List of Open Elective Subjects (VII Semester)

S.No.	Subject Code	Name of open Elective Subjects	Subject offered to Program	Semester
1	AOE0761	Project Management	All Programs	7
2	AOE0762	Biology for Engineers	All Programs except BT	7
3	AOE0763	Object Oriented Programming	EC, ME,BT	7
4	AOE0764	Cloud computing	EC, ME,BT	7
5	AOE0765	Human Psychology and Organizational Behaviour	All Programs	7
6	AOE0766	Sensor Technologies	All Programs	7
7	AOE0767	Nano Technology	All Programs except BT	7
8	AOE0768	Web Technologies	EC, ME,BT	7
9	AOE0769	Database Management System	EC, ME,BT	7
10	AOE0770	Finance for Engineers	All Programs	7
11	AOE0771	Entrepreneurship Development and IPR	All Programs	7
12	AOE0772	Wireless communication	All Programs except EC,ME,BT, IOT	7
13	AOE0773	Digital Image Processing	ME,BT,IOT	7

List of Open Elective Subjects (VIII Semester)

S.No.	Subject Code	Name of open Elective Subjects	Subject offered to Program	Semester
1	AOE0861	Total Quality Management	All Programs	8
2	AOE0862	Food Nutition for Healthy Living	All Programs except BT	8
3	AOE0863	Augmented Reality and Virtual Reality	ALL the Programs Except CSE & Allied	8
4	AOE0864	Introduction to Block Chain	EC,ME,BT	8
5	AOE0865	Customer Relationship Management	ALL Programs	8
6	AOE0866	Sustainable Technologies	ALL the Programs except ME, BT	8
7	AOE0867	Industry 4.0	All Programs except ME	8
8	AOE0868	Internet of Things	ME,BT	8
9	AOE0870	Finance for Engineers	All Programs	8

B.TECH FOURTH YEAR			
Course Code	**AOE0761**	**L T P**	**Credit**
Course Title	**Project Management**	**3 0 0**	**3**
Course Objectives: Objectives of this course are to:		**Duration: 40 Hours**	

1	Understand the basics of project management and its role in facilitating economic growth and prosperity in the country.	
2	Gain insights into markets and understand the feasibility of projects.	
3	Understand and analyse the economic viability of projects.	
4	Enable the students to plan and schedule project tasks.	
5	Equip students to be able to monitor and control projects.	

Course Contents / Syllabus

UNIT-I	**Introduction to Project Management**	**8 Hours**

Projects, Project Management, Objectives and Importance of Project Management, Tools and Techniques for Project Management, Project Team, Roles and Responsibilities of Project Manager, Determinants of project success; phases of project life cycle, classification of projects; generation of project ideas; preliminary screening.

UNIT-II	**Project Identification and Selection**	**8 Hours**

Generation of ideas, Pre-feasibility Report, Stages of Project Feasibility Analysis, Market, Technical, Financial, Social Analysis, Project Implementation Stages Comparative Rating of Product ideas, Approaches to Project Screening and Selection, Project Rating Index. Pre-feasibility Report, Comparative Rating of Product ideas, Project Risk Management: Concepts and Types of Project Risks, Risk Identification, Risks Analysis, Risks Mitigation Strategies.

UNIT-III	**Financial Analysis**	**8 Hours**

Fundamental components of Project Cost, Types of Costs: Direct, Indirect, Recurring, Non-Recurring, Fixed, Variable, Normal, Expedite costs Methods of budgeting – Project cost estimation – Improving cost estimates – Budget uncertainty and risk management – Scheduling the project – Gantt chart – Resource allocation and loading – Social Cost Benefit Analysis (SCBA) of Project: Concept & significance of SCBA, Approaches to SCBA.

UNIT-IV	**Project Scheduling and Network Analysis**	**8 Hours**

Steps in Project Scheduling and Network design, Gantt Chart, Work Breakdown Structure (WBS) & Responsibility Assignment Matrix. Project Network Design: Identifying the Nodes and Activities, Activity on Arrow (AoA) and Activities on Node (AoN) methods, Introduction to PERT and CPM, Crashing in Projects.

UNIT-V	**Project Control**	**8 Hours**

Monitoring the project – Control cycle – Project control – Designing the control system – Evaluation of project: Milestone Analysis and Tracking Gantt chart. Earned Value Analysis (EVA): Planned Value (PV), Earned Value (EV), Cost Variance (CV), Schedule Variance (SV), Cost performance Index (CPI), Schedule performance Index (SPI) – Project auditing – Project termination.

Course outcome: At the end of course, the student will be able to:

CO1	Understand the concept and role of project management.	Understanding (K2)

CO 2	Able to conduct the feasibility of the project.	Applying (K3)
CO 3	Understand, calculate, and evaluate project costs.	Evaluate (K5)
CO 4	Enable the students to understand and apply project scheduling techniques.	Applying (K3)
CO 5	Understanding and applying the project control techniques.	Applying (K3)

Text books

1. Larsen, E.W., Gray C.F., & Joshi, R. (2021). *Project management: The Managerial process*. McGraw Hill.
2. Chandra, P. (2019). *Projects: Planning, Analysis, Selection, Financing, Implementation and Review*. McGraw Hill.

Reference Books

1. Nagarajan, K. (2017). *Project Management.* New Age International Pvt. Ltd.
2. Paneerselvam, R., & Senthilkumar, P. (2013). *Project Management.* Prentice Hall India Learning Pvt. Ltd.
3. Pinto, J.K. (2020). *Project Management.* Global EduTech.
4. Desai, V. (2016). *Project Management.* Himalaya Publishing House.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	H	L				
CO2	**L**	H		M	L	**M**
CO3		M	L	M	H	**M**
CO4				M		H
CO5	L	M	M	H	H	**H**

B.TECH FOURTH YEAR			
Subject Code	**AOE0763**	**L - T - P**	**Credits**
Subject Name	**Object Oriented Programming**	**3 – 0- 0**	**3**

Course objective: The objective of this course is to understand the object-oriented methodology and its techniques to design and develop conceptual models and demonstrate the standard concepts of object-oriented techniques modularity.

Pre-requisites: Basic Knowledge of any programming language like C/C++/Python.

Course Contents/Syllabus

Unit 1	**Introduction to Modelling** **Modelling Concepts**: Importance of modelling, principles of modelling, object-oriented modelling, Introduction to UML, Introduction to Class Diagram and Object Diagram **Object Oriented Programming:** Introduction and Features - Abstraction, Encapsulation, Polymorphism, and Inheritance	**8 HOURS**
Unit 2	**Dynamic Modelling** **Basic Behavioural Modelling**: Use cases, Use case Diagrams, Activity Diagrams, State Machine, Process and thread **Structural Modelling:** Translating classes into data structures, passing arguments to methods, Implementing inheritance	**8 HOURS**
Unit 3	**Programming Style** **Object- Oriented Programming Style:** reusability, extensibility, robustness, programming in the large concept, Procedural v/s OOP, Object-oriented language features, Abstraction and Encapsulation	**8 HOURS**
Unit 4	**Java Basics:** Overview, Program structure, identifiers, variables, constants & operators **Control Statements:** Decision Making, Looping and Branching, method argument, Command Line Argument **Class and Object:** Object Reference, Constructor, Abstract Class, Interface and its uses, Defining Methods, Use of "This" and "Super" keyword, Garbage Collection and finalize () Method	**8 HOURS**
Unit 5	**Features of Java** **Inheritance:** Introduction and Types of Inheritance in Java, Constructors in Inheritance. **Polymorphism:** Introduction and Types, Overloading and Overriding. **Exception Handling:** Exceptions vs. Errors, Handling of Exception & Throw keyword, Try, Catch and Finally Block, Multiple Catch Block	**8 HOURS**

Course Outcomes –

CO1	Identify the key concepts of object-oriented programming that are essential for modelling and the relationships that exist among these concepts.	K2
CO2	Understand, analyse and apply the role of dynamic modelling concepts.	K4

CO3	Understand, analyse and apply OOPs concepts (i.e. abstraction, encapsulation).	K4
CO4	Understand the basic concepts of Java to implement the object-oriented concepts	K3
CO5	To understand the object-oriented approach to implement real world problems.	K3

Text Books:

1. Rumbaugh James et. al, "Object Oriented Modeling and Design", Pearson Education, 1st edition ,1990
2. Booch Grady, Rumbaugh James, Jacobson Ivar, "The Unified Modeling Language User Guide", Pearson Education, 2nd edition, 2005
3. Herbert Schildt, "Java: A Beginner's Guide", McGraw-Hill Education 2nd edition, 2003

Reference Books:

1. Horstmann Cay S., "Core Java Volume I – Fundamentals", Prentice Hall ,12th edition, 2007
2. Bloch Joshua," Effective Java", Addison Wesley , 3rd edition, 2017
3. Balagurusamy E., "Programming with Java A Primer", TMH, 4th edition, 2010

Links: NPTEL/You Tube/Web Link

Unit 1	https://www.youtube.com/watch?v=r59xYe3Vyks&list=PLS1QulWo1RIbfTjQvTdj8Y6yyq4R7g-Al ,2014
Unit 2	https://www.youtube.com/watch?v=ZHLdVRXIuC8&list=PLS1QulWo1RIbfTjQvTdj8Y6yyq4R7g-Al&index=18, 2014
Unit 3	https://www.youtube.com/watch?v=hBh_CC5y8-s ,2019
Unit 4	https://www.youtube.com/watch?v=qQVqfvs3p48 ,2017
Unit 5	https://www.youtube.com/watch?v=2qWPpgALJyw , 2019

B. TECH FOURTH YEAR

Course code	AOE0764	L T P	Credits
Course title	CLOUD COMPUTING	2 0 0	2

Course objective: To provide comprehensive knowledge of Cloud Computing concepts, technologies, and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations.

Pre-requisites: Adequate knowledge of Basics of Computers along with an online course "Google Cloud Computing Foundation Course", IIT Kharagpur, NPTEL.

Course Contents / Syllabus

UNIT-I	CLOUD COMPUTING AND ITS INFRASTRUCTURE	8 Hours

Introduction to Cloud Computing, Definition of Cloud, Evolution of Cloud Computing, Underlying Principles of Parallel and Distributed Computing, Cloud Characteristics, Scalability & Elasticity in Cloud, On-demand Provisioning, Multitenancy, Cloud economics.

UNIT-II	CLOUD VIRTUALIZATION BASICS	8 Hours

Basics and need of Virtualization, Types of Virtualizations, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory – I/O Devices, VMM and its types, Virtual Machines, Virtualization tools, Virtualization Support and Disaster Recovery, Resource Provisioning and Resource Provisioning Methods.

UNIT-III	SERVICE MODELS AND REFERENCE ARCHITECTURES	8 Hours

Service Oriented Architecture, Systems of Systems, Web Services, REST, Publish Subscribe Model, Deployment Model- Public, Private and Hybrid Clouds, IaaS, PaaS, SaaS, Layered Cloud Architecture Design, Challenges and NIST Cloud Computing Reference Architecture, Benefits of CCRA, Architecture Overview – The conceptual Reference Model, Cloud Consumer, Cloud provider, Cloud Auditor, Cloud carrier, Scope of control between Provider and Consumer, IBM's Cloud Computing Reference Architecture (CCRA 2.0).

UNIT-IV	RESOURCE MANAGEMENT	8 Hours

Managed and Unmanaged resources in cloud, **Instance Management**- EC2, Azure Virtual Machine, Google Compute Engine. **Storage Services**: Block Storage, Elastic File Storage, Object Storage- S3, RDS, DynamoDB, Backup, disaster recovery and storage migration. **Network Services**: VPC, Subnets, Routing, Security Groups, DNS, Direct Connect, VPC Endpoints,

UNIT-V	CLOUD SECURITY, MONITORING AND AUDITING	8 Hours

Challenges and Objectives; Cloud data life cycle; Common Attacks in Cloud; Security Standard: Confidentiality, Integrity, and Availability (CIA), Authentication and Authorization, Access controls: Role based access controls, multi-factor authentication; Security policy management, IAM; Security Governance and Open Security Architecture; Monitoring and Auditing.

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

CO 1	Understand the fundamentals of cloud computing and computing techniques.	K2
CO 2	Understand the concepts of virtualization and its role in cloud service delivery.	K2
CO 3	Discuss various services and architecture of cloud	K4
CO4	Understand and analyze the management of various cloud resources like instances, storage and network.	K2
CO 5	Analyze the importance of cloud security solutions with monitoring and auditing.	K4

Textbooks:

1. Ritting house, John W., And James F. Ransome, ―Cloud Computing: Implementation, Management And Security, CRC Press, 2017.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed And Cloud Computing, From Parallel Processing To The Internet Of Things", Morgan Kaufmann Publishers, 2013.
3. Raj kumar Buyya, Christian Vecchiola, S. Thamaraiselvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

Reference Books:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure In The Cloud: Transactional Systems For EC2 And Beyond (Theory In Practice), O'Reilly, 2009.

Links: Prerequisite: **https://nptel.ac.in/courses/106105223**

1) https://docs.aws.amazon.com/EC2
2) https://docs.aws.amazon.com/vpc
3) https://docs.aws.amazon.com/vpcEndpoint
4) https://docs.aws.amazon.com/S3
5) https://docs.aws.amazon.com/Security

B.TECH FOURTH YEAR					
Course Code	**AOE0765**	**L**	**T**	**P**	**Credit**
Course Title	**Human Psychology and Organizational Behavior**	**3**	**0**	**0**	**3**
Course objective:		**Duration: 40 Hours**			
1	To understand the various dimensions of Human psychology.				
2	To familiarize students with the concept of Organizational Behavior.				
3	To enable students to describe how people behave under different conditions and understand why people behave as they do.				
4	To introduce students to the concepts of Team and Organization change.				

Prerequisites: Student must have basic understanding of General Management.

Course Contents / Syllabus

UNIT- I	**Introduction to Organizational Behavior**	**Hours- 8**

Introduction to OB , Definition, Nature and Scope – Environmental and organizational context – Impact of globalization, Diversity, Ethics, culture. Importance of OB in understanding Human Behavior. Cognitive Processes, I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization , Social perception – Attribution Theories ,Locus of control –Attribution Errors.

UNIT-II	**Dimensions of Human Behavior and Psychology**	**Hours-8**

Cognitive Processes, II: Personality and Attitudes, Personality as a continuum - Meaning of personality , Johari Window and Transactional Analysis , Nature and Dimension of Attitudes -Job satisfaction and organizational commitment, Motivational needs and processes, Theories of Motivation

UNIT- III	**Conflict and Stress Management**	**Hours-8**

Stress and Conflict: Meaning and types of stress, Stress Management, Meaning and types of conflict, Effect of stress and intra individual conflict, Conflict management.

UNIT-IV	**Group Dynamics**	**Hours-8**

Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place. Power and Politics: Meaning and types of power – empowerment

UNIT-V	**Leadership and Organizational Change.**	**Hours-8**

High performance work practices, Behavioral performance management: reinforcement and punishment as principles of Learning –Process of Behavioral modification, Leadership theories, Styles, Activities and skills of Great leaders. Organizational change , meaning, factors in Organizational change, process of planned Change, Resistance to change.

Course outcome: At the end of course, the student will be able to

CO 1	Understand the concept of Organization Behavior and human psychology in terms of the key factors that influence organizational behavior.	Knowledge (K2), Remembering (K1)

CO 2	Analyze and evaluate the behavior for enhancing individual and group performance.	Comprehending (K 3)
CO 3	Demonstrate the applicability of analyzing the complexities associated with management of individual behavior in the organization.	Knowledge (K2), Applying (K4)
CO 4	Analyze the complexities associated with management of the group behavior in the organization.	Knowledge (K2), Analyzing (K5)
CO 5	Create the conducive work environment encompassing the theories of leadership and change management.	Applying (K4)

Text books

1. Robbins Stephen P& Judge Timothy A. ―Organizational Behavior (2019, 9th edition, Pearson)
2. Newstrom J. W., & Davis, K. (2011) Human behavior at work (12th ed.). Tata McGraw Hill

Reference Books

1. Robbins &Coulter : Management (Pearson, 19th Edition, 2019)
2. Luthans Fred: Organizational Behavior, (McGraw Hill International Edition, 12th Edition, 2013)
3. Prasad L. M. : Principles and Practices of Management, (Sultan Chand& Sons, 9th edition,2016)
4. Pareek. U. (2010). Understanding Organizational Behavior (2nd ed.). Oxford University Press

B.TECH FOURTH YEAR			
Course code	**AOE0766**	**L T P**	**Credits**
Course Title	**Sensor Technology**	**3 0 0**	**3**

Course Objectives: Student will learn about

1	The concept of sensors and it's characteristics.
2	Various sensor materials and technology used in designing sensors.
3	Commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
4	The use of basic electronics circuits and intelligent sensors for industrial automation.
5	The fundamentals of mechanical terms like pressure, position, force, strain and sensor application in different areas.

Pre-requisites: Basic Electronics and Electrical Engineering

Course Contents / Syllabus

UNIT-I	**Sensors Fundamentals**	**8 hours**

Sensors & Transducers: Definition, Classification & selection of sensors, Sensor Characteristics, Measurement of displacement using Potentiometer, Measurement of position using Hall effect sensors

UNIT-II	**Sensor Materials and Technologies**	**8 hours**

Materials: Passive Materials, Active Materials, Silicon, Polysilicon, semiconductors, Plastics, and Ceramics, Sensor Fabrication, Sensor Technologies: Surface Processing, Nano-Technology, IoT sensors. Pollution sensors, RFID sensors, image sensors, biometric sensors, MEMS and NEMS sensors.

UNIT-III	**Measurement of Physical parameters**	**8 hours**

Measurement of temperature using Thermistors, Thermocouple & RTD, Concept of thermal imaging, Proximity sensors: Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

UNIT-IV	**Interface Electronic Circuits & Intelligent Sensors**	**8 hours**

Input Characteristics of Interface Circuits, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission.

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

UNIT-V	**Sensor application in Different Areas**	**8 hours**

Velocity and Acceleration; Force, Strain, Pressure Sensors. Batteries for Low Power Sensors, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.		
Course outcome: After successful completion of this course, students will be able to		
CO1	Explain the concept of sensors and its characteristics.	**K_1**
CO2	Explain the different materials and technologies used in designing sensors.	**K1, K2**
CO3	Explain and apply sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.	**K2 , K3**
CO4	Apply the basic electronics circuits and intelligent sensors for industrial automation.	**K2**, K3
CO5	Explain the basic fundamentals of mechanical terms like position, strain, and apply sensor for measurement of parameters in different areas.	**K2, K3**
Text books:		
1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013		
2. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.		
3. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).		
Reference Books:		
1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.		
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi		
3. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).		
NPTEL/ YouTube /Learning Source:		
https://youtu.be/1uPTyjxZzyo		
https://youtu.be/q8UuRkOQ9A0		
www.nptel.ac.in		

B.TECH FOURTH YEAR			
Subject Code	**AOE0768**	**L - T - P**	**Credits**
Subject Name-	**Web Technology**	**3 – 0- 0**	**3**
Course objective: This course covers different aspects of web technology such as HTML, CSS, JavaScript, while imparting fundamental knowledge of the Internet, web technology, and web programming. By the end of the course, students will possess the skills to construct both static and dynamic websites proficiently.			
Pre- requisites: Basic Knowledge of any programming language like C/C++/Python/Java. Familiarity with basic concepts of Internet.			
Course Contents/Syllabus			
Unit 1	**Introduction to Web Technology** History of Web and Internet, connecting to the Internet, Introduction to Internet services and tools, Client-Server Computing, Protocols Governing Web, Basic principles involved in developing a Web site, Types of Websites, Web Standards and W3C recommendations		**8 HOURS**
Unit 2	**HTML** **Introduction to HTML:** What is HTML, HTML Documents, Basic structure of an HTML document, creating an HTML document, Mark up Tags, Heading-Paragraphs and Line Breaks **Elements of HTML:** HTML Tags, Working with Text, Lists, Tables and Frames, Hyperlinks, Images, Forms and controls		**8 HOURS**
Unit 3	**CSS** **Concept of CSS:** Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements, objects, Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties)		**8 HOURS**
Unit 4	**JavaScript** Introduction to Client-Side Scripting, Introduction to JavaScript, JavaScript Types, Variables in JS, Operators in JS, Conditional Statements, JavaScript Loops, JS Popup Boxes, JS Events, JS Objects and JS Functions		**8 HOURS**

Unit 5	**Web Hosting** Web Hosting Basics, Types of Hosting Packages, registering domains, Defining Name Servers, Using Control Panel, Creating Emails in cPanel, Using FTP Client and Maintaining a website	**8 HOURS**

Course Outcomes –

CO1	Identify the essential elements and provide an explanation of the fundamental principles behind Web technology and the Internet.	K2
CO2	Applying various HTML5 elements and applications with working on HTML forms for user input.	K3
CO3	Understanding and applying the concepts of CSS	K3
CO4	Analysing and implementing the concept of Java Script and its applications for client-side validation.	K4
CO5	Understand and Analyse the web hosting concepts	K4

Text Books:

1. C Xavier, "Web Technology and Design", New Age International, 1nd edition, 2003
2. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India, 3rd edition, 2011

Reference Books:

(1) Burdman Jessica, "Collaborative Web Development" Addison Wesley,1st edition,1999

(2) Xavier C, "Web Technology and Design", New Age International,1st edition, 2018

(3) Bayross Ivan," HTML, DHTML, Java Script, Perl & CGI", BPB Publication, revised 2nd edition, 2004

Links: NPTEL/YouTube/Web Link

Unit 1	https://youtu.be/96xF9phMsWA , 2021 https://youtu.be/Zopo5C79m2k , 2018 https://youtu.be/ZliIs7jHi1s , 2021 https://youtu.be/htbY9-yggB0, 2017
Unit 2	https://youtu.be/vHmUVQKXlVo , 2020 https://youtu.be/qz0aGYrrlhU, 2021 https://youtu.be/BsDoLVMnmZs , 2021 https://youtu.be/a8W952NBZUE , 2021
Unit 3	https://youtu.be/1Rs2ND1ryYc, 2020 https://youtu.be/vpAJ0s5S2t0 , 2020 https://youtu.be/GBOK1-nvdU4 , 2021 https://youtu.be/Eu7G0jV0ImY , 2021
Unit 4	https://youtu.be/-qfEOE4vtxE , 2022 https://youtu.be/PkZNo7MFNFg, 2019 https://youtu.be/W6NZfCO5SIk, 2019 https://youtu.be/DqaTKBU9TZk , 2021

Unit 5	https://youtu.be/_GMEqhUyyFM , 2021 https://youtu.be/ImtZ5yENzgE , 2019 https://youtu.be/xIApzP4mWyA , 2022 https://youtu.be/qKR5V9rdht0 , 2021

B.TECH FOURTH YEAR			
Subject Code	**AOE0769**	**L - T - P**	**Credits**
Subject Name	**Database Management System**	**3 – 0 - 0**	**3**
Course Objective: The aim of this course is to provide an introductory understanding of database management systems, focusing on the efficient and effective organization, maintenance, and retrieval of information within relational databases.			
Pre- requisites: The student should have basic knowledge of discrete mathematics and data structures.			
Course Contents/Syllabus			
Unit 1	**Introduction** **Basic Concepts:** Data, Information, Database, DBMS, History of Database, Database system Vs File system **Data model:** Hierarchical, Network, Relational, OODBMS, ORDBMS and Non-Relational Schema and instances, data independence and interfaces, structures of Database **Data Modelling using the Entity Relationship Model:** ER model concepts, Degree of relationship, notations for ER diagram, mapping constraints, reduction of ER diagrams to tables **Installation of Oracle 12c/ SQL Server/ PostgreSQL**		**8 HOURS**
Unit 2	**Relational Data Model and Basics of SQL** **Keys:** Super Key, Candidate Key, Primary Key, Alternate Key, Foreign Key and Unique Key **Relational data model Concepts:** Relation, Attribute, Domain, and Tuple **Integrity Constraints:** Entity integrity, Referential integrity, Key constraints, Domain constraints **Introduction to SQL:** Basics of SQL**,** characteristics of SQL, advantages of SQL, SQL data types and literals, Types of SQL commands **Data Definition Language Commands**: Create, Alter, Rename, Truncate and Drop Data **Manipulation Language Commands:** Insert, Delete, Select and Update **Data Control Language Commands:** Grant and Revoke **Transaction Control Language Commands:** Commit, Rollback, Set Transaction and Save Point		**8 HOURS**
Unit 3	**Data Constraints & Clauses** **Data Constraint:** I/O & Business Constraint **Implementation of I/O & Business Constraints:** Primary Key, Composite Key, Foreign Key, Null, Not Null, Default and check Constraint **Aggregate Function:** Min (), Max (), Count (), Avg () and Sum (), Scalar Function **Clauses:** Where, Group by, Having and Order by **Binary Operators & Nested Query** **Set Theory Operator:** Union, Intersect, Minus **Binary Operator:** Cartesian Product, Join, Inner Join - Natural Join, Equi Join &		**8 HOURS**

	Non Equi Join, Outer Join - Left Outer Join, Right Outer Join and Full Outer Join, Division Operator **Nested Query or Sub Query:** IN, NOT IN, Exists, Not Exists, All and Any **Operator & Predicates:** In, And, Or, Like, Between, Aliases	
Unit 4	**Normalization** Functional Dependencies (FD), Closure of an attribute set and FD sets, Canonical Cover of FD Sets, Normalization, Normal Form (NF), Normal Forms based on Functional Dependencies (1 NF, 2 NF, 3 NF, BCNF), Multivalued Dependencies (MVDs) and 4NF, Join Dependencies (JDs) and 5NF, Loss-Less Join Decompositions, Dependency Preservation	**8 HOURS**
Unit 5	**Transaction Processing and Recovery Concept** **Transaction Concepts:** Transaction system, Life cycle of the transaction, ACID Properties, Schedule & types of Schedules, Conflict & View serializable schedule, Recoverability & its types, Log-based recovery, checkpoints, deadlock handling. **Concurrency Control Techniques:** Concurrency Control, Locking Techniques for concurrency control	**8 HOURS**

Course Outcomes –

CO1	Analyze the utilization of a database in resolving complex real-world problems and design the Entity-Relationship (ER) diagram for it.	K4
CO2	Analyse and apply Structured Query Language (SQL) to solve complex queries.	K4
CO3	Understand & implement various data constraints, Operators and nested queries.	K3
CO4	Understand and apply database normalization.	K3
CO5	Understand and implement transaction processes on the database.	K3

Textbooks:

1.Korth, Silbertz, Sudarshan," Database System Concepts",McGraw – Hill, 7th edition 2019

2.Elmasri, Navathe, "Fundamentals of Database Systems", Addison Wesley, 7th edition, 2015

3. Ivan Bayross "SQL, PL/SQL The programming language Oracle",BPB Publication, 4th edition, 2010

Reference Books:

1. Cannolly Thomas and Begg Carolyn, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson Education, 3rd edition, 2007.

2. Ramakrishan Raghu and Gehrke Johannes "Database Management Systems", McGraw-Hill, 2nd edition, 2002

NPTEL/ YouTube/ Faculty Video Link

Unit-1	NPTEL Video Course : NOC:Data Base Management System , 2019 https://www.youtube.com/watch?v=OWX4RvijwLw, 2018
Unit-2	https://www.youtube.com/watch?v=_UZLrD_R0T4, 2022 https://www.youtube.com/watch?v=kr4iTckAVUs ,2021
Unit-3	https://www.youtube.com/watch?v=xxBEPiUWGCg ,2022 https://www.youtube.com/watch?v=bLL5NbBEg2I , 2019
Unit-4	https://www.youtube.com/watch?v=X-1viE7QFtQ , 2022 https://www.youtube.com/watch?v=5ammL5KU4mo , 2008
Unit-5	https://www.youtube.com/watch?v=2yQ9TGFpDuM, 2017 https://www.youtube.com/watch?v=fbYExfeFsI0 , 2021

B.TECH FOURTH YEAR					
Course Code	**AOE0770**	**L**	**T**	**P**	**Credit**
Course Title	**Finance for Engineers**	**3**	**0**	**0**	**3**
Course objective:		**Duration: 40 Hours**			
1	Familiarize students with basic financial accounting concepts & process				
2	Develop analytical skills for financial analysis				
3	Develop capacity to apprise projects and their financing along with solving various issued related to inventory and cash				
4	Understand and construct personal saving and investment portfolios				

Prerequisites: Computational and logical skills

Course Contents / Syllabus

UNIT-I	**Basics of Accounting**	**Hours- 9**

Basics of Accounting: Principles of Accounting , Concept of debit & credit, Books of accounts, Journal, Ledgers, Basic Accounting terminologies, Overview to Deprecation (straight line and diminishing method)

UNIT-II	**Financial Statements Analysis**	**Hours-9**

Financial Statements: Income statement & Position statement: Preparation and analysis Key financial ratios, their interpretation, comparison of ratio with competition to identify improvement areas

UNIT-III	**Project Finance**	**Hours-8**

Appraisal of projects: Techniques, Finance for Startups- Govt Schemes / PSU & PSE Bank Finance, Bank Scrutiny for approvals etc., Project Budgeting, Capex, Opex and Importance of tracking cost of projects in execution,

UNIT-IV	**Working Capital Management**	**Hours-8**

Concepts of Working Capital and its types, Approaches to working capital, Inventory management: Nature, Objective, Techniques of inventory management, Cash Management: Objectives, preparation of Cash Flow Statement and its analysis.

UNIT-V	**Financial Products & Services**	**Hours-6**

Introduction to Personal Financial Portfolio Management, Key Options of Savings &Investment – Debt, Equity, etc. Brief Introduction to Mutual Funds and Stock Market

Course outcome: At the end of course, the student will be able to

CO 1	Understand and record financial transactions.	Knowledge (K2), Remembering (K1), Applying (K4)
CO 2	Analyze and take decision based on income, expenditure, assets & liabilities	Knowledge (K2), Applying (K4)
CO 3	Decide avenues for financing projects and	Knowledge (K2)
CO 4	Understand critical issues in cash and inventory management	Knowledge (K2), Analyzing (K5)
CO 5	Design and apprise their savings & Investment portfolio	Knowledge (K2), Analyzing (K5)

Text books

3. Pandey I M, Financial Management (Vikas Publishing, 11th Ed, 2020)
4. Maheshwari S N, Financial Accounting (Vikas Publishing, 6th Ed. 2019)

Reference Books
5. Van Horne JC, Wachowicz Jr, J M Fundamentals of Financial Management (FT Prentice Hall13th Ed) 6. Khan and Jain - Financial Management (Tata McGraw Hill, 7th Ed.) 7. N.L. Ahuja-Financial Accounting and Analysis-Taxmann Publication-2016 8. R.P.Rustagi-Working Capital Management- Taxmann Publication-2021

B.Tech III YEAR					
Course Code	**AOE0771**	**L**	**T**	**P**	**Credit**
Course Title	**Entrepreneurship Development and IPR**	**3**	**0**	**0**	**3**
Course objective:		**Duration: 40 Hours**			
1	Explore the dimensions of creativity, innovation, and entrepreneurship				
2	Understand the various sources of idea generation and screening				
3	Develop an understanding of intellectual property rights.				
4	Develop an understanding of an idea to a project and various funding sources.				
5	Understand the various requirements of sources of funds for project and financial statements				
Pre-requisites: N/A					
Course Contents / Syllabus					
UNIT-I	**Entrepreneurship**	**08 Hours**			
Entrepreneurship: need, scope, Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship, entrepreneur vs. intrapreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes.					
UNIT-II	**Entrepreneurial Idea and Innovation**	**08 Hours**			
Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness, New initiatives taken by government to promote entrepreneurship in India at larger scale.					
UNIT-III	**Intellectual Property Rights**	**08 Hours**			
Introduction to intellectual property right (IPR), intellectual property and its protection, Forms of Protection depending on product; Patent, copyright, trademark, design knowhow, trade secrets etc.					
UNIT-IV	**Project Management**	**08 Hours**			
Project management: meaning, scope & importance, role of PROJECT manager; project life-cycle, Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal. Introduction to the Project Management tool like P6 Primavera Enterprise Project Portfolio Management.					
UNIT-V	**Project Financing**	**08 Hours**			
Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation, preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance.					
Course outcome: At the end of course, the student will be able to					

CO 1	Develop understanding of basic concepts of entrepreneurship	Knowledge (K2), Remembering (K1) (This an example)
CO 2	Develop an entrepreneurial mindset through knowledge of creativity and innovation	Applying (K 3) Analyzing (K 4)
CO 3	Evaluating and understanding of intellectual property rights.	Analyzing (K4)
CO 4	Understanding of converting an idea to a project and various funding sources	Understanding (K2)
CO 5	Develop knowledge on project finance and financial statements	Applying (K4) Evaluating(K5)

Text books

1. Kumar, Arya; Entrepreneurship; Pearson Education.
2. Blundel, R. and Lockett, N.; Exploring Entrepreneurship Practices and Perspectives; Oxford Publications.
3. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
4. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.;PHI

Reference Books

1. Entrepreneurship 10th Ed (Indian Edition) 2016 by Robert Hisrich Michael Peters Dean Shepherd, McGraw Hill
2. Desai, Vasant; Dynamics of Entrepreneurial Development and Management; Himalaya Publishing.
3. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G

B.TECH FOURTH YEAR			
Course Code	**AOE0772**	**L T P**	**Credits**
Course Name	**Wireless Communication**	**3 0 0**	**3**
Course Objective: Student will learn about			
1	The fundamentals of mobile communication systems.		
2	The concept of cellular communication.		
3	Propagation Models and channel fading		
4	Contention free Multiple access technique (TDMA/FDMA/CDMA) and contention based (Pure ALOHA, Slotted ALOHA, CSMA).		
5	Various modern wireless technologies.		
Pre-requisites: Basic Knowledge of Digital Communication			
Course Contents / Syllabus			
UNIT-I	**Introduction of Wireless Communication**		**8 Hours**
History and evolution of mobile radio systems. General Model of Wireless Communication Link Types of mobile wireless services/systems-Cellular, WLL, Paging, Satellite Systems, Future trends in personal wireless systems.			
UNIT-II	**Cellular Concepts and System Design Fundamentals**		**8 Hours**
Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, frequency reuse, channel assignment, handoff strategies, Interference and system capacity.			
UNIT-III	**Mobile Radio Propagation Models**		**8 Hours**
Radio wave propagation issues in personal wireless systems, Propagation models, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel,			
UNIT- IV	**Equalization, Diversity Techniques & Multiple Access Techniques**		**8 Hours**
Equalization, Rake receiver concepts, Diversity Techniques, Linear predictive coders and channel coding. Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.			
UNIT-V	**Wireless Systems & Standards**		**8 Hours**

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA 2000, IMT 2000 and UMTS, Long Term Evolution (LTE), Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Introduction to 4G, 5G and concept of NGN.		
Course Outcomes: After completion of this course students will be able to		
CO 1	Explain with various generations of mobile communications.	K1, K2
CO 2	Explain concept of cellular communication.	K2
CO 3	Describe the basics of wireless communication.	K2
CO 4	Explain and differentiate contention free and contention based multiple access techniques.	K2,K4
CO 5	Explain Various modern wireless technologies.	K2
Text Books:		
1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.		
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.		
3. T L Singal ,"Wireless Communications ", McGraw Hill Publications.		
Reference Books:		
1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press.		
2. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.		
NPTEL/ YouTube/ Faculty Video Link:		
Unit 1	https://youtu.be/JCGMP37-2EA	
Unit 2	https://youtu.be/f2wlHL1Sok8	
	https://youtu.be/0PWILK-hqbQ	
Unit 3	https://youtu.be/SFcRtZ30rqs	
	https://youtu.be/BKf2mN9W6Nk	
	https://youtu.be/tePZhxRLsjE	
Unit 4	https://youtu.be/GLmF3YB0pQU	
	https://youtu.be/QHqZwBoTJRY	
Unit 5	https://youtu.be/t3FVP5wuG4g	
	https://youtu.be/ixY0Cau4mBM	

B.TECH FOURTH YEAR			
Course Code	**AOE0773**	**L T P**	**Credits**
Course Title	**Digital Image Processing**	**3 0 0**	**3**
Course Objective: Student will learn about			
1	Basics of digital image and various operations on it.		
2	Image enhancement techniques in different domains.		
3	The various noises in images and restoration methods.		
4	The skills to segment a digital image with different methods.		
5	The basics of color image processing and various image compression techniques.		
Pre-requisites: Basic fundamental of mathematics and signal processing			
Course Contents / Syllabus			**Hours**
UNIT-I	**Digital Image Fundamentals:**		**8**
Introduction to Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels, Applications of DIP.			
UNIT-II	**Image Enhancement:**		**8**
Spatial Domain: Basic Gray Level Transformations, Histogram based Processing, Enhancement using Arithmetic/Logic Operations, Spatial Filtering, Smoothing and Sharpening by Spatial Filtering.			
Frequency Domain: Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.			
UNIT-III	**Image Restoration:**		**8**
Image Degradation/Restoration process model, Noise Models, Restoration in the presence of noise only–spatial filtering, Periodic noise reduction by frequency domain filtering.			
UNIT-IV	**Image Segmentation:**		**8**
Point, Line and Edge Detection, Thresholding: Otsu Method, segmentation by region growing and by region			

Splitting and merging, region segmentation using clustering and Super pixels, segmentation: Morphological Watershed.		
UNIT-V	**Colour fundamentals and Image compression:**	**8**
Colour Fundamentals, Colour Models, Pseudocolour Image Processing. Fundamentals, Some Basic Compression Methods: Huffman Coding, Arithmetic Coding, LZW Coding, Run Length Coding.		
Course Outcomes: After completion of this course students will be able to		
CO 1	Apply knowledge of mathematics for image understanding and analysis.	K1
CO 2	Analyse of image enhancement techniques in different domains.	K3,K4
CO 3	Recognize various noises in images and apply restoration methods.	K3,K4
CO 4	Apply different segmentation techniques on image.	K3, K4
CO 5	Apply knowledge of mathematics for color image processing and apply different image compression techniques.	K2,K3
Text Books:		
1. Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010.", Prentice Hall of India.		
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.		
Reference Books:		
1. Milan Sonka, Vaclav Hlavav, Roger Boyle, —Image Processing, Analysis and MachineVision, 2nd ed., Thomson Learning, 2001.		
2. Rangaraj M. Rangayyan, —Biomedical Image Analysis‖, CRC Press, 2005		
3. Pratt W.K, —Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007		
4. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods.Publisher: Pearson Education		
NPTEL/ Youtube/ Faculty Video Link:		
Unit 1	https://youtu.be/T0bgf3V7u-E	
Unit 2	https://youtu.be/bJjgyTQ-BT4	
	https://youtu.be/M7JxDHUW5cc	
	https://youtu.be/JfrcMYBouJE	
Unit 3	https://youtu.be/MrNafUqh860	
	https://youtu.be/gLTlQPYY_pw	
Unit 4	https://youtu.be/j3_Ck5oP5oI	
	https://youtu.be/q1J0VAYFkHg	
Unit 5	https://youtu.be/kSzramCsHA4	
	https://youtu.be/nlwH07G9Efg	

B.TECH FOURTH YEAR			
Course Code	**AOE0861**	**L T P**	**Credit**
Course Title	**Total Quality Management**	**3 0 0**	**3**
Course Objective: The objective of this course is to:		**Duration: 40 Hours**	
1	Get familiarized with the basic concept and framework of Total Quality management.		
2	Understand the Implication of Quality on Business.		
3	Understand the tools and techniques used in TQM.		
4	Outline the evolution of the TQM philosophy.		
5	Understand the Continuous Process Improvement in TQM.		
Pre-requisites: NIL			
Course Contents / Syllabus			
UNIT-I	**Introduction to Quality Management**		**8 Hours**
Introduction – Need for quality –Definitions of quality –– Basic concepts of TQM – TQM Framework –Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention.			
UNIT-II	**TQM Thinkers and Thoughts**		**8 Hours**
Quality Councils – Employee involvement –Team and Teamwork- Recognition and Reward- PDCA cycle, 5S-Kaizen- TQM Gurus			
UNIT-III	**Tools and Techniques for Quality Management**		**8 Hours**
The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, DMAIC, applications to manufacturing, service sector including IT –Bench marking process			
UNIT-IV	**Statistical process and Quality control**		**8 Hours**
Introduction to Statistical process control -Quality function deployment (QFD) – Taguchi quality loss function – Total Productive Maintenance (TPM)			
UNIT-V	**Quality Systems and Certification**		**8 Hours**
Quality Systems- ISO 9000, ISO 9000:2000, ISO 14000, other quality systems. Quality Auditing			
Course outcome: At the end of course, the student will be able to:			
CO 1	Understand the concepts of Quality, TQM, and benefits of TQM.		Understand (K2)
CO 2	Understand the thoughts of various gurus of quality management.		Understand (K2)
CO 3	Understand the tools and techniques utilized for Quality improvement		Understand (K2)

CO 4	Apply quality control concepts to solve industrial problems.	Apply (K3)
CO 5	Understand various Quality Systems and Auditing on implementation of TQM	Understand (K2)

Text books

1. Besterfield, D.H., Besterfield, C., Besterfield, G.H., Besterfield, M., Hemant, U. and Rashmi, U., Total QualityManagement, ed.v, 2018, Pearson.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, South-Western (Thomson Learning), 2011

Reference Books

1. Evans J. R, and Lidsay W. M. – 'The Management and Control of Quality' – Southwestern (Thomson Learning) – 2002
2. Feigenbaum A. V. – 'Total Quality Management – Vol I &II ' – McGraw Hill ,1991
3. Ramasamy, S., Total Quality Management, , McGraw Hill Education,2017
4. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.

B.TECH FOURTH YEAR			
Subject Code	**AOE0863**	**L - T - P**	**Credits**
Subject Name	**Augmented Reality and Virtual Reality**	**3 – 0 - 0**	**3**
Course Objective: This course aims is to familiarize the students with Augmented reality and Virtual Reality and its applications. This course is designed in collaboration with the industry to ensure relevance to industry and market needs.			
Pre- requisites: No			
Course Contents/Syllabus			
Unit 1	**Introduction to Augmented Reality** Overview of Augmented Reality. Explore the Unity Editor and use its essential features. Navigate in 3D space in the Scene view. Create and manipulate Game Objects, create and manage Scenes. Create and manage projects in the Unity Hub. Build and share a project in Unity. Identify the key elements of the Unity Learn ecosystem and their purpose.		**8 HOURS**
Unit 2	**Augmented Reality Development Environment** Exploring Tools and Software for Augmented Reality development on Android, exploring the Applications of Augmented Reality in Different Industries. Understanding the Building Blocks of Augmented Reality.		**8 HOURS**
Unit 3	**Augmented Reality Components** Overview of Vuforia Features and Architecture. Installing and Configuring Vuforia. Vuforia Engine in Unity. About Vuforia Engine and Adding Vuforia Engine. Adding Vuforia Engine Features, Adding Digital Assets, Targets Playing the scene, Building and running app, configuring a project for Digital Eyewear, Integrating Vuforia with Unity.		**8 HOURS**

	Creating an Augmented Reality Android App with Vuforia.	
Unit 4	**Virtual Reality in a Nutshell** Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input and output, Applications of Virtual Reality.	**8 HOURS**
Unit 5	**Representation** of the Virtu**al Reality** Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic. High-Level Concepts of Content Creation in VR - Environmental Design, Affecting Behaviour and Transitioning to VR Content Creation.	**8 HOURS**

Course Outcomes –

CO1	Use the features of software for effective development of AR applications.	K3
CO2	Explore the applications and potential of AR in various industries.	K3
CO3	Design and develop interactive AR experiences.	K6
CO4	Evaluate the usability and user experience of VR applications.	K5
CO5	Generate innovative VR solutions by integrating various technologies and design principles.	K6

Text Books:

3. Maurya Rajesh K., "Computer Graphics with Virtual Reality System", John Wiley & Sons, 3rd edition, 2003
4. Schmalstieg Dieter, Höllerer Tobias, "Augmented Reality: Principles & Practice", Pearson Education India,2016
5. Lavalle M., "Virtual Reality, Steven", Cambridge University Press,2016
6. Sherman William R. and Craig Alan B., "Understanding Virtual Reality", Interface, Application and Design,(The Morgan Kaufmann Series in Computer Graphics)".Morgan Kaufmann Publishers, San Francisco,CA,2002

Reference Books:

1. Linowes Jonathan, Babilinsk Krystian, "Augmented Reality for Developers: Build practical augmented reality applications with Unity, AR Core, AR Kit, and Vuforia", Packt Publishing Limited, 1st edition, 2017.
2. Craig Alan B., Sherman William R. and Will Jeffrey D., "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.

3. Bimber Oliver and Raskar Ramesh, "Spatial Augmented Reality: Merging Real and Virtual Worlds", SpatialAR.com, online edition, 2005.

B. TECH OPEN ELECTIVE

Course code	AOE0864	L T P	Credits
Course title	INTRODUCTION TO BLOCKCHAIN	2 0 0	2

Course objective: To provide the technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the crypto currencies. The basic tenet of this platform is that it allows to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability.

Pre-requisites: Operating System, Data structures.

Course Contents / Syllabus

UNIT-I	Distributed System and Cryptocurrency	8 Hours

Introduction, Examples of distributed Systems, Characterization of Distributed Systems:, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, history and basics of the crptocurrency.

UNIT-II	Cryptography	8 Hours

Introduction to cloud computing and basics of parallel and distributed computing. Classical Cryptosystem, Private key Cryptography, Public key Cryptography, Symmetric and Asymmetric keys, RSA, Diffe-Hellman, Message Authentication and Cryptographic Hash Functions, Properties of Hash Function, SHA-256, Digital Signatures.

UNIT-III	Block Chain Ecosystem	8 Hours

Block chain, Issues and Needs of Block chain, Benefits and Challenges of Block chain, Public Ledgers, Block chain as public ledgers, Block chain Architecture and Design, Categories of Block chain, Block chain 2.0, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, The Chain and the Longest Chain, Tokenized Block chain and token less Block chain, Crypto currency to Block chain 2.0, Permissioned Model of Block chain, Hash pointer and Merkle tree.

UNIT-IV	Essentials of the Blockchain	8 Hours

Payments and double spending, Bitcoin P2P Network, Consensus in a Bitcoin network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay, Proof of Work (POW), Proof of Stake (POS), Mining Difficulty, Mining Pool.

UNIT-V	Permissioned Blockchain and Smart Contracts	8 Hours
Consensus models for permissioned blockchain, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant, Practical Byzantine Fault Tolerance, Objectives and principles for the design of Blockchain systems, Understanding Ethereum, Ethereum Basics, Smart Contracts, Ethereum Smart Contracts, DAO(decentralized autonomous organization).Case studies of the Blockchain - Smart Health Care, Transportation, Smart City, Financial Service, and Supply Chain Management.		
Course outcome: After completion of this course students will be able to:		
CO 1	Describe the basic understanding of the distributed system.	K2
CO 2	To analyze various Private and Public key Cryptosystem for encryption, key exchange, and hashing	K4
CO 3	Describe the basic understanding of Blockchain architecture along with its primitive.	K2
CO 4	Understand the structure of a blockchain and why/when it is better than a simple distributed database	K2
CO 5	Describe the role of smart contract in the Blockchain, what are its legal implications and what it can and cannot do, now and in the near future	K2
CO 6	Understand the concept of smart contract and case studies of the applications of the block chain.	K2
CO 7	Attain awareness of the new challenges that exist in monetizing businesses around blockchains and smart contracts	K2

B.TECH FOURTH YEAR			
Course Code	**AOE0865**	**L T P**	**Credit**
Course Title	**Customer Relationship Management**	**3 0 0**	**3**
Course objective:		**Duration: 40 Hours**	
1	Understand the need for maintaining relations with the customers		
2	Familiarize students with the concept of Customer Relationship marketing.		
3	Acquaint the students with the terminology of Customer Relationship Marketing.		
4	Introduce students to the various technologies and emerging trends in CRM		
Prerequisites: Student must have basic understanding of General Management.			
Course Contents / Syllabus			
UNIT-I	**Introduction to Customer Relationship Management**	**Hours- 8**	
Introduction: Definition of CRM, Emergence of CRM, Models of CRM, Importance of CRM, CRM cycle, CRM in modern context. Understanding relationships: Definition of customers and relationships, need for relationships, need to build relationships with customers, Evolution of relationship as a marketing tool, Customer satisfaction, value and loyalty. Relationship management theories			
UNIT-II	**Managing Customer Acquisition and Customer Loyalty**	**Hours-8**	
Managing Customer Acquisition: customer lifetime value, New customer, prospecting, Customer acquisition programmes, tools for customer acquisition. Managing customer lifecycle: Customer retention, strategies for customer retention, Customer Satisfaction: Concept, Models, rationale Customer loyalty: Concept and significance, Customer loyalty ladder, categories and factors affecting customer loyalty			
UNIT-III	**Strategic and Operational CRM**	**Hours-8**	
Customer value: Concept, sources of customer value, delivering customer value, Strategic CRM: Customer Portfolio Management, CPM models, strategies, tools, Operational CRM: Concept, Salesforce automation, SFA and performance, introduction to SFA softwares, Service Quality, types, Service quality gaps, Service quality and satisfaction, service quality and loyalty, Service quality Measurement scales			
UNIT-IV	**CRM Analytics**	**Hours-8**	

Analytical CRM: Concept, Analytics for CRM strategy and use of Big data, CRM technology: Database management, Data warehousing, data mining, customer care management through IT tools. E CRM: Feature, advantages, technologies, applications,

UNIT-V	**Emerging dimensions of CRM**	**Hours-8**

Emerging dimensions of CRM: Customer experience concepts, managing customer experience

Social CRM, Artificial intelligence and CRM, Cloud CRM and handling Big Data, Emerging CRM technologies (XaaS, PaaS, IaaS), Mobile CRM, Real time CRM tools (e.g. Zoho CRM, Oracle Netsuit and EBS CRM etc.)

Challenges and opportunities of CRM.

Course outcome:	**At the end of course, the student will be able to**	
CO 1	Understand the concept of Customer Relationship Marketing	Knowledge (K2), Remembering (K1)
CO 2	Analyze and evaluate means of acquiring and retaining customers	Comprehending (K 3)
CO 3	Demonstrate the applicability of CRM marketing initiatives, customer service and designing CRM strategy.	Knowledge (K2), Applying (K4)
CO 4	Analyze the new trends in CRM, challenges and opportunities for organizations.	Knowledge (K2), Analyzing (K5)
CO 5	Create a bridge between a customer and organization, also make the students ready to be employable in CRM jobs.	Applying (K4)

Text books

BUTTLE F. (2019) Customer Relationship Management: Concepts and Technologies. 4th Ed. USA: Elsevier Ltd

Reference Books

1. Peelen Ed, Beltman Rob, Customer Relationship Management 2nd Edition
2. Baran J. Roger, Galka.J.Robert, Customer Relationship Management: The Foundation of Contemporary Marketing Strategy 2nd Edition
3. Alok Kumar Rai, CRM CONCEPT & CASES, Prentice Hall of India Private Limited, New Delhi. 2011
4. S. Shanmugasundaram, CRM, Prentice Hall of India Private Limited, New Delhi, 2008
5. Kaushik Mukherjee, CRM, Prentice Hall of India Private Limited, New Delhi, 2008

B.TECH FOURTH YEAR

Course Code	AOE0866	L	T	P	Credit
Course Title	Sustainable Technologies	3	0	0	3

Course objective:

This course explores the main principles that guide modern science and technology towards sustainable solutions. It covers topics as resource management technologies, waste and wastewater treatment, renewable energy technologies, high performance buildings and transportation systems, application of informatics and feedback to sustainable systems, and more the real-life examples and taps into current practices of technology analysis.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	Basics of sustainability	8 hours

Principle of sustainable systems; sustainability definitions, growth and no growth dilemma, principles of sustainable design, principle of sustainable engineering, fundamental of system analysis, growth decay and tipping points.

Technology developments and lifecycle assessments; Technology as a part of anthropogenic environment. Technology readiness levels (TRL), Emerging, converging, disruptive technologies, Life Cycle Assessment

UNIT-II	Metrics for Technology Evaluation	8 hours

Metrics for Technology Evaluation; Purpose of metrics and how they are selected ,Environmental Metrics, Economic Metrics , Social Metrics, Sustainability Index, Metric Balance, Green Chemistry; Principles of Green Chemistry, Mitigating Environmental Risk, Frameworks for, assessment of alternatives, Case of Garment Cleaning Solvents, Green chemistry examples, Multifunctional Materials and Their Impact on Sustainability

UNIT-III	Waste management purpose and strategies	8 hours

Waste management purpose and strategies, recycling: open-loop versus closed-loop thinking, Recycling efficiency, Management of food waste and composting technologies, E-waste stream management, Solar PV Recycling, Reuse and redistribution programs, Circular Economy

UNIT-IV	Applied Renewable Energy Technologies	8 hours

Renewable Energy Basics, Building Integrated Solar Energy Technologies, Solar Thermal Electric Power Generation, Utility Scale Geothermal Energy Systems, Wind Energy Applications and Technologies, Bio-mass Fuelled Combined Heat and Power Systems, Environmental Impact of Renewable Energy.

UNIT-V	Base Load Energy Sustainability	8 hours

Base Load Energy Sustainability, Smart Grid and Demand Response Technologies, Examples of Demand Response Innovations, Can Renewables Meet Global Energy Demand?

Sustainable Transportation Technologies; Alternative Fuel Vehicle Technologies Zero Emission Vehicles, Sustainable Community and Mass Transit Technologies

Course outcome: After completion of course students will be able to

CO 1	Understand the principles of sustainable systems and demonstrate how the economic and technical performance of sustainable technologies can be measured and compared.	K_2
CO 2	Identify the technical and economic obstacles to the widespread use of sustainable technologies.	K_3
CO 3	Assess sustainable technologies to show the greatest long-term promise in terms of social, environmental, and economic metrics.	K_3
CO 4	Identify types of sustainable energy technologies that are closest to commercialization.	K_2

Text books :

1. Sustainable Technologies for the Building Construction Industry" by Alevtina Smirnova
2. Sustainable Technologies: Environmental Issues and Solutions" by T. A. Kuder and B. C. Pijanowski
3. Industrial Ecology and Sustainable Engineering" by T. E. Graedel and B. R. Allenby

Reference Books:

1. Sustainable Technology Development by Paul Weaver , Leo Jansen , Geert van Grootveld , Egbert van Spiegel , Philip Vergragt Routledge; 1st edition.
2. Sustainable Energy Technologies by Eduardo Rincon Mejia, Alejandro de las Heras, CRC press

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://onlinecourses.nptel.ac.in/noc21_me83
Unit 2	https://www.youtube.com/watch?v=YygGzfkhtJc
Unit 3	https://www.youtube.com/watch?v=cjIacnNRLHE&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv
Unit 4	https://www.youtube.com/watch?v=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk
Unit 5	https://www.youtube.com/watch?v=t1sNQHqt75M

B.TECH FOURTH SEMESTER

Course Code	AOE0867	L	T	P	Credit
Course Title	INDUSTRY 4.0	3	0	0	3

Course objective:

The student develop concept related to Automation, familiarize students with the concepts and techniques of robot manipulator, its drive systems and end effectors, introduce the students with Cloud Computing, Bigdata, Cyber Security, understand various types of systems and models in simulation and familiarize students with the concepts rapid prototyping.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	INTRODUCTION TO AUTOMATION	8 hours

Pneumatic system: production and distribution of compressed air, components of pneumatic system, Different types of valves, graphical symbols, graphical representation and design of pneumatic system, electro- pneumatics. Hydraulic system: Different types of valves such as flow, direction control valve, hydraulic pumps, Actuators and auxiliary elements in hydraulics, their applications and use of their graphical symbols, Synthesis and design of circuits (up to 2 cylinders), hydraulic system design, electro-hydraulics.

UNIT-II	FUNDAMENTALS OF ROBOT	8 hours

Robotics – Introduction – Basic structure(manipulator) – classification of robot and Robotic systems – laws of robotics – work space, precision movement. Drive systems Hydraulic, pneumatic and electric systems– servo motors – stepper motors – servo-control. Robot Kinematics: forward and inverse kinematics – trajectory planning: interpolation and approximation. End Effectors: Types of robot end effectors – grippers: mechanical, magnetic, vacuum grippers – Tools as end effectors – Robot applications.

UNIT-III	INTRODUCTION OF CLOUD, BIG DATA AND CYBER SECURITY	8 hours

Introduction to Cloud Computing: Introduction to Cloud Computing, Definition of Cloud, Characteristics of Cloud Computing, Cloud Computing Layered Architecture and Deployment Models, Cloud Computing Service Models

Introduction to Big Data: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Introduction to Security, Security Threats and Vulnerabilities Need of security, CIA Triad, Introduction to security attacks, services and mechanism. Overview of Security threats and Vulnerability: Types of attacks on Confidentiality, Integrity and Availability.

Vulnerability and Threats, Malware: Virus, Worms, Trojan horse. Security Counter Measures:Intrusion Detection and its categories, Antivirus Software.

UNIT-IV	SIMULATION	8 hours

Introduction: Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation.

General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

Models In Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process.

UNIT-V	Additive Manufacturing	8 hours

Elementary Introduction & Understanding of 3D Printing and necessary skill set to pursue in Technology. Design Requirements and Analysis and Career Aspects. A Model Printing on FFF Material i.e. PLA or ABS. Deep Understanding of Composite FDM 3D Printing Technology. Introduction to LDM Technology, Mechanism for Clay Extrusion, Operations & Precautions. Slurry Preparation & Material Prospects & Explanation of slicing software (Preform) for SLA technology. Detailed Explanation of Reverse Engineering, Methods of Reverse Engineering, Advantages and Applications.

Course outcome: After completion of course students will be able to

CO 1	Understand the concept of self-driven vehicles.	K_3
CO 2	Explain the basic concepts of hardware and software architectures.	K_3
CO 3	Know on the safety assurance for Autonomous vehicles.	K_3
CO 4	Understand and explain latest trends and technology in vehicle dynamic modeling	K_4
CO 5	Understand the concept related to vehicle longitudinal control.	K_3

Text books :

1. The Handbook of Research on Integrating Industry 4.0 in Business and Manufacturing

Reference Books:

1) M. Gordan, “Industry 4.0 - Perspectives and Applications”.
2) Routledge,” Additive Manufacturing in Industry 4.0“.

Link: NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://onlinecourses.nptel.ac.in/noc21_me83
Unit 2	https://www.youtube.com/watch?v=vSaGIzbw_kQ
Unit 3	https://www.youtube.com/watch?v=PEl3RWFKOFk
Unit 4	https://www.youtube.com/watch?v=zmbS_TmNDP4&list=PLSGws_74K01-4rcWuB5BEATHSsOrBd1ye
Unit 5	https://www.youtube.com/watch?v=t7yv4gSnNkE&list=PLwdnzlV3ogoWI8QEu4hsT-n_r8UbWbquy

B. TECH. FOURTH YEAR			
Course Code	**AOE0868**	**L T P**	**Credits**
Course Title	**Internet of Things**	**3 0 0**	**3**

Course Objective:

To study about introduction of IoT technology, Components, architecture, network communications and protocols. Course also aims at understanding various hardware and software involved in implementation of IoT, programming concepts using Arduino and Nodemcu to build applications for smart cities.

Pre-requisites: History of Internet, Basics of programming.

Course Contents / Syllabus

UNIT-I	Introduction of IoT and Design Principles	8 Hours

Vision, Definition, Characteristics of IoT, Components of the IoT, Conceptual Framework, Architectural Framework, Technology behind IoT, M2M Communication, IoT/M2M systems layers and design standardization, Difference between IoT and M2M, IoT Examples, Data enrichment and consolidation. Introduction to Integrated Developed Environments, Tools and Programming.

UNIT-II	Hardware Components	8 Hours

Sensors, different types of Sensors, Transducers, Actuators, Radio Frequency Identification (RFID) Technology. Overview of IOT supported Hardware Computational platforms such as Arduino, Node MCU and its architecture

UNIT-III	Programming Arduino and NodeMCU	8 Hours

Arduino platform boards anatomy, Arduino coding using emulator, using libraries, basic programming in Arduino IDE, programming the Arduino for IoT. Programming with Node MCU, Interfacing and programming the various sensors, actuators, IO's peripherals, communication technologies Bluetooth ESP8266 etc. with different platforms.

UNIT-IV	Network & Communication Aspects in IoT	8 Hours

Application Protocols: Layered Architecture of IoT Protocols, Communication Technologies, Low range protocols: BLE, ZigBee, Messaging protocols such as MQTT, CoAP, HTTP, FTP (or Secured FTP), Data dissemination

UNIT-V	IoT Applications	8 Hours
Smart metering, e-health, Smart city automation, Automotive applications, home automation, communicating data with H/W units, mobiles, tablets, Designing of smart streetlights in smart city. Ideation of Mini Project.		
Course outcome: After completion of this course students will be able to		
CO 1	Understand conceptual framework, architecture of IoT and M2M Communication.	K2
CO 2	Describe Sensors, actuators and microcontrollers used in IoT implementation.	K2
CO 3	Implement programs with the help of Arduino, Node MCU and sensors used in implementation of IoT enabled solutions.	K3
CO 4	Interface the hardware with communication technologies to share the data across network.	K3
CO 5	Analyze and Ideate applications like Smart metering system, Smart streetlights, home automation and smart city applications.	K4

Textbooks:

1. Michael Miller "The Internet of Things" by Pearson. 1st Edition March 2015
2. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1st Edition, May 2017.
3. Jeeva Jose, Internet of Things, Khanna Publicatiosn. 1st Edition Jan 2018

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols". 2nd Edition Dec 2011.

NPTEL/ YouTube/ Faculty Video Link:

Unit 1	https://www.youtube.com/channel/UC6ZY_csXZc7YZZm2W8HcQ6A/videos
Unit 2	https://www.youtube.com/channel/UC6ZY_csXZc7YZZm2W8HcQ6A/videos
Unit 3	https://www.youtube.com/channel/UC6ZY_csXZc7YZZm2W8HcQ6A/videos
Unit 4	https://www.youtube.com/channel/UC6ZY_csXZc7YZZm2W8HcQ6A/videos
Unit 5	https://www.youtube.com/channel/UC6ZY_csXZc7YZZm2W8HcQ6A/videos

B.TECH FOURTH YEAR					
Course Code	**AOE0870**	**L**	**T**	**P**	**Credit**
Course Title	**Finance for Engineers**	**3**	**0**	**0**	**3**
Course objective:		**Duration: 40 Hours**			
1	Familiarize students with basic financial accounting concepts & process				
2	Develop analytical skills for financial analysis				
3	Develop capacity to apprise projects and their financing along with solving various issued related to inventory and cash				
4	Understand and construct personal saving and investment portfolios				

Prerequisites: Computational and logical skills

Course Contents / Syllabus

UNIT-I	**Basics of Accounting**	**Hours- 9**

Basics of Accounting: Principles of Accounting , Concept of debit & credit, Books of accounts, Journal, Ledgers, Basic Accounting terminologies, Overview to Deprecation (straight line and diminishing method)

UNIT-II	**Financial Statements Analysis**	**Hours-9**

Financial Statements: Income statement & Position statement: Preparation and analysis Key financial ratios, their interpretation, comparison of ratio with competition to identify improvement areas

UNIT-III	**Project Finance**	**Hours-8**

Appraisal of projects: Techniques, Finance for Startups- Govt Schemes / PSU & PSE Bank Finance, Bank Scrutiny for approvals etc., Project Budgeting, Capex, Opex and Importance of tracking cost of projects in execution,

UNIT-IV	**Working Capital Management**	**Hours-8**

Concepts of Working Capital and its types, Approaches to working capital, Inventory management: Nature, Objective, Techniques of inventory management, Cash Management: Objectives, preparation of Cash Flow Statement and its analysis.

UNIT-V	**Financial Products & Services**	**Hours-6**

Introduction to Personal Financial Portfolio Management, Key Options of Savings &Investment – Debt, Equity, etc. Brief Introduction to Mutual Funds and Stock Market

Course outcome: At the end of course, the student will be able to

CO 1	Understand and record financial transactions.	Knowledge (K2), Remembering (K1), Applying (K4)
CO 2	Analyze and take decision based on income, expenditure, assets & liabilities	Knowledge (K2), Applying (K4)
CO 3	Decide avenues for financing projects and	Knowledge (K2)
CO 4	Understand critical issues in cash and inventory management	Knowledge (K2), Analyzing (K5)
CO 5	Design and apprise their savings & Investment portfolio	Knowledge (K2), Analyzing (K5)

Text books

5. Pandey I M, Financial Management (Vikas Publishing, 11th Ed, 2020)
6. Maheshwari S N, Financial Accounting (Vikas Publishing, 6th Ed. 2019)

Reference Books

9. Van Horne JC, Wachowicz Jr, J M Fundamentals of Financial Management (FT Prentice Hall13th Ed)
10. Khan and Jain - Financial Management (Tata McGraw Hill, 7th Ed.)
11. N.L. Ahuja-Financial Accounting and Analysis-Taxmann Publication-2016
12. R.P.Rustagi-Working Capital Management- Taxmann Publication-2021