SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)

UG Programmes CE, CSE, ECE, EEE, IT & ME are Accredited by NBA

CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

Estd:1980

LIST OF OPEN ELECTIVES
OFFERED BY VARIOUS DEPARTMENTS TO OTHER DEPARTMENTS
IN III YEAR II SEMESTER

Offered by	Course Code	Course Name	Offered to
ARTIFICIAL INTELLIGENCE & DATA SCIENCE	B20ADOE03	Data Analysis Using R	**CE, ECE, EEE & ME**
CIVIL ENGINEERING	B20CEOE03	Intelligent Transport System	**AIDS, CSBS, CSE, ECE, EEE, IT & ME**
	B20CEOE04	Building Services	
COMPUTER SCIENCE & BUSINESS SYSTEMS	B20CBOE03	Business strategy	**CE, ECE, EEE & ME**
COMPUTER SCIENCE & ENGINEERING	B20CSOE04	Data Base Management Systems	**CE, ECE, EEE & ME**
	B20CSOE05	Object Oriented Programming through C++	
	B20CSOE06	Problem Solving using Python	**Only for CE**
ELECTRONICS & COMMUNICATION ENGINEERING	B20ECOE03	Principles of Communications	**AIDS, CE, CSBS, CSE, EEE, IT & ME**
	B20ECOE04	IC Applications	
ELECTRICAL & ELECTRONICS ENGINEERING	B20EEOE03	Fundamentals of Electric Vehicles	**AIDS, CSBS, ECE, IT & ME**
	B20EEOE04	Renewable Energy Sources	**AIDS, CSBS, ECE & IT**
INFORMATION TECHNOLOGY	B20ITOE03	AI Tools & Techniques	**CE, ECE, EEE & ME**
	B20ITOE04	Fundamentals of Data Science	
MECHANICAL ENGINEERING	B20MEOE04	Introduction to Robotics	**AIDS, CE, CSBS, CSE, ECE, EEE & IT**
	B20MEOE05	Operations Management	
	B20MEOE06	Micro-Electro Mechanical Systems	
MATHEMATICS AND HUMANITIES	B20BSOE02	Computational Statistics with R	**AIDS, CE, CSBS, CSE, ECE, EEE, IT & ME**

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ADOE03	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

DATA ANALYSIS USING R

(Offered by AIDS)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1	To make students exercise the fundamentals of statistical analysis in R environment.
2	To analysis data for the purpose of exploration using Descriptive and Inferential Statistics.
3	To understand Probability and Sampling Distributions
4	To learn the creative application of Linear Regression in multivariate context for predictive purpose.

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Understand need of data analytics and the applications.	K2
2	Apply the basic R programming commands in R studio.	K3
3	Apply data generation and manipulation for different kinds of external data.	K3
4	Apply data visualization commands for plotting.	K3
5	Apply different statistical techniques for data analysis	K3

SYLLABUS

UNIT-I (8 Hrs)	**Introduction to Data Analysis** Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics.
UNIT-II (8 Hrs)	**R Programming Basics:** Overview of R programming**,** Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages.
UNIT-III (8 Hrs)	**Reading and getting data into R (External Data):** Using CSV files, XML files, Web Data, JSON files, Databases, Excel files **Using dplyr and tidyr packages**
UNIT-IV (8 Hrs)	**Data Visualization using R** **Working with R Charts and Graphs:** Histograms, Box plots, Bar Charts, Line Graphs, Scatter plots, Pie Charts

UNIT-V (8 Hrs)	**Statistics with R** Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression, Survival Analysis
Text Books:	
1.	Ken Black, 2013, Business Statistics, New Delhi, Wiley.
2	An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.
Reference Books:	
1	Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2	Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013
3	G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CEOE03	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

INTELLIGENT TRANSPORT SYSTEM

(Offered by CE)

(Offered to AIDS, CSBS, CSE, ECE, EEE, IT & ME)

Course Objectives:

1	To know the fundamentals of ITS
2	To study sensor technologies and Data requirements of ITS
3	To know ITS functional areas and user services
4	To study various kinds of ITS architechture
5	To study ITS applications in various fields of transportation engineering

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1	Outline the benefits of ITS from various types	K2
2	Determine various sensor applications and ITS data collection techniques	K3
3	Identify ITS user services and functional areas	K3
4	Classify various ITS models, evaluation methods and ITS planning.	K4
5	Develop suitable ITS technology and assess its effectiveness to solve transportation Problems.	K4

SYLLABUS

UNIT-I (8Hrs)	**Fundamentals of ITS:** Definition of ITS s, The historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS.
UNIT-II (8Hrs)	**Sensor technologies and Data requirements of ITS:** Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection.
UNIT-III (8Hrs)	**ITS functional areas** – Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). ITS User Needs and Services – Travel and Traffic management, Public Transportation

	Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.
UNIT-IV (8Hrs)	**ITS Architecture** – Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.
UNIT-V (8 Hrs)	**ITS applications:** Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Text Books:	
1	Fundamentals of intelligent transportation systems planning ByMashrur A. Chowdhury, Adel WadidSadek.
2	ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
Reference Books:	
1	Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
2	National ITS Architecture Documentation, US Department of Transportation, 2007.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CEOE04	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3Hrs.**

BUILDING SERVICES

(Offered by-CE)

(Offered to AIDS, CSBS, CSE, ECE, EEE, IT & ME)

Course Objectives:

1	Introduce the various electro-mechanical systems that are found in modern buildings
2	Explain the role of various Mechanical, Electrical, Plumbing, Firefighting systems in providing occupant comfort, safety and security in their working and living environment.
3	Emphasize the role of resource conservation in reducing the impact of built environment by integration of renewable energy, resource recycling and biophilic design.

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1	Identify the functional requirements of various types of buildings and rooms in buildings.	K2
2	Apply the significance of fire safety systems and their regular audit in buildings.	K3
3	Develop the Layout of plumbing and drainage systems for different types of buildings	K3
4	Summarise the various lighting, ventilation and acoustic design elements in buildings.	K2
5	Propose the resource conservation strategies for buildings such as rainwater harvesting and Solar Energy utilization.	K2

SYLLABUS

UNIT-I (8 Hrs)	**Introduction** Types of buildings, functional requirements – Role of building Service professionals. **Vertical Transportation** Lifts: Different types of lifts and its uses – Component parts of Lift – Lift Well, Travel, Pit, Hoist way, Machine, Buffer, Lift Car, landing, door, Call indicators, Design Provisions for basic size calculations of enclosure space. Escalators: Different types of escalators and their uses – Components, space calculation, safety measures Ramp: Necessity, gradient calculation, special features to aid movement of physically handicapped and elderly.
UNIT-II (8Hrs)	**Fire Safety** Fire protection requirements for multi-storeyed building. Causes of fire in buildings. Fire detection and fighting systems. Working principles of various fire protection systems. Safety

	requirements in various types of buildings – Fire resistant design and materials – Fire inspection – Provisions for evacuation.
UNITIII (8Hrs)	**Plumbing systems for water supply and sanitation** Types and function of plumbing fixtures, sizes, capacities, traps, interceptors. Storage of water, hot and cold-water supply systems. Drainage systems – One Pipe System, Two Pipe Systems, Vents and purpose of venting, wastewater reclamation.
UNIT-IV (8Hrs)	**Lighting - Ventilation and Acoustics** Natural and electrical lighting, Different lighting schemes, direct light, diffuse light, glare. Different control mechanisms for achieving comfortable light conditions. Lumen and Lux considerations in selecting luminaires. Natural Ventilation and Mechanical Ventilation. Concept of Thermal comfort, Cooling Degree Days, Air changes. Building Acoustics, Acoustic design of buildings and appropriate materials selections
UNIT-V (8Hrs)	**Natural Resource Conservation** Rainwater Harvesting. Components – Catchments, gutters, conduits, filters, storage, recharge or storage structures. Potential of RWH for various locations and building roof and landscape designs. – Domestic Hot Water from Solar Water heaters – Basics of heat transfer, passive and direct heating systems, sizing, cost benefit analysis of using solar water heaters

Textbooks:	
1	The A – Z of practical building construction and it Management, Mantri, Sandeep, Satya Prakashan, New Delhi
2	Plumbing Design and Practise, Deolalikar, S.G. McGraw hill, New Delhi
3	Principle of Fire Safety Engineering: Understanding Fire and Fire Protection, Akhil Kumar Das, PHI Learning Pvt. Ltd. New Delhi
4	Textbook Of Refrigeration And Air-Conditioning, R S Khurmi, S.Chand Publishers
Reference Books:	
1	National Building Code Part 1, 4, 8, 9 Bureau of Indian Standards
2	IS 12783 (Part 1) Code of Practise for plumbing in multistoried buildings, Bureau of Indian Standards
3	2008 Uniform Plumbing Code – India , Bureau of Indian Standards

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CBOE03	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

BUSINESS STRATEGY

(Offered by CSBS)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1.	To know the important aspects of strategic management in an organization.
2.	To provide basic insight into Internal Environment of a firm.
3.	To have a comprehensive view about the External Environment of a firm.
4.	To understand about the corporate strategy and growth strategies of business.
5.	To learn how to implement the strategy and to understand about Corporate governance.

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1.	To learn the fundamental concepts of strategic management to analyze business situations and apply these concepts to solve business problems.	K2
2.	To understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology	K2
3.	To understand the inter-relationships of business to individuals, other organizations, government and society.	K2
4.	To predict the mode of strategy that a business can choose for its development in the future.	K2
	To relate the present business with competitors globally and implementing the appropriate strategy.	K2

SYLLABUS

UNIT-I (10 Hrs)	**Introduction to Strategic Management** Importance of Strategic Management, Vision and objectives, Schools of management thought in strategic management, Strategy Content, Process, and Practice, Fit concept and Configuration perspective in Strategic Management.
UNIT-II (10 Hrs)	**Internal Environment of Firm- Recognizing a Firm's Intellectual Assets** Core Competence as the Root of Competitive Advantage, sources of Sustained Competitive Advantage, Business Processes and Capabilities-based Approach to Strategy.
UNIT-III (10 Hrs)	**External Environments of Firm- Competitive Strategy** Five Forces of Industry Attractiveness that Shape Strategy, The concept of Strategic Groups, and Industry Life Cycle Generic Strategies, Generic Strategies and the Value Chain.

UNIT-IV (10 Hrs)	**Corporate Strategy, and Growth Strategies** The motive for Diversification, Related and Unrelated Diversification, Business Portfolio Analysis, Expansion, Integration and Diversification, Strategic Alliances, Joint Ventures, and Mergers & Acquisitions.
UNIT-V (10 Hrs)	**Strategy Implementation: Structure and Systems** The 7S Framework, Strategies for competing in the globalized markets and internet economy, Organisational values and their impact on strategies, Strategic Control and Corporate Governance.
Text Books:	
1.	Robert M. Grant (2012). *Contemporary Strategic Management*, Blackwell, 7th Edition.
Reference Books:	
1.	M.E. Porter, *Competitive Strategy*, 1980.M.E. Porter,
2.	*Competitive Advantage*, 1985 Richard Rumelt (2011).

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE04	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

DATA BASE MANAGEMENT SYSTEMS

(Offered by CSE)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1.	To introduce about database management systems
2.	To give a good formal foundation on the relational model
3.	To introduce the concepts of basic SQL as a universal Database language
4.	To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design and normalization
5.	To provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques
6.	To explain Transaction management techniques

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1.	Describe fundamental concepts of relational database	K2
2.	Create, maintain and manipulate a relational database using SQL	K3
3.	Apply Conceptual and Logical database design	K3
4.	Apply normalization for database design	K3
5.	Illustrate Storage management and Transaction management techniques.	K2

SYLLABUS

UNIT-I (10 Hrs)	**Introduction**: Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, Centralized and Client Server architecture for the database.
UNIT-II (10 Hrs)	**Relational Model**: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance **BASIC SQL**: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).
UNIT-III (10 Hrs)	**Entity Relationship Model**: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, Generalization/specialization ,Aggregation.

	SQL: Creating tables with relationships, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, views(updatable and non-updatable), relational set operations.
UNIT-IV (10 Hrs)	**Schema Refinement (Normalization)**: Purpose of Normalization or schema refinement, concept of functional dependency, Closure of functional dependency and attribute closure, Normal forms based on functional dependency(1NF, 2NF and 3 NF), Boyce-Codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).
UNIT-V (10 Hrs)	**Transaction Concept**: Transaction State, Implementation of Atomicity and Durability, Schedules, Serializability, Recoverability, Implementation of Isolation levels, 2Pl and Time stamp ordering protocols, Failure Classification, Recovery and Atomicity, ARIES Recovery algorithm. **Indexing Techniques**: Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, B+ Trees: Searching, Insertion, Deletion

Text Books:	
1.	Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 7th Edition, McGraw-Hill Education, 2019.
2.	Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke, 3rd Edition., McGraw-Hill Education (India), 2014.
Reference Books:	
1.	Database Principles: Fundamentals of Design, Implementation, and Management by Steven Morris, Keeley Crockett, Carlos Coronel, Craig Blewett, Cengage, 2020.
2.	Fundamentals of Database Systems by Ramez Elmasri, Shamkant B. Navathe, 7th Edition, Pearson Education India, 2015.
3.	Introduction to Database Systems by C J Date, 8th Edition, Pearson Education, 2009.
e-Resources:	
1.	https://nptel.ac.in/courses/106/105/106105175/
2.	https://www.geeksforgeeks.org/introduction-to-nosql/

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE05	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

OBJECT ORIENTED PROGRAMMING THROUGH C++

(Offered by CSE)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1.	Understand the syntax and principles of Object Oriented Programming.
2.	Design and development of secure and extendable C++ applications.
3.	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism.
4.	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming.
5.	Demonstrate the use of various OOP's concepts with the help of programs.

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1.	Illustrate the process of Object Oriented Paradigm.	K2
2.	Apply the concepts of classes, member functions, constructors and their importance in developing real world applications.	K3
3.	Apply C++ features such as Inheritance, operator overloading to make programs reusable.	K3
4.	Understand Dynamic Memory Management techniques using pointers.	K2
5.	Apply the concept of Generic Programming and Exception handling to built an efficient and error free code.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction to C++**: Difference between C and C++, Evolution of C++, The Object Oriented Technology, Disadvantage of Conventional Programming, Key Concepts of Object Oriented Programming, Advantage of OOP, Object Oriented Language.
UNIT-II (10 Hrs)	**Classes and Objects**: Classes in C++, Declaring Objects, Access Specifiers and their Scope, Defining Member Function, Overloading Member Function, Nested class **Constructors and Destructor:** Constructors and Destructors, Introduction, Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments parameterized Constructor, Destructors, Anonymous Objects
UNIT-III (10 Hrs)	**Operator Overloading and Type Conversion & Inheritance**: The Keyword Operator, Overloading Unary Operator, Operator Return Type, Overloading Assignment Operator

	(=), Rules for Overloading Operators, Inheritance, Reusability, Types of Inheritance, Virtual Base Classes- Object as a Class Member, Abstract Classes, Advantages of Inheritance, Disadvantages of Inheritance.
UNIT-IV (10 Hrs)	**Pointers:** Pointer, Features of Pointers, Pointer Declaration, Pointer to Class, Pointer Object, The this Pointer, Pointer to Derived Classes and Base Class **Binding Polymorphisms and Virtual Functions**: Binding Polymorphisms and Virtual Functions, Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Virtual Destructor.
UNIT-V (10 Hrs)	**Generic Programming with Templates & Exception Handling**: Definition of class Templates, Normal Function Templates, Over Loading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked Lists with Templates, Exception Handling, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements, Specifying Exceptions.

Text Books:	
1.	A First Book of C++, 4th Edition, Gary Bronson, Cengage Learning.
2.	The Complete Reference, C++, 5th Edition, Herbert Schildt, McGraw-Hill Education.
Reference Books:	
1.	Object Oriented Programming C++, Joyce Farrell, Cengage Learning.
2.	C++ Programming: from problem analysis to program design, 6th Edition, DS Malik, Cengage Learning
3.	Programming in C++, Ashok N Kamthane, and Pearson.
4.	Object Oriented Programming using C++, 8th Edition, E.Balaguruswamy, PHI
e-Resources:	
1.	https://nptel.ac.in/courses/106/105/106105151/
2.	https://github.com/topics/object-oriented-programming

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE06	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

PROBLEM SOLVING USING PYTHON

(Offered by CSE)

(Offered to CE)

Pre-requisites: Nil

Course Objectives:

1.	To learn about Python syntax, semantics, and the runtime environment.
2.	To learn the use of lists, tuples, dictionaries and sets in Python programs.
3.	To learn the python package building and Python modules for reusability.
4.	To be familiarized in general coding techniques and object-oriented programming.
5.	To develop the skills of designing GUI and handling exceptions in python.

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1.	Understand the basic principles of python programming.	K2
2.	Apply the knowledge of python programming to perform operations on data structures.	K3
3.	Solve the coding tasks using functions and modular programming.	K3
4.	Use OOP principles and File concepts to solve different problems.	K3
5.	Handle different exceptions raised in python and apply GUI for providing interface to various problems.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction**: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output. **Data Types, and Expression**: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules. **Decision Structures and Boolean Logic**: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. **Repetition Structures**: Introduction, while loop, for loop, Input Validation Loops, Nested Loops.
UNIT-II (10 Hrs)	**Strings and Text Files**: Accessing Character and Substring in Strings, Strings and Number Systems, String Methods Text Files. **Data structures**: **Lists**- creating a list, accessing, slicing and other operations

	Tuples- creating a tuple, accessing and other operations **Dictionaries**- creating a dictionary, accessing keys and values and other operations Sets- creating a set, modifying, removing and other operations
UNIT-III (10 Hrs)	**Design with Function:** Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function. **Modules**: Modules, Standard Modules, Packages.
UNIT-IV (10 Hrs)	**File Operations**: Opening a file, closing a file, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations **Object Oriented Programming:** Concept of class, object and instances, Constructor, class attributes and destructors, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes
UNIT-V (10 Hrs)	**Errors and Exceptions**: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions **Graphical User Interfaces**: The Behaviour of Terminal Based Programs and GUI - Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Text Books:	
1.	Fundamentals of Python First Programs, Kenneth. A. Lambert, 2nd Edition, Cenagage learning,2018.
2.	Python Programming: A Modern Approach, Vamsi Kurama, Pearson,2018.
Reference Books:	
1.	Introduction to Python Programming, Gowrishankar.S, Veena A, first edition ,CRC Press,2018.
2.	Introduction to Programming Using Python, Y. Daniel Liang, Pearson,2013.
e-Resources:	
1.	https://www.tutorialspoint.com/python3/python_tutorial.pdf

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ECOE03	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

PRINCIPLES OF COMMUNICATIONS

(Offered by ECE)

(Offered to AIDS, CE, CSBS, CSE, EEE, IT & ME)

Course Objectives:

1.	Familiarize with the fundamental concepts of communication systems and various techniques of analog modulation and demodulation of signals.
2.	To provide a good understanding of the behaviour of analog communications in the presence of noise.
3.	To introduce the elementary concepts of digital communication systems and familiarize with basic techniques of generating and demodulating pulse modulated signals.
4.	To introduce the elementary concepts of digital representation of analog signals.

Course Outcomes: At the end of the course Students will be able to

S.No	Outcome	Knowledge Level
1	Differentiate various amplitude modulation and demodulation schemes and compare the performance of various amplitude modulation techniques in the presence of noise.	K4
2	Differentiate various frequency modulation and demodulation schemes and analyse the performance of frequency modulation technique in the presence of noise.	K4
3	Understand the basic concepts of sampling and differentiate various Pulse modulation and demodulation techniques.	K2
4	Understand the basic concepts of digital representation of analog signals.	K2
5	Understand the concepts of digital modulation techniques.	K2

SYLLABUS

UNIT-I (10 Hrs)	**AMPLITUDE MODULATION**: Introduction, Frequency Translation, Amplitude Modulation, Switching Modulator, Envelope Detector, Double Side Band-Suppressed Carrier Modulation, Ring Modulator, Coherent Detection, Costas Receiver, Quadrature Amplitude Modulation, SSB Modulation, VSB Modulation, Frequency-Division Multiplexing, Noise in DSB-SC Receivers, Noise in AM Receivers.
UNIT-II (8 Hrs)	**ANGLE MODULATION**: Basic Definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission Bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, Phase-Locked Loop FM demodulator. Noise in FM Receivers, FM Threshold Effect, Pre-Emphasis and De-Emphasis in FM.

UNIT-III (8 Hrs)	**PULSE MODULATION**: Introduction, Why digitize analog sources? The Low Pass Sampling Process, Pulse Amplitude Modulation. Time Division Multiplexing, Pulse width Modulation, Pulse-Position Modulation, Generation and Detection of PWM and PPM waves.
UNIT-IV (8 Hrs)	**DIGITAL REPRESENTATION OF ANALOG SIGNAL:** Quantization of signals, Quantization error, Pulse Code Modulation, Companding, T1 Digital system, Differential Pulse Code Modulation, Delta Modulation
UNIT-V (8 Hrs)	**DIGITAL MODULATION AND TRANSMISSION:** Binary Phase-Shift Keying, Differential Phase-Shift Keying, Differentially-Encoded PSK (DEPSK), Quadrature Phase-Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift-Keying

Text Books:	
1	**Principles of Communication Systems,** H.Taub & D.L.Schilling, TMH, 2011
2	**Communication Systems**, Simon Haykins & Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books:	
1.	Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University Press., 4th edition.
2.	An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3.	Communication Systems, Harold P.E, Stern Samy and A.Mahmond, Pearson Edition, 2004.
4.	Communication Systems: Analog and Digital, R.P.Singh and S.Sapre: TMH 2nd edition, 2007.

e-Resources:	
1.	https://nptel.ac.in/courses/117/105/117105143/
2.	https://nptel.ac.in/courses/117/101/117101051/
3.	https://www.tutorialspoint.com/analog_communication/index.htm
4.	https://www.tutorialspoint.com/digital_communication/index.htm

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ECOE03	OE	3	--	--	3	30	70	3 Hrs

IC APPLICATIONS

(Offered by ECE)

(Offered to AIDS, CSBS, CSE, EEE, IT & ME)

Course Objectives:

1.	To design linear and non-linear applications of operational amplifier
2.	To analyze the concepts of Active filters and waveform generators
3.	To design the basic applications using 555 IC Timer
4.	To analyze the concepts of Analog to digital and Digital to Analog converters
5.	To analyze the concepts of various Digital Logic Families

Course Outcomes: At the end of this course, the students will be able to

S.No	Outcome	Knowledge Level
1.	Design/analyze fundamental circuits based on op-amps	K4
2.	Design and analyze of various active filters, oscillators	K4
3.	Design and Analyze of various applications using IC 555 timer	K4
4.	Analyze the designing of Analog to digital and Digital to Analog converters	K4
5.	Analyze the various Digital IC Logic Families and to implement the logic function	K4

SYLLABUS

UNIT-I (12 Hrs)	**Applications of operational amplifiers**: Basics of Op-Amp, Block Diagram, Ideal characteristics, op-amp parameters, open loop, and closed loop op-amp configurations, Applications of op-amp- summing amplifier, subtractor, Basic Integrator, Basic differentiator, Op-amp As a Comparators, Schmitt trigger,
UNIT-II (9 Hrs)	**Active filters and oscillators**: Butterworth type LPF, HPF first and second order filters, Op-Amp Phase Shift oscillator, Wein-bridge oscillator, Quadrature Oscillator, Voltage to current and current to voltage converters.
UNIT-III (10 Hrs)	**555 Timer:** Introduction, Block diagram, 555 timer as an Astable and Monostable Multivibrator, Applications of 555 Timer as Monostable multivibrator- Frequency divider, Pulse stretcher, Pulse width modulation, Applications of 555 Timer as Astable Multivibrator- Square wave oscillator, FSK Generator, Schmitt trigger.
UNIT-IV (08 Hrs)	**D to A and A to D CONVERTERS:** Introduction, basic DAC techniques – weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters – parallel comparator type ADC, counter type ADC, successive approximation ADC.
UNIT-V (10 Hrs)	**Digital logic Families:** MOS logic, CMOS logic-analysis, **CMOS LOGIC:** CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of logic functions using PAL and PLA

Text Books:

1.	D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age

	International Pvt.Ltd., NewDelhi, India.
2.	Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
Reference Books:	
1.	Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
e-Resources:	
1.	Op-Amp Practical Applications: Design, Simulation and Implementation https://nptel.ac.in/courses/108/108/108108114/
2.	Introduction to Combinational Circuits: https://www.youtube.com/watch?v=yt1Fwrc8ysk

Code	Category	L	T	P	C	I.M	E.M	Exam
B20EEOE03	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs**

FUNDAMENTALS OF ELECTRIC VEHICLES

(Offered by EEE)

(Offered to AIDS, CSBS, ECE, IT & ME)

Course Objectives: Students will learn

1.	About the basic concepts of EVs and vehicle dynamic modeling.
2.	About various configurations of EVs, HEVs and power train components.
3.	About various Energy storage systems for EVs and understand their characteristics.
4.	About the drive systems of EVs and their control.
5.	The charging technology and infrastructure for EVs.

Course Outcomes: Students will be able to

Sl.no	Outcome	Knowledge Level
1.	**Explore** the significance of electric vehicles and vehicle dynamic modeling.	K3
2.	**Illustrate** the configurations of electric vehicles and powertrain components.	K3
3.	**Explore** different energy storage systems for EVs and battery parameters.	K3
4.	**Illustrate** the PMSM and BLDC motor drives used in EVs.	K3
5.	**Illustrate** the charging technologies and infrastructure for EVs.	K3

SYLLABUS

UNIT-I (10 Hrs)	**INTRODUCTION TO ELECTRIC VEHICLES AND MODELING** Introduction to Electric Vehicles (EV), EV History, EV Advantages, Comparisons of EV and Internal Combustion Engine vehicles, Vehicle Dynamics modeling with constant tractive effort, Overview of Basic electrical quantities and Systems: Electric Generator, Motor, Power Converters.
UNIT-II (10 Hrs)	**ARCHITECTURE OF EVs AND POWER TRAIN COMPONENTS** Architecture of EVs and HEVs – Plug-in Hybrid Electric Vehicles (PHEV), Fuel cell EV, Power train components of EVs - EV Transmission Configurations, Transmission Components, Ideal Gearbox: Steady State Model.
UNIT-III (10 Hrs)	**ENERGY STORAGE SYSTEMS FOR EV** Battery Basics, Different types, Battery Parameters, Importance of Lead Acid Batteries and Lithium Batteries (Li-ion, Li-Polymer), Battery Management system, Fuel cell, Super Capacitors, Fly Wheel.
UNIT-IV (10 Hrs)	**ELECTRIC VEHICLE MOTOR DRIVES** Electric Drive Components of EV, Permanent Magnetic Synchronous Motor (PMSM) Drive - Principle and Operation of PMSM, Block diagram representation and operation of PMSM

	Drive, Brushless DC (BLDC) Motor Drive - Principle and Operation of BLDC Motor, Block diagram representation and operation of BLDC Motor Drive.
UNIT-V (10 Hrs)	**EV CHARGING TECHNOLOGY** Overview of the EV battery charging system, Basic Requirements for Charging System, Infrastructure Needed for Charging Electric Vehicles, Charger Architectures, Charger Functions, EV Charging Standards, Schematics of V2G and V2V Technologies.
Text Books:	
1.	Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press, Taylor & Francis Group, 2011.
2.	John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles" Wiley Publication.
Reference Books:	
1.	James Larmine,John Lowry, "Electric Vehicle Technology Explained" Wiley publication, 2nd Edition
2.	Y. Gao, S. Gay and A. Emadi,Modern Electric, Hybrid Electric, and Fuel CellVehicles, CRC Press, 2005.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20EEOE04	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs**

RENEWABLE ENERGY SOURCES

(Offered by EEE)

(Offered to AIDS, CSBS, ECE & IT)

Course Objectives: Students will learn

1.	About the significance of Renewable energy and its current scenario.
2.	To understand the concepts of solar energy and its conversion systems.
3.	About the fundamentals of wind energy and conversion systems. .
4.	About the ocean thermal, wave and tidal energies.
5.	To understand the concepts of geo-thermal energy and fuel cells.

Course Outcomes: Students will be able to

S.No	Outcome	Knowledge Level
1.	**Explore** the importance of Renewable energy resources and world energy scenario.	K3
2.	**Apply** the principles of solar geometry for heat and electric power generation.	K3
3.	**Apply** the wind energy basics for wind turbine operation and power generation.	K3
4.	**Illustrate** the power generation schemes with Ocean thermal, Wave and Tidal Energy	K3
5.	**Illustrate** the power generation schemes with Geo-thermal and Fuel cells.	K3

SYLLABUS

UNIT-I (10 Hrs)	**INTRODUCTION TO NON-CONVENTIONAL ENERGY SOURCES** Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario.
UNIT-II (10 Hrs)	**SOLAR ENERGY** Introduction, solar constant, solar radiation at the earth's surface, solar geometry, solar radiation measurements, estimation of average solar radiation. Solar energy collectors - Physical principles of the conversion of solar radiation into heat, flat plate collectors, concentrating collectors - Parabolic trough and Paraboloid dish collector, Solar electric power generation - principles of solar photo-voltaic cells, conversion efficiency and power output.
UNIT-III (10 Hrs)	**WIND ENERGY** Introduction, basic principles of wind energy conversion-nature of wind, power in the wind, maximum power, forces on the blades, lift and drag forces, aerodynamics, types of wind

	power plants, types of wind turbine, generating systems, application of wind energy, site selection considerations.
UNIT-IV (10 Hrs)	**OCEAN ENERGY** Ocean Thermal Energy conversion - working principle, availability, types, advantages, limitations. Wave Energy - Factors affecting the wave energy, mathematical analysis for potential energy, kinetic energy, Total energy and wave energy conversion devices. Tidal Energy - Basic terminology, types of tidal plants, energy potential estimation from a tidal plant, advantages and limitations.
UNIT-V (10 Hrs)	**GEO-THERMAL ENERGY AND FUEL CELLS** Geo-Thermal Energy - Structure of earth's interior, thermal gradient, geo-thermal energy sources, types of geo-thermal power generation, merits & demerits. Fuel Cells - Principle and classification of Fuel cells, types and conversion efficiency.
Text Books:	
1.	G. D. Rai, "Non-Conventional Energy Sources", fifth edition, Khanna Publishers, 2015.
2.	D. P. Kothari, K. C. Singal and Rakesh Ranjan, "Renewable Energy sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Limited, 2013.
Reference Books:	
1.	S. P. Sukhatme, "Solar Energy", Third edition, Tata McGraw-Hill Education, 1996.
2.	G. N. Tiwari and M. K. Ghosal, "Renewable energy resources", First Edition, Narosa Publishing House, 2004.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ITOE03	**OE**	**3**	**-**	**-**	**3**	**30**	**70**	**3 Hrs.**

ARTIFICIAL INTELLIGENCE TOOLS & TECHINQUES

(Offered by IT)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1	To have a basic proficiency in a traditional AI language including an ability to write simple tointermediate programs and an ability to understand code written in that language
2	To understand the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as mini max, resolution that play an important role inAI programs
3	To have a basic understanding of some of the more advanced topics of AI

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

S.No	Outcome	Knowledge Level
1	Understand the basic applications of AI and problems that can be solved by AI	K3
2	Apply the problem solving strategies to generate best AI solutions usingstate space search	K3
3	Apply AI languages to represent knowledge base	K3
4	Apply AI tools to represent knowledge base	K3
5	Apply uncertainty techniques to solve AI real time problems	K3

SYLLABUS

UNIT-I (10 Hrs)	Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages.
UNIT-II (10 Hrs)	Problem solving: state-space search and control strategies: Introduction, general problem solving: water jug problem, Missionaries-cannibal's problem, Eight-puzzle problem Exhaustive searches: DFS, BFS Heuristic search techniques: Branch and bound, Hill climbing, Beam Search, Best First Search, A* Algorithm, constraint satisfaction Problem reduction and game playing: Introduction, problem reduction: AO* Algorithm, MINMAX procedure, alpha beta pruning, two-player perfect information games.
UNIT-III (10 Hrs)	Logic concepts: Introduction, propositional calculus, proportional logic, natural deductionsystem, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

UNIT-IV (8 Hrs)	Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure.
UNIT-V (12 Hrs)	Expert system and applications: Introduction phases and Architecture in building expert systems, expert system versus traditional systems Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-Shafer theory. Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions.

Text Books:

1.	Artificial Intelligence- Saroj Kaushik, CENGAGELearning.
2.	Artificial intelligence, A modern Approach , 2nded, Stuart Russel, Peter Norvig,PEA.

Reference Books:

1.	Artificial Intelligence- Deepak Khemani, TMH,2013.
2.	Introduction to Artificial Intelligence, Patterson, PHI.
3.	Artificial intelligence, structures and Strategies for Complex problem solving, George F Lugar, 5th ed,PEA.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ITOE04	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

FUNDAMENTALS OF DATA SCIENCE

(Offered by IT)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1	To impart knowledge on basics of data science, data manipulation and exploratory data analysis concepts that is vital for data science.
2	To develop skills for applying tools and techniques to analyze, visualize and interpret data.

Course Outcomes: By the end of the course, the student will be able to:

S.No	Outcome	Knowledge Level
1	Demonstrate knowledge on the concepts of data science to perform mathematical computations using efficient storage and data handling methods in NumPy.	K3
2	Apply Data Preparation and Exploration methods using Pandas to perform data manipulation.	K3
3	Apply Data Cleaning and preparation of data.	K3
4	Create data visualization using charts, plots and histograms to identify trends, patterns and outliers in data using Matplotlib and Seaborn	K3
5	Develop methods to analyze and interpret time series data to extract meaningful statistics.	K4

SYLLABUS

UNIT-I (10 Hrs)	**INTRODUCTION TO DATA SCIENCE** Basic terminologies of data science, Types of data, Five steps of data science, Arrays and vectorized computation using NumPy - The NumPy ndarray: A multidimensional array object, Universal functions: Fast element-wise Array functions, Array-oriented Programming with arrays, File input and output with arrays, Linear algebra, Pseudo random number generation.
UNIT-II (10 Hrs)	**DATA EXPLORATION WITH PANDAS** Process of exploring data, Pandas data structures – Series, Data frame, Index objects; Essential functionality, Summarizing and computing descriptive statistics – Correlation and covariance, Unique values, Value counts and membership; Data loading, Storage, and file formats - Reading and writing data in text format , Binary data formats
UNIT-III (10 Hrs)	**DATA CLEANING, PREPARATION AND DATA WRANGLING** Handling missing data, Data transformation, String manipulation - String object methods, Regular expressions, Vectorized string functions in Pandas; Data wrangling: join, Combine

	and reshape - Hierarchical indexing, Combining and merging datasets, Reshaping and pivoting.
UNIT-IV (10 Hrs)	**DATA VISUALIZATION WITH MATPLOTLIB** Plotting and visualization- A brief matplotlib API primer, Plotting with Pandas and Seaborn, Other python visualization tools; Data aggregation and Group operations Group By mechanics, Data aggregation, Apply: General split-apply-combine, Pivot tables and Cross-tabulation.
UNIT-V (8 Hrs)	**TIME SERIES ANALYSIS** Date and time data types and tools, Time series basics, Date ranges, Frequencies, and shifting Resampling and frequency Conversion – Downsampling, upsampling and Resampling with periods;.

Text Books:	
1.	Wes McKinney, Python for Data Analysis, O'Reilly, 2nd Edition, 2017
Reference Books:	
1.	Sinan Ozdemir, Principles of Data Science, Packt Publishers, 2nd Edition, 2018.
2.	Rachel Schutt, Cathy O'Neil,Doing Data Science: Straight Talk from the Frontline, O'Reilly, 2014.
ADDITIONAL LEARNING RESOURCES:	
1	https://swayam.gov.in/nd1_noc19_cs60/preview
2	https://towardsdatascience.com/
3	https://www.w3schools.com/datascience/
4	https://github.com/jakevdp/PythonDataScienceHandbook
5	https://www.kaggle.com

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE04	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

INTRODUCTION TO ROBOTICS

(Offered by ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	This course is designed to equip the students with basic understanding of working of robot
2.	This course helps the students to understand robot frame assignment and transformations
3.	Students will learn kinematics of robot
4.	Students can formulate joint trajectory planning for robot
5.	Students can learn developing dynamic model and control for robot

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

S.No	Outcome	Knowledge Level
1.	Understand basic components, terminology and applications of robot	K2
2.	Implement the Homogeneous transformation of robot	K3
3.	Solve the forward and inverse kinematics for robot manipulator	K3
4.	Implement proper joint trajectory for robot joint and analyze the dynamics robot manipulator using Lagrange method	K3
5.	Develop linear control for the robot	K3

SYLLABUS

UNIT-I (10 Hrs)	**Fundamentals of robotics:** Robot and robotics, classification of robotics, advantages and disadvantages, Robot-components, degrees of freedom, joints, coordinates, workspace, applications. **Sensors:** potentiometers, encoders. **Actuators:** Characteristics of actuation system and comparison of actuating systems
UNIT-II (10 Hrs)	**Robot position analysis:** Matrix transformations, Homogeneous transformations of matrix, Representations of transformations. **Forward and Inverse Kinematic Equations:** Orientation-RPY angles, Euler angles
UNIT-III (10 Hrs)	**Denavit-Hartenberg representation of forward kinematic equations of robots**: simple 2-DOF, Inverse kinematic of 2-DOF robot. **Differential Motions and Velocities:** Differential relationships, Jacobian, Differential motions of frame, Differential changes between frames.
UNIT-IV (10 Hrs)	**Trajectory planning:** Joint space versus Cartesian space, Joint space trajectory planning: Third-order polynomial trajectory planning, Linear segments with parabolic blends

	Dynamic analysis of robot: Introduction to Lagrangian method, dynamic equation of 2-DOF robot manipulator (RR and RP).
UNIT-V (10 Hrs)	**Control of manipulators:** Feedback and closed loop control, Second order linear systems, Control of second order systems, control-law partitioning, trajectory following control **Nonlinear control of manipulators:** Nonlinear and time varying systems, the nonlinear control problem for manipulators, Lyapunov stability analysis.

Text Books:	
1.	Introduction to Robotics: Analysis, Control, Applications by Saeed B Niku
2.	Introduction to Robotics: Mechanics and Control by J J Craig
3.	Industrial Robotics /Groover M P /Pearson Edu.
Reference Books:	
1.	Introduction to Robotics by SK Saha, The McGrah Hill Company
2.	Robotics / Fu K S/ McGraw Hill
e-Resources:	
1.	https://nptel.ac.in/courses/112105249
2.	https://nptel.ac.in/courses/107106090

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE05	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

OPERATIONS MANAGEMENT

(Offered by-ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	To develop an understanding of how the operations, have strategic importance and can provide a competitive advantage in the workplace.
2.	To understand the managing of operations in the planning phase of a production/operations system.
3.	To understand the managing of operations in the controlling phase of a production/operations system.

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

S.No	Outcome	Knowledge Level
1.	Identify the elements of operations management and apply the basic forecasting techniques to enhance the competitiveness	K3
2.	Analyze plant and process layout	K2
3.	Understand the role of aggregate capacity plans and MPS in operation environments	K2
4.	Apply the basic inventory control techniques in operation environment.	K3
5.	Apply resource requirement planning in operation environment.	K2

SYLLABUS

UNIT-I (10 Hrs)	**Operations Management (OM):** Introduction and Definition; Operations/Production System Model and examples of various production or operating systems; Factors affecting OM; Typical operations under OM. **Forecasting:** Importance of forecasting in OM and different types of forecasting; Methods of Forecasting: qualitative and quantitative (simple problems only).
UNIT-II (8 Hrs)	**Facility/Plant Location:** Introduction; Factors affecting the plant location; Rural v/s Urban sites. **Facility/Plant Layout:** Introduction, Objectives of plant layout; Determinants and Types of layouts; Comparison of layouts for Goods and Services.
UNIT-III (10 Hrs)	**Aggregate Planning and Master Scheduling:** Overview of Operations Planning and Scheduling system; The concept of aggregation, goals for aggregate planning and the costs associated with aggregate planning; Aggregate planning Guidelines; Aggregate planning strategies; Master Scheduling – Introduction, Functions, and guidelines; Assembly v/s

	Process industry scheduling; Difference between Master Scheduling and Shop Floor Scheduling.
UNIT-IV (10 Hrs)	**Fundamentals of Inventory Control:** Inventory defined; Why inventories? Manufacturing v/s Distribution Inventory; Multistage Inventory v/s Multiechelon Inventory; Inventory systems: Q/R Inventory system, Periodic Inventory system, and JIT Inventory system; Inventory costs; Problems on basic EOQ model; Selective inventory control techniques: ABC analysis, VED analysis.
UNIT-V (10 Hrs)	**Resource Requirement Planning:** MRP and CRP overview; objectives of MRP; Inputs to MRP system, Outputs to MRP system, and MRP logic; Limitations and Advantages of MRP; MRP-II; ERP; Introduction to JIT Manufacturing philosophy and its benefits.

Text Books:	
1.	Operations Management by Norman Gaither and Greg Frazier
2.	Production and Operations management by Everett E. Adam, Jr. And Ronald J. Ebert
3.	Operations Management by Joseph. G.Monks, International (3rd) Edition
4.	Modern Production/ operations management by Buffa & Rakesh Sarin
Reference Books:	
1.	Operations Management by S.N. Chary.
2.	Inventory Control Theory and Practice by Martin K. Starr and David W. Miller.
3.	Production And Operation Management by Martand Telsang
4.	Production Control A Quantitative Approach by John E. Biegel.
5.	Production Control by Moore.
e-Resources:	
1.	https://nptel.ac.in/courses/110107141
2.	https://onlinecourses.nptel.ac.in/noc20_me30/preview

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE06	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

MICRO-ELECTRO MECHANICAL SYSTEMS

(Offered by ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	To learn basics of Micro Electro Mechanical Systems (MEMS) and study the various materials used for micromachining techniques and to learn about various sensors and actuators used in MEMS
2.	To give exposure to different MEMS Thermal Sensors and Actuators.
3.	To learn the principle and various devices of MOEMS and Magnetic Sensors And Actuators devices.
4.	To impart knowledge of the basic concept of fluid actuation methods, dielectro phoresis (DEP), electro thermal flow, opto electro wetting (OEW), and thermal effects Micro fluidics and to learn Radio Frequency (RF) MEMS..

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

S.No	Outcome	Knowledge Level
1.	Gain thorough knowledge of materials used for micromachining techniques and Analyze the process of sensors and actuators.	K3
2.	Acquire the knowledge of Heat transfer processes, Thermal effects, Devices such as thermal flow sensors, thermo vessels.	K3
3.	Analyze and develop models for different types of Magnetic Sensors and magnetic sensing and detection. Develop MOEMS technology	K3
4.	Analyze the process Micro Fluidic System.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Introduction:** Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. **Mechanical Sensors and Actuators:** Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.
UNIT-II (10 Hrs)	**Thermal Sensors and Actuators:** Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical

	electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.
UNIT-III (10 Hrs)	**Micro-Opto-Electro Mechanical Systems:** Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.
UNIT-IV (10 Hrs)	**Magnetic Sensors and Actuators:** Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.
UNIT-V (10 Hrs)	**Micro Fluidic Systems:** Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. **Radio Frequency (RF) MEMS:** RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

Text Books:	
1.	MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.
Reference Books:	
1.	Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2.	MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3.	MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4.	Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.
e-Resources:	
1.	https://nptel.ac.in/courses/117105082
2.	https://nptel.ac.in/courses/108108113

Code	Category	L	T	P	C	I.M	E.M	Exam
B20BSOE02	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

COMPUTATIONAL STATISTICS with R

(Offered by EM&H)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE, IT & ME)

Course Objectives: Students are expected to

1	Have an idea on fundamentals of R.programming.
2	Learn R commands for computing probability distributions
3	Learn concept of MLE and use of Neymann-Pearson Lemma
4	Identify the parametric tests and its hypothesis using R
5	Know how to design and conduct experiments by ANOVA and also learn R commands for the same.
6	Learn how to test the hypothesis for non-parametric data.

Course Outcomes: At the end of the course students will be able to

S. No	Outcome	Knowledge Level
1	Identify data structures in R	K3
2	Execute R functions for probability distributions.	K3
3	Demonstrate how an MLE is obtained and use of N-P Lemma.	K3
4	Use R functions for parametric tests of hypothesis.	K3
5	Apply ANOVA techniques to the given data.	K3
6	Make use of testing of hypothesis and its applications to non-parametric data.	K3

SYLLABUS

UNIT-I (12 Hrs.)	**Introduction to R** Introduction to R software – Vectors – Matrices – Arrays – Lists – Data frames – Basic arithmetic operations in R – Importing and exporting files in R.
UNIT-II (10 Hrs.)	**R commands for computing probability distributions** R commands for computing probability distributions-Binomial, Poisson, Uniform, Hyper geometric, Normal, Exponential, Gamma and Weibull distributions.
UNIT-III (12 Hrs.)	**Parametric Estimation and Tests of Hypothesis using R:** Estimation, Maximum Likelihood estimation(MLE), ML estimation for Poisson, Normal and Exponential parameters, Neymann-Pearson Lemma. **Test of hypothesis:** Concept & formulation of hypothesis Type I and Type II errors, Neyman Pearson lemma (without proof), Procedures of testing of hypothesis. Tests of hypothesis for t, F and Chi-square and Normal distributions using R.

UNIT-IV (14 Hrs.)	**ANOVA and its applications using R:** Introduction, Analysis of Variance one-way classification, Analysis of Variance two-way classification. Calculation of ANOVA using R programme.
UNIT-V (12 Hrs.)	**Non-parametric Inference:** Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearmen and Kendall's test. R Programming for Nonparametric tests.

TEXT BOOKS:	
1.	G. Jay Kerns, Introduction to Probability and Statistics Using R, First Edition ISBN: 978-0-557-24979-4. (Free e-book from R software website)
2.	Fundamentals of Mathematical Statistics by S. C. Gupta and V.K. Kapoor, Sultan Chand & Sons Publishers.
3	Introduction to Time Series Analysis and Forecasting, Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, Wiley Publications, 2011A.
4	The Art of R Programming, Norman Matloff, No starch Press.
REFERENCE BOOKS:	
1.	Higher Engineering Mathematics, Dr. B. S. Grewal, 43rd Edition, Khanna Publishers.
2	Fundamentals of Statistics, S C Gupta, 7th Edition, Himalaya publishing house
3.	Probability and statistics for Engineers, Miller and Freund, 7th edition, Prentice-Hall India.
4.	Probability and statistics for Engineers and Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Eighth edition, Pearson Education.
5.	Higher engineering mathematics, B V Ramana, MC Graw Hill Education publications.
6.	R Cookbook, Paul Teetor, Oreilly.
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