 Hours**
Distributed Storage IPFS and Swarm: Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, hosting our frontend: Serving your frontend using IFPS, serving your frontend using Swarm, IPFS file uploader project: Project setup the web page	
Text Books	
1	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
2	Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018.
Reference Books	
1	Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

Quantum Computing	
Course Code: BAI-312 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: Quantum computation captured the imagination of computer scientists with the discovery of efficient quantum algorithms for factoring and fast algorithm for search. Quantum computing exploits the quantum mechanical nature of matter to simultaneously exist in multiple possible states. Building up on the digital binary logic of bits, quantum computing is built on the basis of interacting two-level quantum systems or 'qubits' that follow the laws of quantum mechanics. Addressability of the quantum system and its fragility to fidelity are the major issues of concern, which if addressed appropriately, will enable this new approach to revolutionize the present form of computing. The aim of quantum computing is to do computation using the quantum mechanical effects.

Course Objective:

- To impart the basic understanding of quantum mechanics and its usage in quantum computing.
- To provide the general introduction to the algebra of complex vector spaces.
- To simulate quantum computing algorithms using IBM Qiskit Technology.
- To give insights to conceive and model quantum systems on their own for societal applications.

Pre-requisite: Binary Digital Logic, Linear Algebra, Algorithms Design, Probability and Statistics.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Describe the fundamentals of quantum mechanics in quantum computing.

CO2: Analyse the behaviour of basic quantum algorithms

CO3: Implement simple quantum algorithms and information channels in the quantum circuit model

CO4: Describe the standard quantum algorithms in IBM Qiskit and state the benefits along with constraints of quantum computational models.

Pedagogy:

- Course teaching and learning through lectures, tutorials, assignments, projects and quizzes.
- Encouragement to the students for developing an understanding and simulations of the existing quantum computational models.
- Emphasis on mathematical and programming assignments based on topics fromprevious lectures.
- Course will have a blend of theory and lab practice for the benefit of students.
- Use of ICT, web based sources as well as blackboard teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction to Quantum Computing, Postulates of Quantum Mechanics, Qubit-The smallest unit, Qubit- Bloch sphere representation, Multiple Qubit States and Quantum Gates, Quantum Gates, Quantum Circuits, No-Cloning Theorem and Quantum Teleportation, Bell's Inequality and it's Implications, Super Dense Coding.	
UNIT- II	**11 Hours**
Density Matrix, Bloch Sphere and Density Matrix, Measurement Postulates, Simple Algorithms, Deutsch Algorithm, Deutsch-Josza Algorithm, Bernstein-Vazirani Algorithm, Simon Problem, Grover's Search Algorithm, Shore's Factorization Algorithm	
UNIT-III	**11 Hours**
Quantum Fourier Transform, Period Finding and QFT, Implementing QFT, Implementing QFT-3 qubits, Shor's Factorization Algorithm, Shor's Factorization Algorithm-Implementation, Quantum Error Correction, Quantum Error Correction Three Qubit Code. Fault Tolerance	
UNIT- IV	**10 Hours**
Classical Information Theory, Shannon Entropy, Shannon's Noiseless Coding Theorem, Ven Neumann Entropy, EPR and Bell's Inequalities, Cryptography-RSA Algorithm, Quantum Cryptography, Experimental Aspects of Quantum Computing. Issues of Fidelity, Security and Scalability in Quantum Computing	

Text Books	
1	Vishal Sahni, "Quantum Computing ", McGrawHill, 2007
2	Eleanor Rieffel and Wolfgang," Quantum Computing: A Gentle Introduction", MIT press, 2011
3	Michael Nielsen and Isaac Chuang and, "Quantum Computation and Quantum Information", Cambridge University Press, 2013
References	
1	Michael A. Nielsen and Issac L. Chuang, "Quantum Computation and Information", Cambridge University Press, 2002.
2	P. Kaye, R. Laflamme, and M. Mosca. *An Introduction to Quantum Computing*. Oxford University Press, 2007.
3	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004

Information Theory & Coding	
Course Code:BEC-304 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:**6

Introduction: The course will introduce fundamental principles of information theory and various coding techniques used in digital communication. The course provides sufficient basic knowledge for the undergraduates to understand the coding theory that is major tool to find explicit techniques to enhance error free data propagation with increased efficiency pattern associated to advancement of different digital technologies.

Course Objective:

- Understand the various mathematical models developed for coding schemes utilized in data communication.
- Understand the fundamental concepts and application of coding theory.

Pre-requisite:

- Basic concept of Communication Systems
- Student should have the prior knowledge of Digital Communication Techniques
- Basic knowledge of Probability Theory

Course Outcome: After completion of the course, student will be able to:

- Understand the coding theory thoroughly.
- Understand various applications associated with research
- Analyse logical aspects of model development for digital data communication processes.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	**12 Hours**
Information Theory: Information- Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information- Discrete memory less channels - BSC, BEC - Channel capacity, Shannon limit.	
UNIT-II	**10 Hours**
Source coding: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Channel, Linear Predictive coding, Introduction to Audio coding, Perceptual coding, Masking Techniques, Introduction to Speech Coding, Channel Vocoder.	
UNIT-III	10 Hours
Error control coding: block codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes -	

Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC, Convolution codes - code tree, trellis, state diagram - Encoding - Decoding: Sequential search and Viterbi algorithm.	
UNIT-IV	10 Hours
Error control coding: convolution codes: Principle of Turbo coding Video Compression - Principles I,B,P frames, Motion Estimation, Motion Compensation. Random process: Definition and examples, first order, second order, strictly stationary, wide sense stationary, Ergodic process and Markov process - Binomial, Poisson and Normal processes, sine wave processes, random telegraph process.	
Text Books	
1	R. Bose, "Information Theory, Coding and Cryptography," TMH, 3rd Edition 2016/latest edition.
2	F. Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson Education Asia, 2002/latest edition.
Reference Books	
1	S.Gravano, "Introduction to Error Control Codes," Oxford University Press2007/latest edition.
2	A. Bhattacharya, "Digital Communication," TMH, 2017/latest edition.
3	T. M. Cover and J. A. Thomas, "Elements of Information Theory," Wiley Series in Telecommunication and Signal Processing, 2nd Edition, 2006/latest edition.
4	K.Sayood, "Introduction to Data Compression," Elsevier, 5rd Edition, 2017/latest edition.

Power Electronics	
Course Code: BEC-316 **Contact Hours:**L-3 T-0 P-2 **Course Category:** DEC	**Credits:** 4 **Semester:** 6

Introduction: The course will introduce fundamental principles, concept of power electronics, application of power electronics, uncontrolled converters, advantages and disadvantages of power electronics converters, power electronics systems, power diodes, power transistors, power MOSFETS, IGBT and GTO. The course provides sufficient basic knowledge for the undergraduate to understand the design of converters, AC controllers, Thyristors and their applications.

Course Objective:

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.

Pre-requisite:

- Basic Electronics
- Student should have the prior knowledge of semiconductor electronics
- Circuit Theory

Course Outcome: After completion of the course, student will be able to:

- Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.
- Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits
- Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
- Formulate and analyze a power electronic design at the system level and assess the performance.
- Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.
- Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	12 Hours
Power Electronic Devices: Construction, Principle of operation, Static and dynamic characteristics of Power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT, Safe operating Area, Protection circuits- series and parallel connections.	
UNIT-II	**10 Hours**
AC TO DC Converters: Single phase and three phase controlled rectifiers (half and full converters) with R, RL and RLE load, Estimation of RMS load voltage, RMS load current and	

input power factor, effect of source inductance and firing circuits, Single phase and three phase dual converters.	
UNIT-III	**11 Hours**
DC TO DC Converters: Principle of step up and step down operation, single quadrant DC chopper with R, RL and RLE load, Time ratio control, Estimation of average load voltage and load current for continuous current operation- two quadrant and four quadrant DC choppers, Voltage, current and load-commutated choppers.	
UNIT-IV	**11 Hours**
DC TO AC Converters & AC TO AC Converters: Inverters- Types- Voltage source and current source inverters, single phase bridge inverters, three phase bridge inverters, PWM inverters, Series inverter control of AC output voltage, Harmonic reduction, AC voltage regulator, step up and step down cycloconverter, three phase to single phase cycloconvertor and three phase to three phase cycloconvertor.	
Text Books	
1	M. H. Rashid, "Power Electronics - Circuits Devices and Applications," 4th Edition, Pearson Education, 2014/latest edition.
2	P. C. Sen, "Power Electronics," Tata Mc Graw Hill Education, 12th Edition, 2011/latest edition.
Reference Books	
1	M. D. Singh and K. Kanchandani, "Power Electronics," Tata McGraw-Hill & Hill Publication Company Ltd, 2008/latest edition.
2	J.Vithayathil, "Power Electronics," McGraw Hill series in Electrical and Computer Engineering, USA, 1995/latest edition.
3	U. Loganathan, "Power Electronics," Wiley India Pvt. Limited, 2009/latest edition.
4	P. S. Bhimbra, "Power Electronics," Khanna publishers, 2018/latest edition.

Information Retrieval	
Course Code: BAI-314 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: Information Retrieval aims to focus on various concepts of artificial intelligence for organizing & fetching data in Intelligent manner and fetching the information from the internet databases like search Engines in an intelligent and optimized manner. The Subject will introduce how to intelligently retrieve data from web sources so that the results of queries are exact and efficient.

Course Objective:

- To be familiar with different types of text, encoding and compressions.
- To be able to evaluate the search engines.
- To understand the text categorization, retrieving web information.

Pre-requisite: Knowledge of basic databases and algorithms

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Learn the concepts of text processing such as text-types and text encoding.

CO2: Analyse the performance of different search engines.

CO3: Discuss and relate the classification methods of the text and web information retrieval.

CO4: Describe and compare the various clustering models along with their real-world applications.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes.	
UNIT- II	**11 Hours**
Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio.	
UNIT-III	**11 Hours**
Performance Evaluation: Evaluating search engines. User happiness, precision, recall, Fmeasure. Creating test collections: kappa measure, interjudge agreement. Text Clustering: Clustering versus classification. Partitioning methods. k-means clustering. Mixture of gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents	
UNIT- IV	**10 Hours**
Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting. Web Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank.	
Text Books	
1	Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", Pearson Education, 2nd edition, 2010.
2	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze,"Introduction to Information Retrieval", 2008
3	Christopher D. Manning and Prabhakar Raghavan, Introduction to Information Retrieval, Cambridge Press, 2008.
Reference Books	
1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson, 2nd edition, 2008.
2	David A. Grossman, Ophir Frieder, "Information Retrieval: Algorithms, and Heuristics", Springer, 2012
3	Charles T. Meadow, Bert R. Boyce, Donald H. Kraft, "Text Information Retrieval Systems", Emerald Group Publishing Limited; 3rd edition 2007

Recommender Systems	
Course Code: BAI-316 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: In the current age of information overload, recommender systems offer personalized access for users to efficiently search information and make choices online. This course introduces recommender systems' major concepts, methodologies, evaluation design, and user experiences. A variety of real-world applications are included, such as those deployed in e-commerce sites and social networks.

Course Objective:

- To understand the basic concepts such as user preference and prediction.
- To learn variety of typical recommendation approaches.
- To understand system evaluation design and metrics
- To get the knowledge of human roles in system implementation and user-centered evaluation.

Pre-requisite: Data structures and basic knowledge of programming languages like C, C++.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Describe basic concepts and framework of recommender systems.

CO2: Explain a variety of approaches for building recommender systems.

CO3: Define system evaluation methods from both algorithmic and users' perspectives

CO4: Discuss the applications of recommender systems and apply in various domains.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system. Collaborative Filtering: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.	
UNIT- II	**11 Hours**
Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders	
UNIT-III	**11 Hours**
Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies. Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics.	
UNIT- IV	**10 Hours**
Recommender Systems and communities: Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations, Group recommender systems.	
Text Books	
1	Jannach D., Zanker M. and FelFering A.," Recommender Systems: An Introduction", Cambridge University Press, 2011
2	Ricci F., Rokach L., Shapira D., Kantor B.P., "Recommender Systems Handbook", Springer, 2011
3	Manouselis N., Drachsler H., Verbert K., Duval E., "Recommender Systems For Learning", Springer, 2013
Reference Books	
1	Michael D. Ekstrand, John T. Riedl, and Joseph A. Konstan, "Collaborative Filtering Recommender Systems", Now Publishers Inc, 2011.
2	Aggarwal, Charu C, "Recommender Systems: The Textbook", Springer 2016.

Semantic Web	
Course Code: BAI-318 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: The Semantic Web is a vision about an extension of the existing World Wide Web, which provides software programs with machine-interpretable metadata of the published information and data. It aims to enrich the Web with a layer of machine-interpretable metadata so that computer programs can predictably derive new information.

Course Objective:

- To introduce the basic concept of web and its terminologies.
- Understanding RDF, RDFS, OWL, SPARQL.
- Familiar with current trends and applications of Semantic Web.

Pre-requisite: Computer Networks, basic programming knowledge.

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Comprehend the basic concepts of the semantic web along with its technologies and development.

CO2: Explain the Semantic Web fundamental concepts, issues, architecture and technologies.

CO3: Describe the various technologies of Semantic Web focusing on RDF,Ontology and Sparql.

CO4: State the latest trends and applications of Semantic Web in real-world applications.

Pedagogy:

The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

CONTENTS

UNIT -I	10 Hours
Review of Internet and Web: History, Internet protocols and services, OSI Seven layer model, terms and terminologies, concepts like WWW, W3C, ISP, DNS, Search Engines etc. HTML and it'stags, various web development issues and technologies.Web 1.0 and Web 2.0	
UNIT- II	**11 Hours**
Semantic Web: Limitations of Web 2.0, Need of Web 3.0, Sir Tim Berners LEE vision and contributions, Semantic Web vision and roadmap, Semantic web fundamental concepts and issues,Semantic Web architecture layered cake and technologies, XML basics and metadata, Jorge Cardoso Survey, scientific American article 2001.	
UNIT-III	**11 Hours**
RDF, Ontology and SPARQL: Overview of various technologies of Semantic Web with focus on pillar technologies. Semantic Web standards, RDF basics and examples, RDFS, Ontology and its issues, OWL, Ontology design and development, using Ontology editor Protégé, benefits and challenges of Ontologies, SPARQL and its concerns, Exporting SPARQL query using tools like Protégé, Twinkle etc	
UNIT- IV	**10 Hours**
Applications and upcoming trends: An overview of various Semantic Web Services and applications, Semantic Annotation, Information Extraction and Retrieval, Semantic Search, Semantic Agents and Search Engines, Semantic Social Networks, Web Intelligence, SWoT, Chatbots, Web Data Analytics.	
Text Books	
1	RajendraAkerkar, "Foundations of the Semantic Web:XML,RDF and Ontology" ,Oxford, 2009.
2	Karin Breitman and Marco, "Semantic Web: Concepts, Technologies and Applications", Springer. 2009,
3	Berners-LEE, Godel and Turing, "Thinking on the Web", Wiley, 2006.
Reference Books	
1	John Hebeler, Mathew Fisher and Ryan Blace, "Semantic Web Programming", Wiley, 2011
2	Krotzsch and Rudolph, "Foundations of Semantic Web Technologies", SRC Press, 2009.
3	Grigoris Antoniou and Paul Groth, "A Semantic Web Primer", MIT Press, 2012.

PRINCIPLES OF MANAGEMENT	
Course Code: HMC-302 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: To give a preview of basics of management to engineering students, this course discusses about the basic nature of management and describes the functions of management, the specific roles of contemporary management, and different approaches to designing organizational structures. This will help the students to understand the role of personality, learning and emotions at work, discover and understand the concept of motivation, leadership, power and conflict, understand the foundations of group behavior and the framework for organizational change and development.

Course Objectives:

- To acquaint the students with the fundamentals of managing business
- To make them understand individual and group behavior at workplace so as to improve the effectiveness of an organization.
- The course will use and focus on Indian experiences, approaches and cases.

Pre-requisite: None

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

- Understand the nature of management and describe the functions of management·
- Understanding the specific roles of contemporary management.
- Develop understanding of different approaches to designing organizational structures.
- Understand the role of personality, learning and emotions at work.
- Discover and understand the concept of motivation, leadership, power and conflict.
- Understand the foundations of group behavior and the framework for organizational change and development.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	7 Hours
Introduction: Concept, Nature, Process and Significance of Management; Managerial levels, Development of Management Thought: Classical, Neo-Classical, Behavioral, Systems and Contingency Approaches.	
UNIT-II	7 Hours
Planning: Nature, Scope and Objectives of Planning; Types of plans; Planning Process; Organizing: Nature, Process and Significance; Principles of an Organization; Span of Control; Types of an Organization.	

UNIT-III		7 Hours
Staffing: Concept, Nature and Importance of Staffing. Motivating and Leading: Nature and Importance of Motivation; Types of Motivation; Leadership: Meaning and Importance; Traits of a leader.		
UNIT IV		7 Hours
Controlling: Nature and Scope of Control; Types of Control; Control Process; Control Techniques– Traditional and Modern; Effective Control System.		
Text Books		
1	S.P. Robbins, "Fundamentals Management: Essentials Concepts Applications", Pearson Education, 2014/latest edition.	
2	Gilbert, J.A.F. Stoner and R.E. Freeman, "Management", Pearson Education, 2014. H. Koontz, "Essentials of Management", McGraw Hill Education, 2012/latest edition.	
3	C. B. Gupta, "Management Concepts and Practices", Sultan, latest edition.	
Reference Books		
1	W. Ghillyer, "Management- A Real World Approach", McGraw Hill Education, 2010/latest edition.	
2	K. Mukherjee, "Principles of Management", McGraw Hill Education, 2012/latest edition.	

MARKETING MANAGEMENT	
Course Code: HMC-304 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction - This course will build the basic concept of marketing and related concepts for the engineering students. It will provide an in-depth understanding to various elements of marketing mix for effective functioning of an organization. Students will learn some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Course Objectives:

- To familiarize students with the marketing function in organizations.
- To equip the students with understanding of the Marketing Mix elements and sensitize them to certain emerging issues in Marketing.

Pre-requisite: None

Course Outcomes: – After completion of the course, the students should be able to

- Understand the concept of marketing and related concepts.
- An in-depth understanding to various elements marketing mix for effective functioning of an organization.
- Learn some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	7 Hours
Introduction to Marketing: Nature, Scope and Importance of Marketing, Basic concepts, Marketing Environment.	
UNIT-II	7 Hours
Product: Product Levels, Product Mix, Product Strategy, Product Development, Product Lifecycle and Product Mix Pricing Decisions.	
UNIT-III	7 Hours
Place: Meaning & importance, Types of Channels, Channels Strategies, Designing and Managing Marketing Channel.	

UNIT IV		7 Hours
Promotion: Promotion Mix, Push vs. Pull Strategy; Promotional Objectives, Advertising-Meaning and Importance, Types, Media Decisions, Promotion Mix, Personal Selling-Nature, Importance and Process.		
Text Books		
1	P. Kotler, P.Y. Agnihotri and E.U. Haque, "Principles of Marketing- A South Asian Perspective", Pearson Education, 2012/latest edition.	
2	T. Ramaswamy and S. Namkumar, "Marketing Management Global Perspective: Indian Context", McMillan, Delhi, 2013/latest edition.	
Reference Books		
1	R. Saxena, "Marketing Management", (5th ed.) McGraw Hill Education, 2017/latest edition.	
2	C.W. Lamb, J.F. Hair, C. McDaniel, D. Sharma, "MKTG: a South Asian Perspective with Coursemate",1/e edition Cengage Learning, 2016/latest edition.	
3	R. Winer, "Marketing Management",(4th ed.) Pearson Education, 2012/latest edition.	

FINANCIAL MANAGEMENT	
Course Code: HMC-306 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: Efficient Management of a business enterprise is closely linked with the efficient management of its finances. Accordingly, the objective of the course is to familiarize the engineering students with the basic fundamentals, principles and practices of financial decision-making in a business unit in the context of a changing, challenging and competitive global economic environment. The purpose of the course is to offer the students relevant, systematic, efficient and actual knowledge of financial management that can be applied in practice while making financial decisions and resolving financial problems.

Course Objectives: The objective of the course is to acquaint the students with the overall framework of financial decision-making in a business unit.

- To acquaint the students with the fundamentals of Financial Management
- To make them understand Decisions to be taken as a Finance Manager.
- The course will use and focus on Indian experiences, approaches and cases.

Pre-requisite: None

Course Outcomes:

Upon successful completion of the course, students will be able to:

- Understand the overall role and importance of the finance function for decision-making.
- Recommend whether and why a particular investment should be accepted or rejected by determining an appropriate investment criteria and projecting cash flows associated with corporate project evaluation.
- Differentiate between the various sources of finance and their pros and cons.
- Outline capital requirements for starting a business and management of working capital.
- Analyse the complexities associated with management of cost of funds in the capital structure.
- Apply the concepts of financial management to contemporary financial events.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	7 Hours
Financial Management Definition, scope, objectives of Financial Management, Functions of a finance manager, Time value of money. Sources of Finance for different Organizations.	
UNIT-II	7 Hours
Capital Structure: Meaning ofCapital Structure: Factors Determining Capital Structure. Cost of Capital: Concept, Importance and Classification.	

UNIT-III	7 Hours
Capital Budgeting: Concept, Importanceand Appraisal Methods: Pay Back Period, Accounting, Rate of Return, Net Present Value Method (NPV), Profitability Index, and IRR. Capital Rationing.	
UNIT IV	7 Hours
Working Capital Management: Operatingcycle, Working Capital Estimation, Inventory Management: EOQ Problem.	
Text Books	
1	M.Y. Khan and P.K. Jain, "Financial Management", McGraw Hill Education, 8th Edition, 2018/latest edition.
2	I. M. Pandey, "Financial Management", Vikas Publishing House, 2015/latest edition.
Reference Books	
1	S. Kapil, "Financial Management", Pearson Education, 2012/latest edition.
2	C. Prasanna, "Financial Management: Theory and Practice", McGraw Hill,10th Ed. 2019/latest edition.
3	S.N. Maheshwari, "Financial Management: Principles and Practice", Sultan Chand, LN, 2019/latest edition.

HUMAN RESOURCE MANAGEMENT	
Course Code: HMC-308 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: This course focuses on issues and strategies required to select and develop manpower resources. The main objective of this course is to help the students to acquire and develop skill to design rational decisions in the discipline of human resource management.

Course Objective: The objective of this course is to make students familiar with the basic concepts of human resource management and people related issues.

- To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
- To help the students focus on and analyze the issues and strategies required to select and develop manpower resources.
- To develop relevant skills necessary for application in HR related issues.
- To enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

Pre-requisite: Basic management knowledge

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

- Develop an understanding of the concept of human resource management and to understand its relevance in organizations.
- Develop necessary skill set for application of various HR issues.
- Analyze the strategic issues and strategies required to select and develop manpower resources.
- Integrate the knowledge of HR concepts to take correct business decisions.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents

UNIT-I	7 Hours
Human Resource Management: Introduction to Conceptand Functions of HRM, Role, Status and Competencies of HR Manager, HR Policies, Evolution of HRM. Emerging Challenges of Human Resource Management.	
UNIT-II	7 Hours
Human Resource Planning: HumanResource Planning- Quantitative and Qualitative dimensions; Recruitment – Concept and sources; (E-recruitment, recruitment process outsourcing etc.); Selection – Concept and process; test and interview; placement induction. Job analysis – job description and job specification.	

UNIT-III	7 Hours
Training and Development: Concept and Importance; Identifying Training and Development Needs; Designing Training Programs; Role Specific and Competency Based Training; Evaluating Training Effectiveness; Performance appraisal: nature and objectives; Modern Techniques of performance appraisal.	
UNIT IV	7 Hours
Human Resource Development: Orientation Program; Requisite of an effective Program, Evaluation of Orientation Program. Strategic HRM: HRD audit, ethics and CSR	
Text Books	
1	G. Dessler. "A Framework for Human Resource Management", Pearson Education, 2017, 15th Edition/latest edition.
2	D. A. Decenzo, S. P. Robbins, S. L. Verhulst, "Human Resource Management", Wiley India Private Limited, 2015/latest edition.
Reference Books	
1	Bohlendar and Snell, "Principles of Human Resource Management", Cengage Learning, 2013/latest edition.