CIVIL ENGINEERING

(For the batches admitted from the academic year 2022-23)

Vision

- To produce civil engineers with high technical competencies having value based professional and leadership qualities.

Mission

- To Impart quality education along with practice-based learning with ethical values.
- To impart knowledge in latest technologies and to develop highly competent professionals
- To promote quality education and research for industrial and societal needs

Institutional Objectives

- To create a conductive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development programmes, Entrepreneurship, and extension activities.
- To introduce demand driven new UG & PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Lifelong Learning:* In the fast changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.
- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff, and students from all social, economic, ethics, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.

- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

M.Tech – CE – HIGHWAY ENGINEERING
(For the batches admitted from the academic year 2022-23)

M.Tech I Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D010401	Highway Infrastructure Design	4	0	0	4	40	60	100
2	PC	21D010402	Urban Transportation Planning	4	0	0	4	40	60	100
3	PC	21D010403	Traffic Engineering	4	0	0	4	40	60	100
4	PC	21D010404	Pavement Materials And Properties	4	0	0	4	40	60	100
5	PE	21D010501 21D010502 21D010503	**Elective-I** a. Applied Statistics b. Project Management c. Bridge Engineering	4	0	0	4	40	60	100
6	PE	21D010504 21D010505 21D010506	**Elective-II** a. Remote Sensing & Global Positioning Systems b. Ground Improvement Methods c. Advanced Concrete Technology	4	0	0	4	40	60	100
7	PC	21D010405	Highway Engineering Lab	0	0	4	2	40	60	100
Total							**26**	**280**	**420**	**700**

M.Tech II Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D010406	Highway Project Formulation And Economics	4	0	0	4	40	60	100
2	PC	21D010407	Pavement construction, Maintenance & Management	4	0	0	4	40	60	100
3	PC	21D010408	Pavement Analysis And Design	4	0	0	4	40	60	100
4	PC	21D010409	Traffic Analysis	4	0	0	4	40	60	100
5	PE	21D010507 21D010508 21D010509	**Elective-III** a. Road Safety Engineering b. Land Use And Transportation Modeling c. Transportation System	4	0	0	4	40	60	100
6	PE	21D010510 21D010511 21D010512	**Elective-IV** a. Environmental Impact Assessment for Transportation Projects b. GIS Applications in Transportation Engineering c. Optimization Techniques	4	0	0	4	40	60	100
7	PC	21D010410	Traffic Engineering Lab	0	0	4	2	40	60	100
Total							**26**	**280**	**420**	**700**

M.Tech III Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	OE	21D110601 21D110602 21D110603	**Elective-V** a. Research Methodology b. Human Values & Professional Ethics c. Intellectual Property Rights	4	0	0	4	40	60	100
2	PE	21D010513	**Elective-VI (MOOCs)**	0	0	0	0	0	0	0
3	PC	21D010413	Comprehensive Viva Voce	0	0	0	2	100	0	100
4	PC	21D010414	Seminar	0	0	0	2	100	0	100
5	PC	21D010415	Teaching Assignment	0	0	0	2	100	0	100
6	PC	21D010416	Project Work Phase I	0	0	0	4	0	0	0
Total							**14**	**340**	**60**	**400**

M.Tech IV Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D010417	Project Work Phase II	0	0	0	12	0	0	0
Total							**12**	**0**	**0**	**0**

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

Course Code	HIGHWAY INFRASTRUCTURE DESIGN		L	T	P	C
21D010401			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Students will develop a good command of the concepts involved in `geometric design of intersections, horizontal & vertical alignment of roads & pedestrian facilities.
- Students can describe the urban street hierarchy and functional classification system.
- Identify and define the elements of a roadway cross-section. Discuss concepts related to the roadway design speed.
- They can discuss alignment and grade elements including sight distance; horizontal and vertical curves; terrain and acceptance grades for urban local and collector streets.
- They can define the functional area of an intersection. Identify key design elements for intersections.

UNIT-I (10 Hrs)

Highway Classification and Cross Section Elements : Functional Classification Of Highway System; Carriageway, Shoulders, Formation, Right Of Way; Kerbs, Foot Paths, Medians- Design Specifications.

Pavement Surface Characteristics – Skid Resistance, Factors Affecting Skid Resistance, Measurement Of Skid Resistance; Road Roughness, Measurement of Road Roughness; Camber, Objectives Of Camber, Design Standards.

UNIT - II (12 Hrs)

Sight Distances And Geometric Design:

Sight Distances: Stopping Sight Distance, Overtaking Sight Distance And Intermediate Sight Distance. Importance Of Sight Distances In Horizontal And Vertical Curves.

Horizontal And Vertical Alignment: Objectives Of Horizontal Curves; Super Elevation – Need For Super Elevation; Method Of Computing Super Elevation; Minimum Radius Of Curve; Methods Of Attainment Of Super Elevation; Extra Widening On Curves; Transition Curves – Objectives And Design. Gradients – Types Of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves And Design Criteria For Vertical Curves; Combination Of Vertical And Horizontal Curves – Grade Compensation.

UNIT-III (10 Hrs)

Intersection Design: Types Of Intersections; Design Principles For Intersections; Design Of At-Grade Intersections – Channelization, Objectives; Traffic Islands And Design Standards; Rotary Intersection – Concept And Design, Advantages And Disadvantages; Grade Separated Interchanges – Types, Warrants And Design Standards.

UNIT-IV (10 Hrs)

Traffic Signs And Road Markings : Types Of Road Signs; Guidelines For The Provision Of Road Signs; Cautionary Signs, Regulatory Signs, Information Signs – Design Standards;

Road Markings: Objectives Of Road Markings; Types Of Road Markings; Role Of Road Markings In Road Safety And Traffic Regulation; Specification For Road Markings. Highway Appurtenances – Delineators, Traffic Impact Attenuators, Safety Barriers.

UNIT-V (08 Hrs)

Miscellaneous Elements: Requirements Of Pedestrians; Pedestrian Facilities On Urban Roads; Cycle Tracks – Guidelines And Design Standards; Bus Bays – Types And Guide Lines; Design Of On-Street And Off Street Parking Facilities – Guidelines For Lay Out Of On-Street And Off Street Parking .

TEXT BOOKS:

1. "Principles and Practice of Highway Engineering", L. R. Kadiyali and N. B. Lal, Khanna Publications
2. "Traffic Engineering and Transportation Planning", L. R. Kadiyali, Khanna Publications

REFERENCE BOOKS:

1. "Highway Engineering", C. E. G. Justo and S. K. Khanna, Nem Chand and Brothers.
2. "IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas"

Course Code	URBAN TRANSPORTATION PLANNING		L	T	P	C
21D010402			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- The course introduces students to the fundamentals of Urban transportation planning.
- It familiarizes students with contemporary transportation planning issues and methods of analysis.
- The course presents relationships between transportation and urban land use systems and new tools to address environmental and quality of life impacts of transportation are presented

UNIT - I (12 Hrs)

Urban Transportation Planning And Travel Demand: Urban Issues, Travel Characteristics, Evolution Of Planning Process, Supply And Demand – Systems Approach. Overall Planning Process, Long Term Vs Short Term Planning.

Travel Demand Function, Independent Variables, Travel Attributes, Assumptions In Travel Demand Estimation, Sequential, And Simultaneous Approaches, Aggregate And Disaggregate Techniques.

UNIT - II(12 Hrs)

Data Collection And Inventories: Collection Of Data – Organisation Of Surveys And Analysis, Study Area-_Definition And Guidelines, Zoning Principles, Types And Sources Of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use Of Secondary Sources.

UNIT - III (10 Hrs)

Trip Generation And Distribution : Definition Of Trip –Trip Characteristics- Types Of Trips – Home Based And Non-Home Based Trips – Factors Affecting Trip Making Behaviour -Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction Models.

Trip Distribution: Growth Factor Methods- Uniform Growth Factor – Average Growth Factor – Fratar Method– Advantages And Disadvantages Of Growth Factors. Gravity Model – Formulation And Calibration.

UNIT - IV (8 Hrs)

Mode Choice And Traffic Assignment: Factors Affecting Mode Choice-Mode Choice Behaviour - Competing Modes, Mode Split Curves, Models And Probabilistic Approaches-Use Of Diversion Curves.

UNIT - V (8 Hrs)

Traffic Assignment: Basic Elements Of Transport Networks, Coding, Route Properties, Minimum Path, **Assignment Techniques:** All-Or-Nothing Assignment, Capacity Restraint Technique, Multiple Route Assignment. Basic Numerical Examples.

TEXT BOOKS:

1. "Introduction to Transportation Planning", C.J. Chisty.
2. "Transportation Engineering & Planning", C.S. Papacostas.
3. "Introduction to Transportation Planning", M. J. Bruton, Hutchinson of London Ltd.

REFERENCE BOOKS:

1. "Traffic Engineering and Transport Planning", L. R. Kadivali, Khanna Publishers
2. Lecture Notes On UTP - Prof. S. Raghavachari , R.E.C.Warangal
3. "Metropolitan transportation planning", John W. Dickey, Tata McGraw Hill, New Delhi, 1975

Course Code	TRAFFIC ENGINEERING		L	T	P	C
21D010403			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand traffic, its properties, measurement, simulation and control.
- To understand traffic flow variables and their measurement. Survey methods and data analysis techniques required by traffic engineers are presented.
- To compute highway capacity & level of service
- To understand Parking analysis, traffic safety, traffic signal control, regulation and signal design
- To Detrimental effects of traffic on environment, Air and Noise pollution are discussed.

UNIT-I (10 Hrs)

Traffic Characteristics Measurement And Analysis:

Basic Traffic Characteristics - Speed, Volume And Concentration. Relationship Between Flow, Speed And Concentration. Traffic Measurement And Analysis - Volume Studies - Objectives, Methods. Speed Studies – Objectives, Definition Of Spot Speed, Time Mean Speed And Space Mean Speed; Methods Of Conducting Speed Studies; Presentation Of Speed Study Data; Head Ways And Gaps; Critical Gap; Gap Acceptance Studies.

UNIT-II (10 Hrs)

Highway Capacity And Level Of Service: Basic Definitions Related To Capacity; Level Of Service Concept; Factors Affecting Capacity And Level Of Service; Computation Of Capacity And Level Of Service For Two Lane Highways, Multilane Highways And Freeways. Numerical Exercises.

UNIT-III(10 Hrs)

Parking Analysis: Types Of Parking Facilities – On-Street Parking And Off-Street Parking Facilities; Parking Studies And Analysis- Parking Inventory Study, Parking Usage Study By Patrolling, Questionnaire Survey, Cordon Surveys; Evaluation Of Parking Parameters; Parking Accumulation, Parking Load, Parking Turnover, Parking Index, Parking Volume. Numerical Exercises.

UNIT-IV (10 Hrs)

Traffic Safety :Accident Studies And Analysis; Causes Of Accidents - The Road, The Vehicle, The Road User And The Environment; Engineering, Enforcement And Education Measures For The Prevention Of Accidents. Accident Data Recording – Condition Diagram, Collision Diagram.

UNIT-V(10 Hrs)

Traffic Control, Regulation Signal Coordination: Traffic Signals –Types Of Signals; Principles Of Phasing; Timing Diagram; Design Of Isolated Traffic Signal By Webster Method, Warrants For Signalization. Optimum Cycle Time- Saturation Flow Rate – Corrections For Left And Right Turns – Numerical Exercises.

Signal Coordination: Signal Co-Ordination Methods, Simultaneous, Alternate, Simple Progression And Flexible Progression Systems.

TEXT BOOKS:

1. "Traffic Engineering and Transportation Planning", L.R. Kadiyali, Khanna Publishers.
2. "Principles of Highways Engineering and Traffic Analysis", Fred Mannering & Walter Kilareski, John Wiley & Sons Publication
3. "Traffic Engineering - Theory & Practice", Louis J. Pignataro, Prentice Hall Publication.

REFERENCE BOOKS:

1. "Transportation Engineering - An Introduction", C. Jotin Khisty, Prentice Hall Publication.
2. "Fundamentals of Transportation Engineering", C. S. Papacostas, Prentice Hall India.
3. I.T.E. Traffic Engineering Hand Book.

Course Code	PAVEMENT MATERIALS AND PROPERTIES		L	T	P	C
21D010404			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- The main objective of this course is to provide students with a thorough understanding of the basic Pavement materials and their desired Properties
- To familiarize the students with Bituminous Concrete Mixes
- To make student to understand Bitmen Modification and use of Cement Concrete Mixes in `Pavements
- Introduce the students to various Advanced Concrete Types

UNIT-I (12 Hrs)

Subgrade Soil: Requirements Of Subgrade Soil; Different Types Of Soils, Mechanical Properties Of Soil; Soil Classification; Index Properties Of Soil; Different Laboratory And In-Situ Procedures For Evaluating The Mechanical Properties Of Soils Viz. SPT, DCPT, CPT, CBR, Plate Load Test & Resilient Modulus; Suitability Of Different Types Of Soil For The Construction Of Highway Embankments And Pavement Layers; Field Compaction And Control. Dynamic Properties Of Soil;FWD Test.

UNIT-II (11 Hrs)

Aggregates: Origin, Classification, Types Of Aggregates; Sampling Of Aggregates; Mechanical And Shape Properties Of Aggregates, Tests on Aggregate, Aggregate Texture And Skid Resistance, Polishing Of Aggregates; Proportioning And Blending Of Aggregates: Super Pave Gradation, Fuller And Thompson's Equation ; Use Of Locally Available Materials In Lieu Of Aggregates.

UNIT–III (9 Hrs)

Bitumen And Bituminous Concrete Mixes : Bitumen Sources And Manufacturing, Chemistry Of Bitumen, Bitumen Structure, Rheology Of Bitumen, Elastic Modulus, Dynamic Modulus, Visco-Elastic And Fatigue Properties, Creep Test, Stiffness Modulus Of Bitumen Mixes Using Shell Nomographs; Resilient, Diametral Resilient And Complex (Dynamic) Moduli Of Bituminous Mixes, Permanent Deformation , Parameters And Other Properties.

Modified Bitumen: Crumb Rubber Modified Bitumen, Natural Rubber Modified Bitumen, Polymer Modified Bitumen; Introduction To Emulsified Bitumen And Its Characterization; Desirable Properties Of Bituminous Mixes, Design Of Bituminous Mixes: Modified Marshall's Specifications, Introduction To Super Pave Mix Design Procedure.

UNIT–IV (8 Hrs)

Cement And Cement Concrete Mixes : Types Of Cements And Basic Cement Properties, Special Cements; Quality Tests On Cement; Tests On Cement Concrete Including Compressive Strength, Flexural Strength, Modulus Of Elasticity And Fatigue Properties.

UNIT–V (10 Hrs)

Introduction To Advanced Concretes: Like Self Compacted Concrete, Light Weight Concrete, Roller Compacted Concrete For Pavement Application; IS Method Of Cement Concrete Mix Design With Case Studies; Role Of Different Admixtures In Cement Concrete Performance; Joint Fillers For Jointed Plain Cement Concrete Pavements .

TEXT BOOKS:

1. "Highway Materials, Soils and Concretes", Atkins, N. Harold, Fourth Edition, 2002, Prentice-Hall.
2. "Highway Materials – Kerbs", Robert D. and Richard D. Walker, McGraw-Hill, 1971.
3. "Principles of Transportation Engineering", Das, A. and Chakroborty, P., 1st Edition, PHI Publication

REFERENCE BOOKS:

1. Relevant IRC and IS Codes of Practices.
2. "Pavement design and materials", Papagiannakis A. Thomas and Eyad A. Masad, John Wiley & Sons.
3. "*The Shell Bitumen Handbook*", Read, J. and Whiteoak, D., Thomas, Fifth edition, Telford Publishing, London 2003.

Course Code	APPLIED STATISTICS (ELECTIVE - I)		L	T	P	C
21D010501			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand different sampling techniques
- To Understands about statistical distribution and probability.
- To Acquire in depth knowledge regarding different methods of regression, correlation
- To Acquire in depth knowledge regarding different methods of sampling distributions

UNIT - I (10 Hrs)

Introduction & Sampling Techniques: Frequency Distribution; Mean; Standard Deviation; Standard Error, Skewness; Kurtosis; Definitions And Applications; Simple Random Sampling; Stratified Sampling; Systematic Sampling; Sample Size Determination; Applications In Traffic Engineering,

UNIT - II (10 Hrs)

Statistical Distributions And Probability: Binomial, Poisson, Exponential And Normal Distributions; Moments Of Random Variable: Fitting Of Distributions: Chi- Square Test Of Goodness-Of-Fit; Applications In Traffic Engineering. Probability. Laws Of Probability; Conditional Probability And Independent Events; Laws Of Expectation.

UNIT-III (10 Hrs)

Regression And Correlation: Linear Regression And Correlation; Multiple Correlation Coefficient; Standard Error Of Estimate; Analysis Of Variance; Curvilinear Regression; Applications In Transportation Engineering.

UNIT - IV (10 Hrs)

Principal component analysis; Time series analysis. Exact Sampling Distributions – Chi-square distribution; Students t-distribution; F-distribution; Numerical Examples in Transportation Engineering.

UNIT - V (10 Hrs)

Tests of Significance & Confidence Interval – Large Sample And Small Sample Tests; Tests For Single Mean, Means Of Two Samples, Proportions, Two Variances, Two Observed Correlation Coefficients, Paired T-Tests, Applications. Tests Of Significance & Confidence Interval-Intervals For Mean, Variance And Regression Coefficients; Applications In Traffic Engineering Problems.

TEXT BOOKS:

1. "Fundamentals of Mathematical Statistics", Gupta, S.C And Kapoor, K.V., Sultan Chand.

REFERENCE BOOKS:

1. "Basic Statistics", Simpson And Kafks, Oxford And IBH Calcutta, 1969.
2. "Multivariate Data Analysis", Cootey W.W & Cohens P.R, John Wiley &Sons.

Course Code	PROJECT MANAGEMENT (ELECTIVE – I)		L	T	P	C
21D010502			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Introduce to the students the concepts of Organization, Management, Leadership and Team work and Project Management Information System
- Make the students familiarize with concepts of Cost estimation, Resource Planning, Break-even Analysis and Life Cycle Analysis
- Make the students to understand Laws of Contracts, Documentation, Arbitration and Quality Management related Issues
- Make students to grasp the Tools for Project Scheduling, Human Resources management and Inventory management

UNIT-I (10 Hrs)

Introduction to Project Management: A systems Approach, Systems Theory and Concepts, Organisation, Management Functions, Overview of Management Objectives, Tools and Techniques.

Project Management – Processes and Organisational Structures – Team Management – Project Manager as a Team Leader – Leadership Qualities, PMIS

UNIT-II (10 Hrs)

Construction Cost and Value Engineering: Types of Estimates, Implementation of Cost Controls, Project Cost Forecasting, Cost Optimisation and Resources Planning -Value Engineering. Techniques for Project Selection, Break-Even Analysis, Cost Modelling, Energy Modelling, Life Cycle Cost Approach.

UNIT-III (10 Hrs)

Contract Management in Construction Industry, Quality Control and Safety: Tendering and Contracting, Laws of Contracts, subcontracts, Potential Problems, Post Contract Problems, Documents, Conditions, Arbitration, Special Features of International Contracts.

Quality Management and Safety in Construction Industry. Quality control by statistical methods, sampling plan, control charts, ISO 14000, Safety Measures, Safety Programmes, Safety Awareness and Implementation of Safety Plan – Compensation.

UNIT-IV (10 Hrs)

Project Scheduling and Analysis Methods: CPM, PERT, Linear programming, queuing concept, simulation, bidding models, game theory; Numerical Examples.

UNIT-V (10 Hrs)

Human Resource Management and Construction Management Practices : Man Power Planning – Training – Motivation – Industrial Relations – Welfare Measures – MIS – Components and Structure – Personal Management. Resource Management and Inventory - Basic concepts, labour requirements & productivity, non-productive activities, site productivity, equipment and material management, inventory control. Construction Management Practices - Implementation of Procedures and Practices – International Experiences – Case Studies – Examples.

TEXT BOOKS:

1. "Project Management - A systems approach to Planning, Scheduling and Controlling", Herold Kerzner, CBS Publishers and Distributors.
2. "Fundamentals of Construction Management and Organisations", K.Waker A Teraih and Jose M.Grevarn.

REFERENCE BOOKS:

1. "Indian highways – a framework for commercialization", Gajendra Hald.
2. Risk management in construction projects NCP-centre of distance education for construction industry manager.

Course Code	BRIDGE ENGINEERING (ELECTIVE – I)		L	T	P	C
21D010503			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Introducing the students to different types of Bridges and Loads acting on them
- Familiarize the students with the Design and Analysis of Girder Bridges and Continuous Bridges
- Familiarize the students with the Design and Analysis of Prestressed Concrete Bridges
- Providing knowledge on various components of Bridges and the design standards associated with them
- Provide insight into the analysis of Deck Slabs and Substructure of Bridges

UNIT-I (10 Hrs)

Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads- Longitudinal forces-Seismic loads. Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect- Erection Forces and effects-Width of roadway and footway-General Design Requirements.

UNIT-II (10 Hrs)

Solid slab, Girder Bridges & Continuous Bridges: Introduction-Method of Design.Girder Bridges - Introduction-Method of Design-Courbon's Theory. Continuous Bridges-Introduction-Span lengths- Analysis of Continuous bridges-Decking of Girders with constant Moment of Inertia. Continuous bridges with variable Moment of Inertia-Method of Analysis –Girders with Parabolic Soffit-Method of plotting Influence lines-Girders with Straight Haunches-Design steps for Continuous Bridges.

UNIT-III (10 Hrs)

Pre-Stressed Concrete Bridges: Basic principals- Method of Pre-srtessing- Pretensioning and Post-tensioning – Comparision-Freyssinet Method-Magne Blanet System-Lee-Mc call system-Basic Assumptions-Losses in Prestress-Equation based on Initial and final stress conditions-Cable Zone- Design of selections-Condition of first crack- Ultimate load design-Shear-Vertical Pre-stressing-Diagonal Tension in I-section- End Block-Magnel's method-Emperical Method.

UNIT-IV (10 Hrs)

General Design requirements-Mild steel reinforcement in prestessed concrete member- Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section- Propped-Design of Propped Composite Section- Unpropped composite section-Two stage Pre-stressing-Shrinking

stresses-General Design requirements for Road Bridges.

UNIT-V (10 Hrs)

Analysis of Bridge Decks and Substructure: Harmonic analysis and folded plate theory-Grillage analogy- Finite strip method and FEM.

Sub-structure of bridges: Substructure-Beds block-Piers- Pier Dimensions- Design loads for piers-Abutments- Design loads for Abutments.

TEXT BOOKS:

1. "Design of Concrete Bridges" M.G.Aswani, V.N.Vazirani and M.M.Ratwani.
2. "Bridge Deck Behaviour", E.C.Hambly.
3. "Prestressed Concrete bridges", N. Krihnam Raju

REFERENCE BOOKS:

1. "Concrete Bridge Design and Practice", V.K.Raina.
2. "Prestress Concrete – A fundamental Approach", Edward Navy
3. Relevant IRC and IS Code Books

Note: This subject must be taught by M-Tech. Structural Engineering, faculty only

Course Code	REMOTE SENSING & GLOBAL POSITIONING SYSTEMS (ELECTIVE – II)		L	T	P	C
21D010504			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand Basic Principles and Developments In Remote Sensing
- To Understand Pre-Processing and enhancement techniques for Remotely Sensed Data
- To Understand about different types of filtering techniques and fundamentals of GPS

UNIT-I (12 Hrs)

Remote Sensing Technology : Basic Principles – Introduction, Electromagnetic And Its Properties, Interaction With Earth Surface Materials, Recent Developments In Remote Sensing, Social And Legal Implications of Remote Sensing, Status Of Remote Sensing.

Remote Sensing. Platforms & Sensors - Introduction, Characteristics Of Imaging Remote Sensing Instruments, Satellite Remote Sensing System – A brief over view , other remote sensing satellites.

UNIT-II (11 Hrs)

Pre-Processing And Enhancement Techniques For Remotely Sensed Data: Introduction, Cosmetic Operation; Geometric Connection And Registration, Atmospheric Correction.

UNIT–III (9 Hrs)

Enhancement Technique - Introduction, Human Visual System, Contrast Enhancement; Pseudo Color Enhancement.

Image Transforms: Introduction, Arithmetic Operations, Empirically Based Image Transforms, Principal Component Analysis , Multiple Discriminant Analysis Etc.

UNIT–IV (8 Hrs)

Filtering Technique Classification: Low-Pass (Smoothing Filters) High Pass (Sharpening) Filters, Edge Detection, Frequency Domain Filters. Geometrical Basis, Classification, Unsupervised And Supervised Classification, Classification Accuracy.

UNIT–V (10 Hrs)

G.P.S.: Introduction, Elements Of Satellite Surveying, Eglobal Positioning System, Gps Satellites, Adjustment Computations, Gps Observables, Application Of Gps Technology In Highway Alignment, Network Planning.

TEXT BOOKS:

1. "Principles of Remote Sensing", Paul Jumani, ELBS , 1985.

REFERENCE BOOKS:

1. "GPS Satellite Surveys", Alfred Leick , Willey & Sons
2. "Computer Processing of Remotely sensed Images - An Introduction", Paul M. Mather, John Wiley & Sons 1989.

Course Code	GROUND IMPROVEMENT METHODS (ELECTIVE – II)		L	T	P	C
21D010505			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Provide an introduction to the design and philosophy of geotechnical site investigations and a legislation element incorporating contaminated land.
- Students will learn about the range of exploration and testing techniques available to geotechnical engineers.
- Students will also learn how investigations are planned and how the results of investigations relate to the design process.

UNIT - I (10 Hrs)

Introduction to Engineering Ground Modification: Need and Objectives, Identification of Soil Types, In Situ and Laboratory Tests To Characterize Problematic Soils; Mechanical, Hydraulic, Physico-Chemical, Electrical, Thermal Methods, and their Applications.

UNIT - II (10 Hrs)

Mechanical Modification – Deep Compaction Techniques- Blasting Vibrocompaction, Dynamic Tamping And Compaction Piles.

UNIT - III (10 Hrs)

Hydraulic Modification – Objectives And Techniques, Traditional Dewatering Methods And Their choice, Design Of Dewatering System, Electro-Osmosis, Electro- Kinetic Dewatering. Filtration, Drainage And Seepage Control With Geosynthetics, Preloading And Vertical Drains.

UNIT - IV (10 Hrs)

Physical and Chemical Modification – Modification by admixtures, shotcreting and guniting technology, modification at depth by grouting, crack grouting and compaction grouting, jet grouting, thermal modification, ground freezing.

UNIT - V (10 Hrs)

Modification By Inclusions and Confinement - Soil Reinforcement, Reinforcement with Strip, and Grid Reinforced Soil. In-Situ Ground Reinforcement, Ground Anchors, Rock Bolting and Soil Nailing.

TEXT BOOKS:

1. "Engineering Principles of Ground Modifications", Hausmann, M. R. (1990), McGraw Hill Publications
2. "Ground Improvement", M. P. Moseley and K. Krisch (2006), 2nd Edition, Taylor and Francis
3. "Ground Control and Improvement", Xianthakos, Abreimson and Bruce

REFERENCE BOOKS:

1. "Designing With Geosynthetics", Koerner, R. M (1994) – Prentice Hall, New Jersey.
2. "Earth Reinforcement and Soil Structures", Jones C. J.F.P. (1985), Butterworths, London.
3. "Ground Improvement by Deep Vibratory Methods", K. Krisch & F. Krisch (2010), Spon Press.
4. "Foundation Design Principles and Practices" Donald P Coduto, 2nd edition, Pearson, Indian edition, 2012

Course Code	ADVANCED CONCRETE TECHNOLOGY (ELECTIVE – II)		L	T	P	C
21D010506			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To study the properties of concrete making materials
- To do mix design
- Familiar with the methods of concreting
- Knowledge about advance tests on concrete

UNIT-I (10 Hrs)

Cements And Admixtures: Portland Cement – Chemical Composition - Hydration, Setting And Finenesses Of Cement – Structures Of Hydrated Cement – Mechanical Strength Of Cement Gel - Water Held In Hydrate Cement Paste – Heat Of Hydration Of Cement – Influence Of Compound Composition On Properties Of Cement – Tests On Physical Properties Of Cement – I.S. Specifications – Different Types Of Cements – Admixtures.

UNIT-II (10 Hrs)

Aggregates: Classification Of Aggregate – Particle Shape And Texture – Bond Strength And Other Mechanical Properties Of Aggregate Specific Gravity, Bulk Density, Porosity, Absorption And Moisture In Aggregate – Soundness Of Aggregate – Alkali – Aggregate Reaction, Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Practical Grading – Road Note No.4 Grading Of Fine And Coarse Aggregates Gap Graded Aggregate – Maximum Aggregate Size.

UNIT-III (10 Hrs)

Fresh Concrete: Workability – Factors Affecting Workability – Measurement Of Workability By Different Tests – Effect Of Time And Temperature On Workability – Segregation And Bleeding – Mixing And Vibration Of Concrete – Quality Of Mixing Water.

Hardened Concrete: Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water In Mix – Nature Of Strength Of Concrete – Strength In Tension And Compression- Griffith's Hypothesis – Factors Affecting Strength – Autogeneous Healing –Relation Between Compression And Tensile Strength – Curing And Maturity Of Concrete Influence Of Temperature On Strength – Steam Curing – Testing Of Hardened Concrete – Compression Tests – Tension Tests – Factors Affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.

UNIT-IV (11 Hrs)

Elasticity, Shrinkage And Creep: Modulus Of Elasticity – Dynamic Modulus Of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Draying Shrinkage - Mechanism Of Shrinkage – Factors Affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep Of Concrete – Factors Influencing Creep – Relation Between Creep And Time – Nature Of Creep – Effect Of Creep.

UNIT-V (9 Hrs)

Mix Design: Proportioning Of Concrete Mixes By Various Methods – Fineness Modulus, Trial And Error, Mix Density, Road Note. No. 4, ACI And ISI Code Methods – Factors In The Choice Of Mix Proportions – Durability Of Concrete – Quality Control Of Concrete – Statistical Methods – High Strength Concrete Mix Design. **Special Concrete's**: Light Weight Concretes –Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types Of Fibers - Factories Affecting Properties Of FRC – Applications Polymer Concrete – Types Of Polymer Concrete Properties Of Polymer Concrete and Applications

TEXT BOOKS:

1. "Properties of Concrete", A. M. Neville, Pearson Publication, 4th Edition
2. "Concrete Technology", M. S. Shetty, S. Chand & Co., 2004
3. "Concrete Technology", A. M. Neville, Pearson Publication

REFERENCE BOOKS:

1. "Design of Concrete Mix", Krishna Raju, CBS Publishers
2. "Concrete: Micro Structure, Properties and Materials", P. K. Mehta and J. M. Monteiro, Mc-Graw Hill Publishers
3. "Concrete Technology", A.R. Santha Kumar, Oxford University Press, New Delhi
4. "Concrete Technology", M.L. Gambhir, Tata Mc. Graw Hill Publishers, New Delhi
5. "Non-Destructive Test and Evaluation of Materials", J. Prasad & C. G. K. Nair, Tata McGraw Hill Publishers, New Delhi

Course Code	HIGHWAY ENGINEERING LAB		L	T	P	C
21D010405			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Objective material characterization of aggregates.
- Fundamental tests on Bitumen

1. Test on Soil – Soil Consistency Tests, Sieve Analysis
i) Compaction Of Soil
ii) CBR Test

2. Test on Aggregate – Shape Test
i) Impact And Crushing Tests On Aggregate
ii) Abrasion And Attrition Test
iii) Soundness Test

3. Tests on Bitumens – Viscosity, Penetration, Ductility Tests
i) Flash And Fire Point Tests
ii) Bitumen Extraction Tests

4. Test on Bitumen & Concrete Mix:
i) Design Of Cement Concrete Mix For Highway
ii) Marshal Stability Mix Design

Course Code	HIGHWAY PROJECT FORMULATION & ECONOMICS		L	T	P	C
21D010406			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Understand the need & scope of Project Formulation.
- Understand the costs and savings involved in Highway Projects
- Learn Economic Evaluation Methods of Highway Projects
- Understand the concepts of Accident Costs and Travel time Savings
- Learn to deal with Project Analysis for Environmental Impact Assessment.

UNIT I: (10 Hrs)

Project Formulation: Requirements In Project Formulation, Components Of Project, Non-Monetary And Monetary Criteria In Formulation Of Project, Preparation Of DPR – Guidelines. **Highway Projects and Economic Evaluation:** Need For Economic Evaluation; Principles Of Economic Evaluation; Development Of Cash Flow Diagrams, Cost And Benefit Components, Discounting Criteria.

UNIT II: (10 Hrs)

Vehicle Operating Costs: Vehicle Operating Costs; Components Of VOC, Factors Affecting VOC, Road User Cost Study In India, Factors Affecting Fuel Consumption- Relationships, Factors affecting Spare Parts Consumption.

UNIT III: (10 Hrs)

Value of Travel Time Savings: Economic Concept Of Evaluation Of Travel Time Savings; Issues Connected With Evaluation Of Travel Time Savings,Methodologies Used for Evaluation of Travel Time- Wage Rate Approach, Revealed Preferences Approach.

UNIT IV: (10 Hrs)

Accident Costs; Methodologies For Economic Evaluation Of An Accident ; Factors Involved-Gross Output Approach, Net Output Approach, Life Insurance Approach, Court Award Approach, Implicit Public Sector Evaluation Approach, Value of Risk Change Approach, Issues in Indian context.

UNIT V: (10 Hrs)

Basic Methods of Economic Analysis : Equivalent Uniform Annual Cost Method; Present Worth Of Cost Method; Equivalent Uniform Annual Net Return Method; Net Present Value Method;

Benefit Cost Ratio Method; Rate Of Return Method. Applications Of These Methods To Highway Projects.

TEXT BOOKS:

1. "Economic Analysis for Highways", Winfrey. R, International Text Book Company.
2. "Traffic Engineering and Transport Planning", L.R Kadiyali, Khanna Publishers.
3. "Road Project Appraisal for Developing Countries", J. W. Dickey, John Wiley & Sons.

REFERENCE BOOKS:

1. Road User Cost Study, CRRI
2. "Fundamental of T.P. Engineering", by C.J. Chisty.
3. "Transportation Engineering & Planning", C.S. Papacostas.

Course Code	PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT		L	T	P	C
21D010407			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Introduce students to Pavement Management Systems
- Helps students to Understand Serviceability Concept and evaluation Methods
- Introduces to the students the Concepts of Quality Control and Assessment
- Gives the student the knowledge about construction of various components of Pavements like Sub-base, Base and shoulders
- Helps the students to learn the Design Concepts of Bituminous Roads and concrete Roads.

UNIT – I (12 Hrs)

Pavement Management System: Components Of PMS And Their Activities; Major Steps In Implementing PMS; Pavement Maintenance Management Components Of Maintenance-Management And Related Activities. Network And Project Level Analysis; Prioritization Techniques And Formulation Of Maintenance Strategies.

UNIT – II (10 Hrs)

Pavement Inventories and Evaluation : Serviceability Concepts ;Visual Rating ;Pavement Serviceability Index; Roughness Measurements ;Distress Modes – Cracking Rutting Etc; Pavement Deflection – Different Methods, Skid Resistance, Roughness, Safety – Aspects; Inventory System – Assessment Of Deficiencies.

UNIT – III (10 Hrs)

Pavement Maintenance and Quality Control : Causes Of Deterioration, Traffic And Environmental Factors, Methods Of Maintaining WBM, Bitumen And Cement Concrete Roads, Quality Assurance; Quality Control – ISO 9000 , Sampling Techniques – Tolerances And Controls Related To Profile And Compaction

UNIT – IV (8 Hrs)

Construction of Base, Subbase and Shoulders : Roadway And Drain Excavation, Excavation And Blasting, Embankment Construction, Construction Of Gravel Base, Cement Stabilised Sub-Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Shoulder Construction.

UNIT – V (10 Hrs)

Bituminous Pavement Construction and Cement Concrete Pavement Construction:

Preparation And Laying Of Tack Coat; Bituminous Macadam ,Penetration Macadam, Built Up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments

And Overlay Construction, IRC Specifications, Introducing Mechanical Mixers, Pavers, Finishers. Cement Concrete Pavement Analysis - Construction Of Cement Roads, Manual And Mechanical Methods, Joints In Concrete And Reinforced Concrete Pavement And Overlay Construction – Related Equipment

TEXT BOOKS:

1. "Pavement Management Systems", Haas and Hudson, W. R., Mcgraw Hill Publications.
2. "Pavements and Surfacing for Highways and Airports", Sargious, M. A., Applied Science Publishers Ltd.
3. "Highway and Traffic Engineering for Developing Countries", Bent Thagesan, 1996.

REFERENCE BOOKS:

1. Bridge and Pavement Maintenance- Transportation Research Record No.800, TRB.
2. Pavement Management for Airports, Roads and Parking Lots- Shahin M.Y, 1994.
3. MORTH - Specifications

Course Code	PAVEMENT ANALYSIS AND DESIGN		L	T	P	C
21D010408			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Engineering analysis of stresses and strains in `typical highway pavement structures due to loading from traffic and climate; characterization of paving materials; structural pavement design by IRC, and AASHTO for flexible and rigid pavement are discussed.
- Overlay design for Flexible and Rigid pavement is discussed

UNIT-I (10 Hrs)

Factors Affecting Pavement Design: Variables Considered In Pavement Design, Types Of Pavements, Functions Of Individual Layers, Classification Of Axle Types Of Rigid Chassis And Articulated Commercial Vehicles, Legal Axle And Gross Weights On Single And Multiple Units, Tire Pressure, Contact Pressure, EAL And ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane Distributions & Vehicle Damage Factors, Effect Of Transient & Moving Loads.

UNIT-II (10 Hrs)

Stresses In flexible and Rigid Pavements: Stress Inducing Factors In Flexible And Rigid Pavements; Stress In Flexible Pavements: Visco-Elastic Theory And Assumptions, Layered Systems Concepts, Stress Solutions For One, Two And Three Layered Systems, Fundamental Design Concepts;

Stresses In Rigid Pavements: Westergaard's Theory And Assumptions, Stresses Due To Curling, Stresses And Deflections Due To Loading, Frictional Stresses, Stresses In Dowel Bars & Tie Bars

UNIT-III (10 Hrs)

Materials and Characteristics:

CBR And Modulus Of Subgrade Reaction Of Soil, Mineral Aggregates – Blending Of Aggregates, Binders, Polymer And Rubber Modified Bitumen, Fibre Reinforced Concrete, Permanent Deformation Parameters And Other Properties, Effects And Methods Of Stabilisation And Use Of Geo Synthetics, Non Destructing Testing.

UNIT-IV (11 Hrs)

Design of Flexible and Rigid Pavements: Development Of Design Methods, Flexible Pavement Design Concepts, Asphalt Institute's Methods With HMA And Other Base Combinations, AASHTO, IRC Methods For Highways And Low Volume Roads, Design Of Rigid Pavements: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Rigid Pavement

Design For Low Volume Rural Roads And Highways. Design Of Overlays: Types & Design Of Overlays: IRC Methods Of Overlay Design, Importance Of Profile Correction Course.

UNIT-V (10 Hrs)

Airfield Pavement Design : Aircraft Configurations, Flexible Airport Pavements - IS Specifications And Design, Corps Of Engineers, FAA Methods, AI Methods. Rigid Airport Pavements – IS Specifications, PCA Method, Corps Of Engineers Method, FAA Method.

TEXT BOOKS:

1. "Design of Functional Pavements", Nai C. Yang, Mcgraw Hill Publications
2. "Concrete Pavements", AF Stock, Elsevier, Applied Science Publishers
3. "Pavement Analysis & Design", Yang H. Huang, Prentice Hall Inc.

REFERENCE BOOKS:

1. "Principles of Pavement Design", Yoder.J. & Witzorac Mathew, W. John Wiley & Sons Inc
2. "Pavement and Surfacings for Highway & Airports", Micheal Sargious, Applied Science Publishers Limited
3. IRC Codes for Flexible and Rigid Pavements Design

Course Code	TRAFFIC ANALYSIS		L	T	P	C
21D010409			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To focus on Traffic Measurements and Analysis using various theories of Statistics
- To give the knowledge of application of Statistical Distributions for Traffic Analysis
- To explain the use of queuing theory for Traffic Analysis
- To introduce the concept of Shockwave Theory and its use in `Traffic Analysis
- To make the student understand Pedestrian Delays and warrants associated with Pedestrian Control.

UNIT – I (10 Hrs)

Traffic Flow Description: Types Of Statistical Distributions; Discrete And Continuous Distributions; Counting And Interval Distributions Used In Traffic Analysis; Poisson's Distribution For Vehicle Arrivals; Headway Distributions – Exponential Distribution; Shifted Exponential Distribution; Erlang Distribution; Composite Distribution. Numerical Exercises.

UNIT-II (10 Hrs)

Queueing Theory:M/M/1 & D/D/I System:

Introduction To Queuing Theory; Notation Used For Describing A Queue System; Analysis Of M/M/1 System; Assumptions And Derivation Of System State Equations; Application Of M/M/1 Analysis For Parking Garages And Toll Plazas- Numerical Examples.

Queueing Theory - D/D/1 System: Traffic Interruptions Like Accidents Or Bottlenecks; Analysis Of D/D/1 System For Delay Characteristics; Traffic Signal Analysis As D/D/1 System; Computation Of Delays And Queue Dissipation Time – Numerical Examples.

UNIT – III (10 Hrs)

Pedestrian Delays And Gaps: Pedestrian Gap Acceptance And Delays; Concept Of Blocks, Anti-Blocks, Gaps And Non-Gaps; Underwood's Analysis For Pedestrian Delays; Warrants For Pedestrian Crossing Facilities – Minimum Vehicular Volume Warrant, Minimum Pedestrian Volume Warrant, Maximum Pedestrian Volume Warrant;

UNIT – IV (10 Hrs)

Shockwave Theory: Concept Of Shockwave; Causes For Traffic Interruptions And Shockwaves; Flow-Density Diagram Use In Shockwave Analysis; Use Of Time- Space Diagram For Shockwave Description; Bottleneck Situations And Shockwaves; Traffic Signal And Shockwave Theory; Numerical Examples For Application Of Shockwave Theory;

UNIT – V (10 Hrs)

Traffic Simulation: Introduction To Simulation; Need For Simulation Modelling; Steps In Simulation; Interval Oriented And Event Oriented Simulation; Use Of Random Numbers In Simulation; Random Number Generation Methods; Computing Headways And Arrival Times Based On Random Numbers; Basic Concepts Of Simulation Modelling Application For Signalised Intersections, Pedestrian Crossings And Transit Scheduling.

TEXT BOOKS:

1. "Traffic Flow Theory: A Monograph", TRB Special Report 165
2. "Fundamentals of Transportation Engineering", C. S. Papacostas, Prentice Hall India Publication

REFERENCE BOOKS:

1. "Principles of Highway Engineering and Traffic Analysis", F. L. Mannering & W. P. Kilareski, John Wiley Publishers.
2. "Traffic Flow Fundamentals", A. D. May, , Prentice Hall India Publication
3. "Fundamentals of Traffic Engineering", Mcshane & Rogers

Course Code	ROAD SAFETY ENGINEERING (ELECTIVE – III)		L	T	P	C
21D010507			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Discusses the fundamentals causes of road accidents & some of the statistical methods to analyze the traffic safety.
- The accident investigation and risk management are dealt.
- Introduction of Road Safety as an integral part of Road Design is emphasized.

UNIT-I (10 Hrs)

Accident Investigations and Risk Management: Collection Of Accident Data, Assessment Of Road Safety, Methods To Identify And Prioritize Hazardous Locations And Elements, Determine Possible Causes Of Crashes, Crash Reduction Capabilities And Countermeasures, Effectiveness Of Safety Design Features, Accident Reconstruction, Condition And Collision Diagram.

UNIT-II (10 Hrs)

Traffic Engineering Studies; Statistical Methods In Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons- Traffic Management Measures And Their Influence On Accident Prevention.

UNIT -III (10 Hrs)

Road Safety in Transport Planning And Geometric Design: Vehicle And Human Characteristics, Road Design And Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

UNIT-IV (10 Hrs)

Role of Signs and Markings in Safety: Types Of Signs – Design Specifications – Guidelines For Installation – Role Of Signs In Safety; Types Of Road Markings – Design Specifications – Role Of Road Markings In Safety.

UNIT-V (10 Hrs)

Traffic Management Systems For Safety, Road Safety Audits And Tools For Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS And Safety.

TEXT BOOKS:

1. "Traffic Engineering and Transportation Planning", L.R. Kadiyali, Khanna Publishers
2. "Fundamentals of Transportation Engineering", C. S. Papacostas, Prentice Hall India.
3. Road Safety by NCHR

REFERENCE BOOKS:

1. "Transportation Engineering – An Introduction", C. Jotin Khisty, B. Kent Lall
2. "Fundamentals of Traffic Engineering", Richardo G Sigua
3. "Handbook of Road Safety Measures", 2nd Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson

Course Code	LAND USE AND REGIONAL TRANSPORTATION PLANNING (ELECTIVE – III)		L	T	P	C
21D010508			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Introduces to the fundamentals of Urban transportation planning.
- It familiarizes students with contemporary transportation planning issues and methods of analysis.
- The concepts of Regional Transportation Planning are introduced.
- Introduces the concepts of Regional Road Network Planning.

UNIT - I (10 Hrs)

Urban Regional Dynamics: Population, Urbanisation And Migration, Urban Forms And Structures, Sector Theory, Urban Nodes, Multi Nuclei, Concept Of Region, Hierarchy Of Activities Issues Related To Regional Planning, Methods Of Delineation Regions, Hierarchy Of Regions, Findings Of Commission On Urbanisation, Introduction To Micro Economic Theories Of Landuse, Concepts By Van Thunan, Christaller And Losch.

UNIT - II (10 Hrs)

Landuse Transportation Models: Classification Of LUT Models, Economic Base Mechanism, Allocation Mechanism And Spatial Allocation And Employment Relationships, Garin Lowry Models, Contribution By Putman And Wilson, Issues Related To Landuse Transport - Interaction, Case Study Examples..

UNIT - III (9 Hrs)

Regional Travel Demand Estimation: Factors Affecting Goods And Passenger Flows, Use Of Mathematical Models To Estimate Freight And Passenger Demand, Abstract Mode Models, Mode Specific Models, Direct Demand Models, IVF Models, IO Model, Case Studies, Truck Terminal Location – Planning.

UNIT IV (10 Hrs)

Regional Network Planning: Problems In Developing Countries, Network Characteristics - Circuitry, Connectivity, Mobility, Accessibility And Level Of Service Concepts - Network Structures And Indices – Network Planning – Evaluation – Graph Theory – Cut Sets – Flows & Traversing – Optimum Network - Inter-Modal Co- Ordination. Special Features Of Low Volume Roads – Rural Road Network Planning.

UNIT - V (9 Hrs)

Policy Formulation and Evaluation: Application Of Landuse Forms And Structures A Urban And Regional Levels, Use Of Multi-objective And Goal Programming Techniques, Small Area Management, Residential Neighbourhood And Structure Planning.

TEXT BOOKS:

1. "Integrated Landuse and Transport Modelling: Decision Chains and Hierarchies", Barra, T. D., Cambridge University Press, 2005.
2. "Urban Development Models", Baxter Et Al, Construction Press
3. "The Land Use Transport System", Blundon, W. R. and J Black, 2nd Edition, Australian National University Press, 1984

REFERENCE BOOKS:

1. "An Introduction to Transportation Planning (The Living Environment)", Bruton, M. J., UCL Press, London, UK, 2000.
2. "Transportation Engineering", C.J. Khisty and B. Kent Lall, Prentice Hall of India Pvt. Ltd., 2002.
3. "Transportation Engineering and Planning", C.S. Papacostas and P.D. Prevedouros, Prentice Hall of India Pvt. Ltd., 2001.
4. "Landuse Transportation Planning", Chari, S. R., Lecture Notes, REC, Warangal, 1988
5. "Metropolitan Transportation Planning", Dicky J.W., Script Book Co., Washington-D.C., 1975.
6. "Transportation Planning Handbook", John D. Edwards, 2nd Edition, Institution of Transportation Engineers, 1999.
7. "Regional and Urban Models in Geography and Planning", Wilson, A.G., Pion Press.

Course Code	TRANSPORTATION SYSTEM MANAGEMENT (ELECTIVE – III)		L	T	P	C
21D010509			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Discusses the systems approach of transportation planning
- Discusses various measures related to TSM
- Describes the Management of Transit and Para-Transit
- Discusses the measure to promote non-auto modes

UNIT-I: (10 Hrs)

TSM Philosophy: Systems Approach To Transportation Planning; Long Term Strategies And Short Term Measures; TSM Actions – Objectives And Philosophy; Relevance Of TSM Actions To Indian Urban Context. Broad Spectrum Of TSM Actions.

UNIT-II: (10 Hrs)

Traffic Management Measures I: Measures For Improving Vehicular Flow – One Way Streets-Advantages and Disadvantages- Guidelines for Implementation; Signal Improvements, Transit Stop Relocation, Parking Management.

UNIT-III: (10 Hrs)

Traffic Management Measures II: Reversible Lanes-Guidelines for Applicability; Reducing Peak Period Traffic – Staggering Of Working Hours-Different Methods; Congestion Pricing-Methods-Differential Toll Policies Differential Parking Fee policy.

UNIT-IV: (10 Hrs)

Measures to Promote Transit and Non-Auto Modes: Preferential Treatment To High Occupancy Vehicles; Car Pooling; Transit Service Improvement Measures; Transit Management Improvement Measures; Transit And Para Transit Integration; Para-Transit Role In Urban Areas; Multi-Modal Coordination. Measures To Promote Non-Auto Modes - Pedestrianisation; Bicycle Transportation – Advantages; Planning Bicycle Facilities – Class I, Class II And Class III Bikeways; Junction Treatments For Cycle Tracks.

UNIT-V: (10 Hrs)

Bus Route Network Planning ,Management and Evaluation: Types Of Bus Route Net Works; Suitability For A Given Urban Area; Types Of Routes – Corridor Routes, Activity Routes And Residential Routes; Issues In Route Network Evaluation – Number Of Routes, Length Of Routes; Route Alignment Methods; Service Coverage And Accessibility Index.

TEXT BOOKS:

1. "Transportation System Management Notes", S. R. Chari, REC, Warangal
2. "Metropolitan Transportation Planning", John W Dickey, Tata McGraw Hill

REFERENCE BOOKS:

1. "The Bicycle Planning", Mike Hudson, Open Books, Uk
2. "Transportation Engineering– An Introduction", C. Jotin Khisty & B. Kent Lall, Prentice Hall.
3. "Traffic and Highway Engineering", Nicholas J. Garber and Lester A. Hoel, Cengage Learning, USA, 2009.

Course Code	ENVIRONMENTAL IMPACT ASSESSMENT FOR TRANSPORTATION PROJECTS (ELECTIVE – IV)		L	T	P	C
21D010510			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To explain the relation between Human Activities and Environment
- To familiarize students with various indicators of different Environmental systems
- To introduce the concepts of Environmental Impact assessment of Transportation Projects
- To discuss the issues related to Industrial Development and Environmental Impact

UNIT-I: (10 Hrs)

Introduction: Environment And Its Interaction With Human Activities – Environmental Imbalances - Attributes, Impacts, Indicators And Measurements - Concept Of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives Of EIA, Advantages And Limitations Of EIA

UNIT-II: (10 Hrs)

Environmental Indicators - Indicators For Climate - Indicators For Terrestrial Subsystems - Indicators For Aquatic Subsystems - Selection Of Indicators - Socio- Economic Indicators - Basic Information - Indicators For Economy - Social Indicators - Indicators For Health And Nutrition - Cultural Indicators - Selection Of Indicators.

UNIT-III: (10 Hrs)

Environmental Impact Assessment For Transportation Projects: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety & Capacity Impacts– Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical Case Studies

UNIT- IV: (10 Hrs)

Environmental Issues in Industrial Development: On-Site And Off-Site Impacts During Various Stages Of Industrial Development, Long Term Climatic Changes, Green House Effect, Industrial Effluents And Their Impact On Natural Cycle, Environmental Impact Of Highways, Mining And Energy Development

UNIT-V: (10 Hrs)

Methodologies for Carrying Environmental Impact Assessment: Overview Of Methodologies Adhoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing A Methodology, Review Criteria.

TEXT BOOKS:

1. "Environmental Impact Analysis", Jain, R.K., Urban, L.V., Stracy, G.S., (1991), Van Nostrand Reinhold Co., New York
2. "Environmental Impact Assessment", Rau, J.G. and Wooten, D.C., (1996), McGraw Hill Pub. Co., New York

REFERENCE BOOKS:

1. "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO, (1987), UNESCO/UNEP, Paris
2. "Environmental Impact Assessment", Canter, L.W., (1997), McGraw Hill Pub. Co., New York

Course Code	GIS APPLICATIONS IN TRANSPORTATION ENGINEERING (ELECTIVE – IV)		L	T	P	C
21D010511			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To introduce the basics of GIS.
- To explain the Geographic Data collection.
- To make the student to learn the GIS Data Processing, Analysis and Modelling.
- To make the student to learn about application of GIS in `Transportation Engineering.

UNIT-I: (10 Hrs)

Introduction to GIS and Data Input & Output: Introduction, GIS Over View, Use Of GIS In Decision Making, Data Processing, Components Of GIS, The GIS And The Organization. Data Input And Output - Data Input - Key Board Entry, Manual Digitizing, Scanning, Remotely And Sensed Data, Existing Digital Data, Census Related Data Sets, Data Output - Hard Copy And Soft, Copy Devices.

UNIT-II: (10 Hrs)

Data Quality and Management : Components Of Data Quality - Micro Level, Macro Level Components, Sources Of Error, Data Accuracy; Data Management - The Data Base Approach, 3 Classic Data Models, Nature Of Geographic Data, Spatial Data Models, Databases For GIS

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UNIT-III: (10 Hrs)

GIS Analysis and Functions: Organizing Geographic Data For Analysis, Maintenance And Analysis Of The Spatial Data And Non-Spatial Attribute Data And Its Integration Output Formatting.

UNIT-IV: (10 Hrs)

Implementing a GIS: Awareness, Developing System Requirements, Evaluation Of Alternative Systems, System Justification And Development Of An Implementation Plan, System Acquisition And Start Up, Operation Of The System.

UNIT-V: (10 Hrs)

Application of GIS in Transportation Engineering : Intelligent Information System For Road Accessibility Study, GIS Data Base Design For Physical Facility Planning, Decision Support Systems For Land Use Planning. GIS Applications In Environment Impact Assessment. GIS Based Highway Alignment, GIS Based Road Network Planning, GIS Based Traffic Congestion Analysis and Accident Investigation.

TEXT BOOKS:

1. "Principles of Geographical Information Systems", Burrough, P.A., Oxford Publication
2. "GIS for Urban & Regional Planning", Scholten & Stillwen, 1990, Kulwer Academic Publisher.
3. "GIS A Management", Perspenfi Stan Aronoff, WDL Publisher.

REFERENCE BOOKS:

1. "Concepts and Techniques of Geographic Information Systems", Lo, C.P. & Yeung A.K.W., Prentice Hall of India, New Delhi.
2. "Getting Started with Geographic Information Systems", Clarke, K., Prentice Hall, New Jersey.
3. "Fundamentals of Geographic Information Systems", DeMers, M.N., John Wiley & Sons, New York.

Course Code	OPTIMIZATION TECHNIQUES (ELECTIVE – IV)		L	T	P	C
21D010512			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand linear and non-linear programming
- To understand various search methods like Fibonacci Search; Multi-Dimensional Search Methods; Univariate Search
- To understand dynamic and integer linear programming.

UNIT-I: (10 Hrs)

Linear Programming: Introduction and Formulation of Models; Conversity; Simplex Method; Two Phase Method; Degeneracy, Non - Existent And Unbounded Solutions; Duality In L.P. Dual Simplex method, Sensitivity Analysis; Revised Simplex Method; Transportation And Assignment Problems.

UNIT-II: (10 Hrs)

Non-Linear Programming: Classical Optimisation Methods; Equality And Inequality Constraints; Lagrange Multipliers; & Kuhn-Tucker Conditions; Quadratic Forms; Quadratic Programming And Seal's Methods.

UNIT-III: (10 Hrs)

Search Methods: One Dimensional Optimisation; Fibonacci Search; Multi Dimensional Search Methods; Univariate Search; Gradient Methods; Steepest Descent/Ascent Methods; Conjugate Gradient Method; Fletcher - Reeves Method; Penalty Function Approach.

UNIT-IV: (10 Hrs)

Dynamic Programming: Principle Of Optimality; Recursive Relations; Solution Of L.P.Problem; Simple Examples.

UNIT-V: (10 Hrs)

Integer Linear Programming: Gomory's Cutting Plane Method; Branch And Bound Algorithm; Travelling Salesman Problem; Knapsack Problem; Linear C-1 Problem.

TEXT BOOKS:

1. "Introduction to Optimisation", J. C. Pant; Jain Brothers; New Delhi.
2. "Optimisation Theory and Applications", S. S. Rao; Wiley Eastern Ltd., New Delhi.

REFERENCE BOOKS:

1. "Optimisation Methods", K. V. Mital, Wiley Eastern Ltd.. New Delhi

Course Code	TRAFFIC ENGINEERING LAB		L	T	P	C
21D010410			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Analyzing characteristics of traffic
- Various parameter related to delay, speeds and headways

1. Traffic Surveys:

i. Traffic Volume Studies
ii. Spot Speed Studies
iii. Floating Car Technique
iv. Headway and Gap-Acceptance Studies
v. Delay Studies
vi. Pedestrian Survey

2. Parking Surveys:

i. On-Street Parking Studies
ii. Off-Street Parking Studies

3. Applications of MX-Roads Software.

4. Road Safety Auditing.

REFERENCE BOOKS:

1. "Principles and Practice of Highway Engineering", L. R. Kadiyali and N. B. Lal, Khanna, 2007.
2. "Traffic Engineering and Transportation Planning", L. R. Kadiyali, Khanna Publications, 2007.
3. MX-Roads Software Manual.

Course Code	RESEARCH METHODOLOGY (ELECTIVE V)		L	T	P	C
21D110601			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

UNIT - I (9 Hrs)

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT - II (11 Hrs)

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT - III (8 Hrs)

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT - IV (11 Hrs)

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT - V (11 Hrs)

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

TEXT BOOKS:

1. "Research Methodology: Methods And Techniques", C.R.Kothari, 2nd Edition, New Age International Publishers.
2. "Research Methodology: A Step By Step Guide For Beginners", Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. "Research Methodology And Statistical Tools", P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition, Excel Books, New Delhi.

REFERENCE BOOKS:

1. "Scientists Must Write", Robert Barrass (Available As Pdf on Internet)
2. "Crafting Your Research Future", Charles X. Ling And Quiang Yang (Available as PDF on Internet)

Course Code	HUMAN VALUES AND PROFESSIONAL ETHICS (ELECTIVE V)		L	T	P	C
21D110602			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT - I (10 Hrs)

HUMAN VALUES: Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

UNIT - II (10 Hrs)

ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

UNIT - III (10 Hrs)

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT - IV (10 Hrs)

ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk Safety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UNIT - V (10 Hrs)

GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

TEXT BOOKS:

1. "Engineering Ethics includes Human Values" by M. Govindarajan, S.Natarajan and V. S. Senthil Kumar-PHI Learning Pvt. Ltd-2009.
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

REFERENCE BOOKS:

1. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata Mc Graw Hill– 2003.
2. "Professional Ethics and Morals" by Prof. A. R. Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A. Alavudeen, R.Kalil Rahman and M.Jayakumaran, Laxmi Publications.

Course Code	INTELLECTUAL PROPERTY RIGHTS (ELECTIVE V)		L	T	P	C
21D110603			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- To create awareness about current trends in IPR and Govt. steps in fostering IPR

UNIT – I (10 Hrs)

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II (9 Hrs)

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III (11 Hrs)

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV (10 Hrs)

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V (10 Hrs)

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits. International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS:

1. "Intellectual Property Right", Deborah. E. Bouchoux, Cengage Learing.
2. "Intellectual Property Right", Nleashmy
3. "The Knowledge Economy", Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

ELECTRICAL AND ELECTRONICS ENGINEERING
(For the batches admitted from the academic year 2021-22)

Vision

- To be recognized for producing meritorious electrical engineers with research proficiency and social commitment

Mission

- To impart quality education with practice-based learning in producing electrical engineers with ethical values.
- To encourage the faculty and students to acquire mastery in cutting edge technologies.
- To implement research activities with social commitment.

Institutional Objectives

- To create a conductive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development programmes, Entrepreneurship, and extension activities.
- To introduce demand driven new UG & PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Lifelong Learning:* In the fast-changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.

- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff and students from all social, economic, ethics, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.
- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

M.Tech – EEE – POWER ELECTRONICS

(For the batches admitted from the academic year 2021-22)

Semester I (First Year)

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D430401	Advanced Power Semiconductor Devices	4	0	0	4	40	60	100
2	PC	21D430402	Machine Modeling and Analysis	4	0	0	4	40	60	100
3	PC	21D430403	Solid-State DC Drives	4	0	0	4	40	60	100
4	PC	21D430404	Applications of Power Electronics to Power Systems	4	0	0	4	40	60	100
5	PE		**Elective-I**	4	0	0	4	40	60	100
		21D430501	a. Modern Control Engineering & Principles of Optimal Control							
		21D430502	b. Optimization & Heuristic search Techniques							
		21D430503	c. Advanced Digital Signal Processing							
6	PE		**Elective-II**	4	0	0	4	40	60	100
		21D430504	a. FPGA based Digital System Design							
		21D430505	b. Solid-state Lighting and Control							
		21D430506	c. Hybrid Electric Vehicle Systems							
7	PC	21D430405	Power Electronics and Simulation Lab	0	0	4	2	40	60	100
Total							**26**	**280**	**420**	**700**

Semester II (First Year)

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D430406	Advanced Power Converters	4	0	0	4	40	60	100
2	PC	21D430407	Power Quality	4	0	0	4	40	60	100
3	PC	21D430408	Advanced Drives & Control	4	0	0	4	40	60	100
4	PC	21D430409	Renewable Energy Conversion Systems	4	0	0	4	40	60	100
5	PE	21D430507 21D430508 21D430509	**Elective-III** a. Reactive Power Compensation and Management b. Adaptive Control c. HVDC & EHVAC Transmission Systems	4	0	0	4	40	60	100
6	PE	21D430510 21D430511 21D430512	**Elective-IV** a. Distributed Generation & Micro Grid Control b. Energy Efficient Electrical Systems c. Intelligent Control Techniques	4	0	0	4	40	60	100
7	PC	21D430410	Electrical Drives and Simulation Lab	0	0	4	2	40	60	100
Total							**26**	**280**	**420**	**700**

Semester III (Second Year)

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	OE	21D110601 21D110602 21D110603	**Elective – V** a. Research Methodology b. Human Values and Professional Ethics c. Intellectual Property Rights	4	0	0	4	40	60	100
2	PE	21D430513	**Elective - VI (MOOCS)**	0	0	0	0	0	0	0
3	PC	21D430411	Comprehensive Viva-Voce	0	0	0	2	100	0	100
4	PC	21D430412	Seminar	0	0	0	2	100	0	100
5	PC	21D430413	Teaching Assignment	0	0	0	2	100	0	100
6	PC	21D430414	Project Work Part – I	0	0	0	4	0	0	0
Total							**14**	**340**	**60**	**400**

Semester IV (Second Year)

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D430415	Project Work Part - II	0	0	0	12	0	0	0
Total							**12**	**0**	**0**	**0**

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

Course Code	ADVANCED POWER SEMICONDUCTOR DEVICES		L	T	P	C
21D430401			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand the static and dynamic characteristics of current controlled power semiconductor devices.
- To understand the static and dynamic characteristics of voltage-controlled power semiconductor devices.
- To enable the students for the selection of devices for different power electronics applications.
- To understand the control and firing circuit for different devices.

UNIT-I (10Hrs)

Introduction: Power switching devices, overview – Attributes of an ideal switch, application requirements, Device selection strategy – On-state and switching losses –Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

UNIT-II (12Hrs)

Current Controlled Devices: BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation.

UNIT-III (12Hrs)

Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT (Mos Controlled Thyristor), FCT (Field Controlled Thyristor), RCT (Reverse Conducting Thyristor) .

UNIT-IV (10Hrs)

Firing and Protecting Circuits: Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

UNIT-V (10Hrs)

Thermal Protection: Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design.

TEXT BOOKS:

1. "Power Electronics Circuits, Devices and Applications", Rashid M. H., Prentice Hall India, Third Edition, New Delhi.
2. "Power Electronics: Devices, Drivers, Applications and Passive Components", B.W. Williams Tata McGraw Hill.

REFERENCE BOOKS:

1. "Advanced power electronics converters", Euzeli dos santos, Edison R. da silva.
2. "Fundamentals of Power Semiconductor Devices", B. Jayanth Baliga, Springer Press, 2008.

Course Code	MACHINE MODELING AND ANALYSIS		L	T	P	C
21D430402			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Identifying the methods and assumptions in modelling of machines.
- To recognize the different frames for modelling of AC machines.
- To write voltage and torque equations in state space form for different machines.

UNIT – I (12 Hrs)

Modeling and Analysis of DC Machine: Magnetically coupled circuits, Machine windings and air-gap MMF, winding inductances and voltage equations - Separately excited dc generators, Separately excited dc motors, inter connection of machines, transfer functions of dc machines, dc series motor, dc shunt machines, dc compound machines, linearization techniques for small perturbations, cross field machines, transfer functions of cross field machines, Electric braking of dc motors.

UNIT -II (10 Hrs)

Reference Frame Theory: Introduction to transformations, equations of transformations, change of variables, and transformation to an arbitrary reference frame, commonly used reference frames, transformation between reference frames, Steady-state phasor relationships and voltage equations.

UNIT -III (12 Hrs)

Modeling of Three Phase Induction Machines: Voltage and torque equations in machine variables, Voltage and torque equations in arbitrary reference frame, Steady-state analysis and its operation. Free acceleration characteristics viewed from various reference frames, dynamic performance during sudden changes in load torque, dynamic performance during a three-phase fault at the machine terminals

UNIT – IV (12 Hrs)

Modeling of Synchronous Machine: Voltage and torque equations in machine variables, Voltage equations in arbitrary and rotor reference frame, torque equations in in substitute variable, Steady-state analysis and its operation - Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria

UNIT – V (10 Hrs)

Modeling of Brushless DC Machines: Voltage and torque equations in machine variables, Voltage and torque equations in rotor reference frame variables, Analysis of steady state operation, dynamic performance.

TEXT BOOKS:

1. "Analysis of Electric Machinery and Drive Systems", Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff, 3rd Edition, WILEY-IEEE Press, 2013.

REFERENCE BOOKS:

1. "Electrical Motor Drives: Modelling, Analysis and Control", R. Krishnan, Prentice-Hall, 2001.
2. "Thyristor control of Electric Drives", Vedam Subramanyam, TMH, 18th Re-print, 2008.

Course Code	SOLID STATE DC DRIVES		L	T	P	C
21D430403			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system
- To study and analyze the operation of the converter / chopper fed DC drive, both qualitatively and quantitatively.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
- To understand the implementation of control algorithms using microcontrollers and phase locked loop.

UNIT–I (12 Hrs)

DC Motors and Drive Systems: DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high-speed drives and modern drives.

Characteristics of mechanical system – dynamic equations, components of torque, types of load Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT–II (12 Hrs)

Converter Fed DC Motors Control: Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT–III (10 Hrs)

Chopper Fed DC Motors and Their Control: Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control – Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT–IV (12 Hrs)

Closed Loop Control of DC Drives: Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT–V (10 Hrs)

Digital Control Of D.C Drive: Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

TEXT BOOKS

1. "Power Semiconductor controlled Drives", Gopal K Dubey, Prentice Hall Inc., New Yersy, 1989.
2. "Electric Motor Drives – Modeling, Analysis and Control", R. Krishnan, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

REFERENCE BOOKS

1. "Fundamentals of Electrical Drives", Gobal K. Dubey, Narosal Publishing House, New Delhi, 2001.
2. "Modern Power Electronics and AC Drives", Bimal K. Bose Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
3. "Electric Drives – Concepts and Applications", Vedam Subramanyam, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
4. "Thyristor DC Drives", P.C Sen, John wiely and sons, New York, 1981
5. "Power Electronics", M. D. Singh

Course Code	APPLICATIONS OF POWER ELECTRONICS TO POWER SYSTEMS (Common to PE, PID, PEED and PED)		L	T	P	C
21D430404			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To develop the understanding of uncompensated lines and their behaviour under heavy loading conditions.
- To understand the concept and importance controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.

UNIT–I (10 Hrs)

General System considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

UNIT–II (12 Hrs)

Shunt Compensators: Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static VAR Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability, Enhancement and Power Oscillation Damping

UNIT–III (10 Hrs)

Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, Thyristor controlled series capacitor, SSSC.

UNIT–IV (10 Hrs)

Combined Compensators: Introduction, Unified power flow controller, basic operating principles, independent real and reactive power flow control, and control structure, basic control system for P and Q control.

UNIT–V (10 Hrs)

Mitigation of Harmonics: Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

TEXT BOOKS

1. "Understanding FACTS", Narain G. Hingorani, Laszlo Gyugyi, IEEE press
2. "Electrical Power Systems Quality", Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, McGraw Hill,2003

REFERENCE BOOKS

1. "Flexible A.C. Transmission System", Y. H. Song, A. T. Johns, IEE, London, 1999

Course Code	MODERN CONTROL ENGINEERING & PRINCIPLES OF OPTIMAL CONTROL (Elective – I)		L	T	P	C
21D430501			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Learn about concepts of controllability, observability and Pole placement design
- Understand concepts of full order and reduced order observer designs
- Learn about model decomposition and robust control
- Understand optimal control problem and various functional
- Learn about state regulator and Riccati equation

UNIT – I (12 Hrs)

Review of State-space representation, Controllability - Pole assignment using State feedback – Ackerman's formula for feedback gain determination; Observability. Duality. Effect of state feedback on controllability and observability. Controllable subspace – decomposition of states into controllable and uncontrollable components

UNIT –II (10 Hrs)

Design of full-order observer – Bass Gura algorithm. The separation principle - Combined observer – controller compensator. Design of reduced order observer. Unobservable subspace – decomposition of states into observable and unobservable components – Canonical decomposition theorem

UNIT – III (12 Hrs)

Reducibility – realization of transfer function matrices. Model decomposition and decoupling by state feedback. Design of robust control system for asymptotic tracking and disturbance rejection using State variable equations. Transfer function interpretations – transfer function form of observer and state estimate feedback. State-space interpretation of internal model principle

UNIT – IV (10 Hrs)

Introduction to optimal control, Calculus of variations: Fundamental concepts, functionals of single function, functional involving several independent functions, fixed end point problem, necessary and sufficient conditions for optimal control.

UNIT –V (10 Hrs)

Discrete-time linear state regulator – Algorithm for the solution, Use of observer in implementing the control law. Continuous-time linear state regulator – Matrix Riccati equation. Time invariant linear state regulator – the reduced matrix Riccati equation - An iterative method to solve the reduced matrix Riccati equation. Suboptimal linear regulator

TEXT BOOKS

1. "Modern Control Engineering", Katsuhiko Ogata, 5th Edition, Prentice Hall India, 1997
2. "Modern Control System Theory", M. Gopal, Revised 2nd Edition, New Age International Publishers, 2005.
3. "Optimal control systems", D.S. Naidu, CRC Press, First edition, 2002.

REFERENCE BOOKS

1. "Linear Systems", Thomas Kailath, Perntice Hall, 1980.
2. "Control System Design", Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson Education, 2000.
3. "Linear System Theory and Design", Chi-Tsong Chen, OXFORD University Press.
4. "Modern Control Systems", Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu India, 2009.
5. "Optimal Control Theory an Introduction", Donald E.Kirk, Prentice - Hall Network series First Edition, 1970.

Course Code	OPTIMIZATION & HEURISTIC SEARCH TECHNIQUES (Elective – I)		L	T	P	C
21D430502			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Learn about optimization problem and basic optimization issues
- Understand the concept of linear programming
- Learn about transportation problem and solution
- Understand unconstrained optimization techniques
- Acquire knowledge about various heuristic optimization techniques

UNIT –I (12 Hrs)

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT –II (10 Hrs)

Linear Programming: Standard form of a linear programming problem– geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT –III (12 Hrs)

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method. Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

UNIT –IV (10 Hrs)

Unconstrained Optimization Techniques: Univariate method, Random Search methods, Grid Search method, Pattern Directions, Powell's method, Simplex method, Gradient of a function, Steepest Descent (Cauchy) method, Conjugate Gradient (Fletcher-Reeves) method, Newton's method.

UNIT –V (10 Hrs)

Heuristic Optimization Techniques: Meta heuristic search methods: Genetic Algorithm based optimization, Simulated Annealing Techniques, Swarm Intelligent Algorithms, PSO, etc.

TEXT BOOKS

1. "Modern Heuristic Optimization Techniques", Kwang Y. Lee, Mohamed A. El-Sharkawi
2. "Engineering optimization: Theory and practice", S. S. Rao,New Age International Pvt. Ltd, 3rd edition, 1998.
3. "Introductory Operations Research", H.S. Kasene & K.D. Kumar, Springer (India), Pvt. Ltd.

REFERENCE BOOKS

1. "Optimization Methods in Operations Research and systems Analysis", K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. "Operations Research", Dr. S.D.Sharma.
3. "Operations Research: An Introduction", H.A. Taha, PHI Pvt. Ltd., 6th edition
4. "Linear Programming", G. Hadley

Course Code	ADVANCED DIGITAL SIGNALPROCESSING (Elective – I)		L	T	P	C
21D430503			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Understand the basic concepts of digital signals and systems
- Learn about transformation techniques and Filter realizations
- Learn about design concepts of IIR and FIR filters
- Understand the concept of quantization and error analysis
- Learn about poly phase decomposition and various applications

UNIT–I (10 Hrs)

Introduction, Analog-to-digital and Digital-to-Analog conversion, sampled and hold circuit, Continuous-time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast-Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

UNIT – II (12 Hrs)

Z - Transforms - Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z- Transform, z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function. Digital Filter Structures, Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT-III (10 Hrs)

IIR Digital Filter Design - Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

UNIT-IV (10 Hrs)

FIR Digital Filter Design - Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT-V (12 Hrs)

Analysis of Finite word length effects - The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary-rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

TEXT BOOKS

1. "Digital Signal Processing", S.K. Mitra, Tata McGraw-Hill, Third Edition, 2006.
2. "Principle of Signal Processing and Linear Systems", B.P. Lathi, Oxford International Student Version, 2009
3. "Continuous and Discrete Time Signals and Systems", M. Mondal and A Asif, Cambridge, 2007.

REFERENCE BOOKS

1. "Digital Signal Processing- Fundamentals and Applications", Li Tan, Indian reprint, Elsevier, 2008.
2. "Discrete- Time Signal Processing", Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, Pearson Edu, 2008.

Course Code	FPGA BASED DEGITAL SYSTEM DESIGN (Elective – II)		L	T	P	C
21D430504			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Design and optimize complex combinational and sequential digital circuits
- To Model combinational and sequential digital circuits by Verilog HDL
- To Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels
- To Develop test benches to simulate combinational and sequential circuits.
- To Understand the FPGA Architecture

UNIT - I (10 Hrs)

Introduction to FPGAs - Introduction, Field-programmable Gate Arrays, Programmability and DSP, History of the Microchip, Technology Offerings, Influence of Programmability, Challenges of FPGAs.

UNIT - II (10 Hrs)

Verilog HDL Coding Style - Lexical Conventions - Ports and Modules — Operators -Gate Level Modelling - System Tasks & Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions

UNIT - III (12 Hrs)

Verilog Modeling of Combinational & Sequential Circuits - Behavioral, Data Flow and Structural Realization — Adders — Multipliers- Comparators - Flip Flops -Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO — Single port and Dual port RAM — Pseudo Random LFSR — Cyclic Redundancy Check

UNIT - IV (12 Hrs)

Synchronous sequential circuit - State diagram-state table —state assignment-choice of flip-flops — Timing diagram —One hot encoding- Mealy and Moore state machines — Design of serial adder using Mealy and Moore state machines - State minimization — Sequence detection-Design of vending machine using One Hot Controller.

UNIT - V (12 Hrs)

FPGA and its Architecture - Types of Programmable Logic Devices- PLA & PAL- FPGA Generic Architecture. ALTERA Cyclone II Architecture — Timing Analysis and Power analysis

using Quartus-II- SOPC Builder- NIOS-II Soft-core Processor- System Design Examples using ALTERA FPGAs —Traffic light Controller, Real Time Clock - Interfacing using FPGA: VGA, Keyboard, LCD.

TEXT BOOKS

1. "Digital VLSI System Design: A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog", S. Ramachandran, Springer Publication, 2007
2. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Prentice Hall, Second Edition, 2003
3. "FPGA-based Implementation of Signal Processing Systems", Roger Woods, John McAllister, Gaye Lightbody, Ying Yi John Wiley & Sons, Ltd, 2008.

REFERENCE BOOKS

1. "Digital Systems design using VHDL", Charles H Roth, Jr Thomson Books/Cole
2. "FPGA Based System Design", Wayne Wolf, Prentices Hall Modern Semiconductor Design Series
3. "Complete Digital design — A Comprehensive Guide to Digital Electronics and Computer system Architecture", Mark Balch, Mc Graw Hill, 2007

Course Code	SOLID STATE LIGHTING AND CONTROL (Elective – II)		L	T	P	C
21D430505			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To introduce the concept of Solid State Lighting and to impart the skills necessary for implementing light emitting diode in various sectors of illumination.
- To Redesigning an existing office and educational facility with LED luminaire,

UNIT-I (12 Hrs)

Fundamentals of lighting & terminologies - Generation of radiation, CCT, CRI & CT, Review of Light sources, Solid State Lighting Photons emission in LEDs, Life cycle of photon, Overall, Internal, External & Extraction efficiency of photons in LEDs, Optical characteristics of LED, Light escape cone and its relevance in LED design & Numerical Lambertian Radiation pattern .

UNIT-II (12 Hrs)

LEDs & White light generation : Role of extraction efficiency & methods to increase it Materials used for LEDs ,Different types of LEDs, manufacturing technology White light generation, Challenges & Issues, RGB LED – CIE x-y chromaticity diagram, Advantages & disadvantages , Electrical Characteristics of LED & dependence of photometry Driver circuits – linear regulators, resistive circuits & current mirror

UNIT-III (10 Hrs)

Driving Circuits for LEDs: Switching Regulators – Buck Converter- Boost Converter, Buck Boost Converter, SEPIC Converter, Numerical on Driver design for LEDs, Necessity of closed control loop & its considerations, closed loop control of LED, Dimming approaches.

UNIT-IV (10 Hrs)

Design of LED Luminaires - Redesigning an existing office and educational facility with LED luminaire, lighting quality and Energy conservation analysis of redesigned facility. OLEDs and its types, principle, advantages, disadvantages and application, AC LEDs and its challenges, Selecting components for drivers.

UNIT-V (10 Hrs)

Application of LEDs - Traffic lights, Automotive signage, Displays- Alphanumeric displays, Full color video displays, Medical Applications- phototherapy of neonatal jaundice, Photo dynamic therapy, photo synthesis- plant growing, photo bioreactors.

TEXT BOOKS

1. "Introduction to solid state lighting", Arturas Zukauskus, Michael S. Shur and Remis Gaska, Wiley interscience 2002
2. "Power Electronic converters, Applications and Design", Mohan Underland and Robbins, John Wiley and sons, 1989
3. "LEDs for Lighting Applications", Patrick Mottier, John Wiley & Sons, 2009

REFERENCE BOOKS

1. "Light emitting Diodes", E Fred Schubert, (2nd Edition), Cambridge University press, 2006
2. "Introduction to Light Emitting Diode Technology and Applications", Gilbert Held, CRC press, 2009
3. Application Notes from Texas Instruments, National semiconductors, Hitachi

Course Code	HYBRID ELECTRIC VEHICLE SYSTEMS (Elective – II)		L	T	P	C
21D430506			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Introduce the fundamental concepts, principles, analysis and design of hybrid and electric vehicles
- Introduce the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc.

UNIT – I (10 Hrs)

Introduction to Hybrid Electric Vehicles: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies

UNIT–II (10 Hrs)

Hybrid Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

UNIT–III (10 Hrs)

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT–IV (10 Hrs)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT–V (10 Hrs)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXT BOOKS

1. "Electric and Hybrid Vehicles: Design Fundamentals", Iqbal Hussein, CRC Press, 2003.
2. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.
3. "Advanced Electric Drive Vehicles", Ali Emadi, CRC Press, 2017

REFERENCE BOOKS

1. "Electric Vehicle Technology Explained", James Larminie, John Lowry, Wiley, 2003.
2. "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Sheldon S. Williamson, Springer, 2013.
3. http://nptel.ac.in/syllabus/108103009

Course Code	POWER ELECTRONICS AND SIMULATION LAB		L	T	P	C
21D430405			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand the operation of Power Electronic converters
- To enable the students gain a fair knowledge on the programming and simulation of Power Electronics.

List of Experiments:

1. Single Phase Full Controlled Converter With R And R-L Loads
2. Single Phase AC Voltage Controller With R And R-L Loads
3. Single Phase Cycloconverter
4. McMurray Full Bridge Inverter
5. Thyristorised Chopper
6. Simulation of Three Phase Fully Controlled Converter with R and R-L Loads using MATLAB/PSIM.
7. Simulation of Three Phase AC Voltage Controller with R and R-L Loads using MATLAB/PSIM.
8. Simulation of Three Phase Inverter in 180^0 Conduction Mode with Star & Delta Connected loads.
9. Simulation of Choppers.
10. Simulation of Single Phase Cycloconverter

(Simulation software tools: Matlab/Simulink/PSPICE/PSIM)

Course Code	ADVANCED POWER CONVERTERS		L	T	P	C
21D430406			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand Principle of Operation Advanced Power Converters.
- To describe the operation of multi level inverters with switching strategies for high power applications.
- To comprehend the design of resonant converters and switched mode power supplies.

UNIT-I (12 Hrs)

PWM Inverters: Principle of Operation – Performance Parameters – Single Phase Bridge Inverter – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Single Phase Inverters – Advanced Modulation Techniques for Improved Performance –Numerical Problems.

Three Phase Inverters –180 Degree Condition –120 Degree Conduction – Analysis – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Three Phase Inverters – Comparison of PWM Techniques – Harmonic Reductions – Current Source Inverter – Variable DC Link Inverter – Buck and Boost Inverter – Inverter Circuit Design – Applications – Numerical Problems.

UNIT-II (12 Hrs)

Resonant Pulse Inverters: Series Resonant Inverters – Analysis with Unidirectional Switches & Bidirectional Switches – Evaluation of Currents and Voltages – Frequency Response of Series Resonant Inverters – Series Loaded Inverter –Parallel Loaded Inverter –Series and Parallel Loaded Inverters – Parallel Resonant Inverters – Voltage Control of Resonant Inverters – Class E Resonant Inverter & Class E Resonant Rectifier – Numerical Problems.

Resonant Converters – Zero Current Switching Resonant Converters – L Type– M Type – Zero Voltage Switching Resonant Converters – Comparison Between ZCS And ZVS – Resonant Converters – Two Quadrant ZVS Resonant Converters – Resonant DC-Link Inverters – Numerical Problems.

UNIT-III (12 Hrs)

Multilevel Inverters: Multilevel Concept – Types of Multilevel Inverters – Diode Clamped Multilevel Inverter – Improved Diode Clamped Inverter – Flying Capacitors Multilevel Inverter – Cascaded Multilevel Inverter– Principle of Operation – Main Features– Applications –

Reactive Power Compensation, Back-to-Back Intertie System, Adjustable Drives– Switching Device Currents – DC Link Capacitor Voltage Balancing – Features of Multilevel Inverters – Comparisons of Multilevel Converters – Numerical Problems.

UNIT-IV (10 Hrs)

DC Power Supplies - DC Power Supplies – Types – Switched Mode DC Power Supplies – Fly Back Converter –Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter –Resonant DC Power Supplies – Bidirectional Power Supplies – Applications, Numerical Problems.

UNIT-V (10 Hrs)

AC Power Supplies: AC Power Supplies – Types – Switched Mode Ac Power Supplies – Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications, Numerical Problems.

TEXT BOOKS

1. "Power Electronics", Mohammed H. Rashid, Pearson Education, Third Edition.
2. "Fundamentals of Power Electronics", Robert Warren Erickson and Dragan Maksimovic, Springer US, 2nd Edition, 2001.

Course Code	POWER QUALITY		L	T	P	C
21D430407			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Understand the different power quality and power frequency problems in the power system.
- Analyzing the types and causes of Electrical transients.
- Various types of Harmonics their causes and effects on Power System.
- The Concept of Electromagnetic Interference and its impacts Power Quality and Power System.

UNIT – I (10 Hrs)

Introduction to power quality and power frequency disturbance - Introduction to Power Quality - Power Quality Issues - Susceptibility Criteria - Role of Power Suppliers and Users - Power Quality Standards. Introduction to Power Frequency Disturbances - Common Power Frequency Disturbances - Cures for Low Frequency Disturbances - Voltage Tolerance Criteria.

UNIT – II (10 Hrs)

Electrical transients - Introduction to Transients - Transient System Model - Examples of Transient Models and Their Response - Types and Causes of Transients - Examples of Transient Waveforms – Three Phase unbalance – single phase faults – phase to phase faults – two phase to ground faults – seven tips of three phase unbalanced sag.

UNIT – III (10 Hrs)

Harmonics - Definition of Harmonics - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle – Causes of Voltage and Current Harmonics – Individual and Total Harmonic Distortion - Harmonic Signatures - Effect of Harmonics on Power System Devices - Guidelines for Harmonic Voltage and Current Limitation - Harmonic Current Mitigation.

UNIT – IV (10 Hrs)

Electromagnetic interference - Introduction to EMI - Frequency Classification - Electrical Fields - Magnetic Fields - EMI Terminology - Power Frequency Fields - High Frequency Interference - EMI Susceptibility - EMI Mitigation - Health Concerns of EMI.

UNIT – V (10 Hrs)

Power quality problems – EMI impact - Introduction to Power Quality Measurements - Power Quality Measurement Devices - Power Quality Measurements - Test Locations - Test Duration - Instrument Setup - Instrument Guidelines

TEXT BOOKS

1. "Power quality", C. Sankaran, CRC Press
2. "Electrical Power Systems Quality", Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd.

REFERENCE BOOKS

1. "Understanding Power quality problems", Math H. J. Bollen IEEE Press
2. "Power quality enhancement using custom power devices", Arindam Ghosh, Gerard Ledwich, Kluwer academic publishers.

Course Code	ADVANCED DRIVES & CONTROL		L	T	P	C
21D430408			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand principle operation of scalar control of ac motor and corresponding speed-torque characteristics
- To understand the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To understand the brushless dc motor principle of operation.

UNIT-I (10 Hrs)

Induction Motor- An Overview - Review of Steady-State Operation of Induction Motor, Equivalent Circuit Analysis, Torque-Speed Characteristics. Phase Controlled Induction Motor Drive, Stator Voltage Control of Induction Motor, Phase-Controlled Converter Fed Induction Motor, Power Circuit and Gating, Reversible Phase-Controlled Induction Motor Drive, Torque-Speed Characteristics.

UNIT-II (12 Hrs)

Voltage Source Inverter Fed Induction Motor Drive - Stator Voltage and Frequency Control of Induction Motor, Torque-Speed Characteristic Static Frequency Changers, PWM Inverter Fed Induction Motor Drive, Variable-Voltage Variable-Frequency Operation of Induction Motor, Constant E/f and V/f Control Schemes, Slip Regulation. Current Source Inverter Fed Induction Motor Drive, Stator Current and Frequency Control of Induction Motor, Auto Sequentially Commutated Inverter (ASCI), Power Circuit, Commutation, Phase Sequence Reversal, Regeneration, Steady-State Performance.

UNIT-III (12 Hrs)

Rotor Side Control of Slip-Ring Induction Motor - Slip-Power Recovery Schemes, Steady-State Analysis- Range of Slip, Equivalent Circuit, Performance Characteristics; Rating of Converters. Vector Control of Induction Motor, Principles of Vector Control, Direct Vector Control, Derivation of Indirect Vector Control, Implementation – Block Diagram, Estimation of Flux, Flux Weakening Operation.

UNIT-IV (10 Hrs)

Control of Synchronous Motor Drives - Synchronous Motor and Its Characteristics- Control Strategies-Constant Torque Angle Control- Power Factor Control, Constant Flux Control, Flux Weakening Operation, Load Commutated Inverter Fed Synchronous Motor Drive, Motoring and Regeneration, Phasor Diagrams.

UNIT- V (10 Hrs)

PMSM and BLDC Drives - Characteristics of Permanent Magnet, Synchronous Machines With Permanent Magnet, Vector Control of PMSM- Motor Model and Control Scheme, Constant Torque Angle Control, Constant Mutual Flux Linkages, Unity PF Control. Modeling of PM Brushless Dc Motor, Drive Scheme, Commutation Torque Ripple, Phase Advancing.

TEXT BOOKS

1. "Electric Motor Drives Modeling", Analysis & control, R. Krishnan, Pearson Education, 2001.

REFERENCE BOOKS

1. "Modern Power Electronics and AC Drives", B. K. Bose Pearson Publications, 2001.
2. "Power Electronics control of AC motors", MD Murphy & FG Turn Bull, Pergaman press, 1st edition, 1998
3. "Fundamentals of Electrical Drives", G.K. Dubey, Narosa Publications, 1995.

Course Code	RENEWABLE ENERGY CONVERSION SYSTEMS		L	T	P	C
21D430409			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To create the awareness of energy conservation in students
- To identify renewable energy sources for electrical power generation
- To analyze different energy storage methods
- To have knowledge on environmental effects of energy conversion

UNIT–I (10 Hrs)

Solar photo voltaic power and thermal systems- The PV cell, Module and array, equivalent electrical circuit, open circuit and short circuit current, i-v and p-v curves, array design. Energy collection, solar power plant, synchronous generator, commercial power plants

UNIT – II (12 Hrs)

Fundamental of wind turbines - Historical back ground, power contained in wind, thermodynamics of wind energy, efficiency limit for wind energy conversion, maximum energy obtainable for a thrust-operated converter, types of wind energy conversion devices, some relevant definitions, aerodynamics, design of wind turbine rotor, power speed, torque-speed characteristics, wind turbine control systems, control strategy.

UNIT –III (10 Hrs)

Grid connected systems - constant voltage, constant frequency generation, reactive power compensation, variable voltage, variable frequency generation, effect of wind generator on the network. Classification of schemes, operating area, induction generators, doubly fed induction generator, wound field synchronous generators, the permanent magnet generators.

UNIT – IV (10 Hrs)

Integration of wind forms in to the power system -Reactive power compensation-Static VAR compensator- Static synchronous compensator-STATCOM and FSIG stability, HVAC connections, HVDC connections-LCC-HVDC, VSC-HVDC, Multi terminal HVDC, HVDC Transmission-opportunities and challenges

UNIT –V (10 Hrs)

Energy storage and hybrid energy systems - Battery, types of batteries, equivalent electrical circuit, performance characteristics, lead- acid battery, battery design, battery charging, charging

regulators, battery management, flywheel. Diesel generator and photo-voltaic system, wind-diesel hybrid system, wind-Photo voltaic systems

TEXT BOOKS

1. "Wind and solar Power Systems Design, analysis & Operation", Mukund R. Patel CRC, Taylor & Francis, 2nd edition

REFERENCE BOOKS

1. "Wind Electrical Systems", S. N.Bhadra, D. Kastha, S. Banerjee Oxford University press.
2. "Wind energy generation modeling and control", Anaya-Lara, Jenkins et al John Wiley & Sons, Ltd

Course Code	REACTIVE POWER COMPENSATION & MANAGEMENT (Elective – III)		L	T	P	C
21D430507			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

UNIT – I (10 Hrs)

Load Compensation - Objectives and specifications – Reactive power characteristics – Inductive and capacitive approximate biasing – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads - Examples.

UNIT – II (10 Hrs)

Steady – state & transient state reactive power compensation in transmission system - Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensation - Series capacitor compensation – Compensation using synchronous condensers –Examples.

UNIT – III (12 Hrs)

Reactive power coordination & demand side management - Objective – Mathematical modeling – Operation planning – Transmission benefits – Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under Voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences. Load patterns – Basic methods - load shaping – Power tariffs - KVAR based tariffs - penalties for voltage flickers and Harmonic voltage levels.

UNIT – IV (12 Hrs)

Distribution & user side reactive power management - System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics - Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances –

Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of capacitors, characteristics and Limitations.

UNIT – V (10 Hrs)

Reactive power management in electric traction systems and arc furnaces - Typical layout of traction systems – Reactive power control requirements – Distribution transformers - Electric arc furnaces – Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

TEXT BOOKS:

1. "Reactive Power Control in Electric Power Systems", J. E. Miller, John Wiley and Sons, 1982
2. "Reactive power Management", D. M. Tagare, Tata McGraw Hill, 2004.

Course Code	ADAPTIVE CONTROL (Elective – III)		L	T	P	C
21D430508			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Understand the concept of adaptive control problem, basic models of adaptive control
- Learn about Self Tuning Regulator
- Learn about STR control mechanisms and LQG control
- Understand the concept of MRAS
- Learn about SOAS and Gain scheduling

UNIT – I (12 Hrs)

Introduction, Block Diagram of an Adaptive System, Effects of Process Variations on System Performance, Types of Adaptive Schemes, Formulation of the Adaptive Control Problem, Least Squares Method and Regression Models for Parameter Estimation, Estimating Parameters in Models of Dynamic Systems, the Finite Impulse Response Model, The Transfer Function and Stochastic Model.

UNIT – II (10 Hrs)

Block Diagram of Deterministic Self Tuning Regulator (STR), Pole Placement Design – Process Model, Causality Conditions. Indirect STRs – Estimation, Continuous - Time STRs, Direct STRs – Minimum Phase Systems, Adaptive Control Algorithm, Feed Forward Control, Non Minimum Phase Systems – Adaptive Control Algorithm, Algorithm For Hybrid STR.

UNIT – III (12 Hrs)

Design of Minimum Variance and Moving - Average Controllers, Stochastic STR – Indirect STR, Algorithm for Basic STR, Theorems on Asymptotic Properties. Unification of Direct STRs, Generalized Direct Self Tuning Algorithm, Self Tuning Feed Forward Control. Linear Quadratic STR – Theorems on LQG Control, Algorithms for Indirect LQG – STRs Based on Spectral Factorization and Riccati Equation

UNIT – IV (12 Hrs)

Model Reference Adaptive System (MRAS), The MIT Rule, Block Diagram of an MRAS for adjustment of Feed Forward Gain based on MIT Rule. Adaptation Gain – Methods for determination. Design of MRAS using Lyapunov Theory – Block Diagram of an MRAS based on Lyapunov Theory for a First Order System. Proof of The Kalman – Yakubovich Lemma, Adjustment Rules for Adaptive Systems, Relation between MRAS and STR.

UNIT – V (10 Hrs)

Gain Scheduling – Principle, Block Diagram, Design of Gain Scheduling Controllers, Nonlinear Transformations, Block Schematic of a Controller based on Nonlinear Transformations. Application of Gain Scheduling for Ship Steering, Flight Control. Self Oscillating Adaptive System (SOAS) – Principle, Block Diagram, Properties of The Basic SOAS, Procedure for Design of SOAS. Industrial Adaptive Controllers and applications.

TEXT BOOKS

1. "Adaptive control", K.J.Astrom and Bjorn Wittenmark, Pearson Edu., 2nd Edn.
2. "Adaptive control", Sankar Sastry,

REFERENCE BOOKS

1. "Adaptive Control System - Techniques & Applications", V.V.Chalam, Marcel Dekker Inc.
2. "Adaptive control systems", Miskhin and Braun, Mc Graw Hill
3. "Adaptive Control, Filtering and Signal Processing", Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar,
4. "Adaptive control", G.C. Goodwin
5. "Stable Adaptive Systems", Narendra and Anna Swamy.

Course Code	HVDC & EHVAC TRANSMISSION SYSTEMS (Elective – III)		L	T	P	C
21D430509			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- HVDC and EHVAC systems and their applications.
- Different Harmonics suppression filters and their role in power systems.
- Various theories like Electrostatic field and Travelling Wave Theory
- How to control the Voltage in various systems for effective and efficient system.

UNIT – I (10 Hrs)

Introduction to HVDC systems - Introduction, Basic means of control-power reversal-constant current versus constant voltage control- Desired features of control- Actual control characteristics - Constant minimum ignition angle control -constant current control - Constant extinction angle control-stability of control - Tap changer control - Frequency control.

UNIT – II (10 Hrs)

Harmonics suppression filters, interaction between ac and dc systems - Characteristic Harmonics-troubles caused by harmonics-definitions of wave distortion or ripples –means of reducing harmonics-design of AC filters –Dc side filters- Voltage interaction –DC power modulation – Power frequency control-Large signal modulation – active and reactive power coordination.

UNIT – III (12 Hrs)

EHVAC Transmission system - Introduction to EHVAC, Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples. Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors – Surface voltage gradient on conductors – Distribution of voltage gradient on sub-conductors of bundle – Examples.

UNIT – IV (12 Hrs)

Electro static field &Traveling wave theory - Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in unenergized double circuit line - Electromagnetic interference - Examples. Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end - Reflection and refraction coefficients - Lumped parameters of distributed lines - Generalized constants - No load voltage conditions and charging current.

UNIT – V (10 Hrs)

Voltage control - Introduction to Voltage Control - Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

TEXT BOOKS:

1. "EHVAC Transmission Engineering", R. D. Begamudre, New Age International (p) Ltd.
2. "HVAC and DC Transmission", S. Rao
3. "HVDC power Transmission systems", K.R.Padiyar, 2nd edition, Wiley Eastern limited.

REFERENCE BOOKS:

1. "High voltage direct current transmission", J.Arrilaga, IEE power engineering series.
2. "Direct current transmission", E.W.Kimbark, Vol-1, Wiley inter science-New york.

Course Code	DISTRIBUTED GENERATION & MICROGRID CONTROL (Elective – IV)		L	T	P	C
21D430510			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Able to know about the concept of distributed generation, distribution network & the concept of Microgrid, its configuration, advantages & limitations.
- Able to understand the basic concepts in combined heat and power, Wind energy conversion systems, solar photovoltaic systems & other renewable energy sources.
- Able to analyze the impact of Microgrid & Active distribution network management system on various factors.
- Able to know the effect of SCADA & understand the concept of Power quality disturbances, improvement technologies & issues of premium power in DC integration.

UNIT – I (10 Hrs)

Introduction to distributed generation and Microgrid concept - Introduction to distributed generation - Active distribution network - Concept of Microgrid - Microgrid configuration - Interconnection of Microgrids - Technical and economical advantages of Microgrid - Challenges and limitations of Microgrid development - Management and operational issues of a Microgrid - Dynamic interactions of Microgrid with main grid – low voltage DC grid.

UNIT – II (10 Hrs)

Distributed energy resources - Introduction - Combined heat and power (CHP) systems: Micro-CHP systems - Wind energy conversion systems (WECS): Wind turbine operating systems - Solar photovoltaic (PV) systems: Classification of PV cell - Small-scale hydroelectric power generation - Other renewable energy sources - Storage devices.

UNIT – III (10 Hrs)

Microgrid and active distribution network management system - Introduction - Impact on heat utilisation - Impact on process optimisation - Impact on market - Impact on environment - Impact on distribution system - Impact on communication standards and protocols - Network management needs of Microgrid - Microsource controller - Central controller.

UNIT – IV (10 Hrs)

SCADA and Active distribution networks - Introduction - Existing DNO SCADA systems - Control of DNO SCADA systems - SCADA in Microgrids - Human–machine interface (HMI) - Hardware components - Communication trends in SCADA - Distributed control system (DCS) -

Sub-station communication standardization - SCADA communication and control architectures - Communication devices.

UNIT – V (10 Hrs)

Impact of DG integration on power quality and reliability - Introduction - Power quality disturbances - Power quality sensitive customers - Power quality improvement technologies - Impact of DG integration - Issues of premium power in DG integration.

TEXT BOOKS

1. "Microgrids and Active Distribution Networks", S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institution of Engineering and Technology, 2009.

Course Code	ENERGY EFFICIENT ELECTRICAL SYSTEMS (Elective – IV)		L	T	P	C
21D430511			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Analyse the concepts of electricity billing and electrical load management.
- To understand the types of electrical products and systems that can lose energy.
- Learn how to measure energy loss.
- Able to know how to select and size equipment for the application.

UNIT – I (10 Hrs)

Electrical System: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefits, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

UNIT – II (10 Hrs)

Electric Motors: Types, Losses in electric motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving methods in electric motors.

UNIT – III (10 Hrs)

Lighting System: Light source, choice of lighting, illumination requirements, and energy conservation aspects. Energy efficient lighting controls, comparison of sodium vapor, halogen, CFL and LED lamps.

UNIT – IV (10 Hrs)

Electric Drives: Maximum demand controllers, energy efficient drives, soft-starters with energy saver, variable speed drives, energy efficient techniques in drives.

UNIT – V (10 Hrs)

Power Electronic Systems: Automatic power factor controllers, electronic ballast, occupancy sensors, energy saving in power electronic controlled systems. Calculation of energy frequency ratio in the performance of star ratings

TEXT BOOKS

1. "Energy Efficiency for Engineers and Technologists", Eastop T.D & Croft D.R, Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCE BOOKS

1. "Power System Engineering", D P Kothari, I J Nagrath, 2nd Edn., Tata McGraw-Hill Co 2008
2. Bureau of Energy Efficiency (BEE) : www.bee-india.nic.in
3. The Energy and Resource Institute (TERI): http://www.teriin.org/
4. "Energy Efficiency for Engineers and Technologists", TD Eastop and DR Croft, First Edition, Longman Group UK Ltd., 1990.
5. *www.bee-india.nic.in* (Guide on Energy Efficient room Air conditioners)

Course Code	INTELLIGENT CONTROL TECHNIQUES (Elective – IV)		L	T	P	C
21D430512			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Learn about basic concepts of AI
- Understand concepts of ANN and various learning algorithms
- Learn about Genetic Algorithm, ACO and Tabu search concepts
- Understand the concepts of Fuzzy
- Learn about Fuzzy logic controller and design using MATLAB

UNIT – I (10 Hrs)

Introduction to control techniques, need of intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule - based systems, the AI approach. Knowledge representation. Expert systems. Data Pre - Processing: Scaling, Fourier transformation, principal - component analysis and wavelet transformations.

UNIT – II (12Hrs)

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and Training the neural network. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab / Neural Network toolbox.

UNIT – III (12Hrs)

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems.

UNIT – IV (10 Hrs)

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases

UNIT – V (10 Hrs)

Fuzzy modeling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox. Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

TEXT BOOKS

1. "A comprehensive Foundation", Simon Haykins, Neural Networks: Pearson Edition, 2003.
2. "Fuzzy logic with Fuzzy Applications", T.J.Ross, Mc Graw Hill Inc, 1997.
3. "Genetic Algorithms", David E Goldberg

REFERENCE BOOKS

1. "Neural Network Design", M.T.Hagan, H. B. Demuth and M. Beale, Indian reprint, 2008.
2. "Principles of Neuro computing for science and Engineering", Fredric M.Ham and Ivica Kostanic, McGraw Hill, 2001.
3. "Neural Network Fundamentals with Graphs, Algorithms and Applications", N.K. Bose and P.Liang, Mc - Graw Hill, Inc. 1996.
4. "Intelligent System - Modeling, Optimization and Contro"l, Yung C. Shin and Chengying Xu, CRC Press, 2009.
5. "Soft computing & Intelligent Systems - Theory & Applications", N.K.Sinha and Madan M Gupta, Indian Edition, Elsevier, 2007.
6. "Fuzzy logic Intelligence, Control, and Information", John Yen and Reza Langari, Pearson Education, Indian Edition, 2003.
7. "Fuzzy Control and Fuzzy Systems", Witold Pedrycz, Overseas Press, Indian Edition, 2008.

Course Code	ELECTRICAL DRIVES AND SIMULATION LAB		L	T	P	C
21D430410			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Understand the operation of Power Electronic Drives.
- Enable the students gain a fair knowledge on the simulation of Power Electronics Drives.

LIST OF EXPERIMENTS:

1. 1-Phase AC input Thyristorised DC Drive with Closed Loop Control.
2. 3-Phase AC input Thyristorised DC Drive with Closed Loop Control.
3. Four Quadrant Chopper fed PMDC Motor Drive with Speed Closed Loop Control.
4. 1-Phase AC Induction Motor Speed Control using Cyclo Converter.
5. 3-Phase AC Wound Rotor Induction Motor Speed Control from rotor side.
6. Simulation of VSI fed Induction motor (square wave and PWM inverters).
7. Simulation of induction motor with open loop constant V/F control.
8. Simulation of Closed loop speed control of BLDC motor.
9. Simulation of speed control of separately excited DC motor.
10. Simulation of PMSM.

(Simulation software tools: Matlab/Simulink/PSPICE/PSIM)

Course Code	RESEARCH METHODOLOGY (Elective V – OPEN ELECTIVE)		L	T	P	C
21D110601			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

UNIT – I (10 Hrs)

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT – II (10 Hrs)

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT – III (10 Hrs)

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT – IV (10 Hrs)

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT – V (10 Hrs.)

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

TEXT BOOKS

1. "Research Methodology: Methods And Techniques", C.R.Kothari, 2nd Edition, New Age International Publishers.
2. "Research Methodology: A Step By Step Guide For Beginners", Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. "Research Methodology And Statistical Tools", P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition, Excel Books, New Delhi.

REFERENCE BOOKS

1. "Scientists Must Write", Robert Barrass (Available As Pdf on Internet)
2. "Crafting Your Research Future", Charles X. Ling And Quiang Yang (Available as PDF on Internet)

Course Code	HUMAN VALUES AND PROFESSIONAL ETHICS (Elective V – OPEN ELECTIVE)		L	T	P	C
21D110602			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVE:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT - I (8 Hrs)

Human Values - Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

UNIT - II (10 Hrs)

Engineering Ethics- Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

UNIT - III (10Hrs)

Engineering As Social Experimentation - Engineering As Social experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT - IV (8 Hrs)

Engineers Responsibility For Safety And Risk - Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk Safety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UNIT - V (10 Hrs)

Global Issues - Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics.

TEXT BOOKS

1. "Engineering Ethics includes Human Values" by M. Govindarajan, S.Natarajan and V. S. Senthil Kumar-PHI Learning Pvt. Ltd-2009.
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

REFERENCE BOOKS

1. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata Mc Graw Hill– 2003.
2. "Professional Ethics and Morals" by Prof. A. R. Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A. Alavudeen, R.Kalil Rahman and M.Jayakumaran, Laxmi Publications.

Course Code	INTELLECTUAL PROPERTY RIGHTS (Elective V – OPEN ELECTIVE)		L	T	P	C
21D110603			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- To create awareness about current trends in IPR and Govt. steps in fostering IPR

UNIT - I (10 Hrs)

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT - II (10 Hrs)

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT - III (10 Hrs)

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT - IV (10 Hrs)

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT - V (10 Hrs)

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS:

1. "Intellectual Property Right", Deborah. E. Bouchoux, Cengage Learing.
2. "Intellectual Property Right", Nleashmy
3. "The Knowledge Economy", Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

MECHANICAL ENGINEERING

(For the batches admitted from the academic year 2021-22)

Vision

- To provide society with centre of learning that makes the youth dynamic professionals with social commitment.

Mission

- Sound knowledge with analytical ability and practical exposure.
- Professional competence and creativity
- Efficient capable professionals with ethical values
- Fit for the industry

Institutional Objectives

- To create a conductive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development Programmes, Entrepreneurship and extension activities.
- To introduce demand driven new UG & PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Life Long Learning:* In the fast-changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners

and tech savvy.

- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff, and students from all social, economic, ethics, cultural and religious back grounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.
- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

M.Tech – MECH. – MACHINE DESIGN
(For the batches admitted from the academic year 2021-22)

Semester I (First year)

S.No	Category	Course Code	Course Title	Hours per week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P				
1	BS	21D151101	Computational Methods	4	0	0	4	40	60	100
2	PC	21D150401	Advance Finite element methods	4	0	0	4	40	60	100
3	PC	21D150402	Advanced Mechanisms	4	0	0	4	40	60	100
4	PC	21D150403	Advanced Mechanics of Solids	4	0	0	4	40	60	100
5	PE	21D150501 21D150502 21D150503	**Elective - I** a. Computer Application in Design b. Materials Technology c. Quality Concepts in Design	4	0	0	4	40	60	100
6	PE	21D150504 21D150505 21D150506	**Elective – II** a. Tribology in Design b. Gear Engineering c. Design of Hydraulic and Pneumatic Systems	4	0	0	4	40	60	100
7	PC	21D150404	Simulation Laboratory	0	0	3	2	40	60	100
Total							**26**	**280**	**420**	**700**

Semester II (First year)

S.No	Category	Course Code	Course Title	Hours per week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P				
1	BS	21D151102	Advanced Optimization Techniques	4	0	0	4	40	60	100
2	PC	21D150405	Fracture fatigue and creep deformation	4	0	0	4	40	60	100
3	PC	21D150406	Industrial Robotics and Expert system	4	0	0	4	40	60	100
4	PC	21D150407	Mechanical Vibrations	4	0	0	4	40	60	100
5	PE	21D150507 21D150508 21D150509	**Elective – III** a. Experimental Stress Analysis b. Theory of Plasticity c. Applied Engineering Acoustics	4	0	0	4	40	60	100
6	PE	21D150510 21D150511 21D150512	**Elective – IV** a. Design for Manufacturing b. Pressure Vessel Design c. Mechanics of Composite Materials	4	0	0	4	40	60	100
7	PC	21D150408	Machine Dynamics Laboratory	0	0	3	2	40	60	100
Total							**26**	**280**	**420**	**700**

Semester III (Second year)

S.No	Category	Course Code	Course Title	Hours per week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P				
1	OE	21D110601 21D110602 21D110603	**Elective –V** a. Research Methodology b. Human Values and Professional Ethics c. Intellectual Property Rights	4	0	0	4	40	60	100
2	PE	21D150513	**Elective – VI (MOOCS)**	0	0	0	0	-	-	-
3	PC	21D150409	Comprehensive Viva – Voice	0	0	0	2	100		100
4	PC	21D150410	Seminar	0	0	0	2	100		100
5	PC	21D150411	Teaching Assignment	0	0	0	2	100		100
6	PC	21D150412	Project work phase – I	0	0	0	4			
Total							**14**			**400**

Semester IV (Second year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P				
1	PC	21D150413	Project work Phase – II	0	0	0	12	-	-	-

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

Course Code	COMPUTATIONAL METHODS		L	T	P	C
21D151101			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Students will demonstrate aptitude in standard numerical techniques for solving various classes of problems.
- Students will learn the theory underlying the derivation of standard numerical techniques and the development of algorithms.
- Modelling of engineering problems drawn from different disciplines of mechanical engineering.

UNIT–I (12 Hours)

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

UNIT – II (12 Hours)

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrained optimization

Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III (10 Hours)

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT – IV (12 Hours)

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

UNIT – V (10 Hours)

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

TEXT BOOKS:

1. "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale Tata Mc-Grawhill
2. "Applied numerical analysis", Curtis F. Gerald, partick. O. Wheatly Addison-wesley,1989
3. "Numerical methods", Douglas J. Faires, Riched Burden Brooks/cole publishing company, Second edition, 1998.

REFERENCES:

1. "Numerical mathematics and computing", Ward cheney & David Kincaid Brooks/Cole publishing company, 1999, fourth edition.
2. "Mathematical methods for physics and engineering", Riley K.F.M.P.Hobson & Bence S.J.Cambridge universitypress,1999.

Course Code	ADVANCED FINITE ELEMENT METHODS		L	T	P	C
21D150401			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- You learn modern analysis techniques used widely in engineering practice and the sciences, and you use these techniques in a general finite element program.
- You learn how to establish computational models of problems of solids and fluids, solve them on your laptop, and assess the accuracy of the results.
- You capitalize on your knowledge of mechanics, reinforce your knowledge, and solve problems that can only be tackled numerically on the computer. Great knowledge in your tool box whatever your goals.

UNIT–I (12 Hours)

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT–II (10 Hours)

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensionalfin,

UNIT–III (12 Hours)

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT–IV (12 Hours)

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Iso-parametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

UNIT–V (10 Hours)

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems. Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

TEXT BOOKS:

1. "Introduction to Finite element methods", Chandraputla & Ashok D. Belagondu by Pearson 2012
2. "An introduction to Finite element methods", VN Reddy published by Mcgraw Hill 2006.

REFERENCES:

1. "Finite element method in Heat transfer and fluid dynamics", J.N.Reddy, CRCpress,1994
2. "Finite Element Method", Zienckiwicz O.C. & R. L.Taylor,McGraw-Hill,1983.
3. "Finite Element of Nonlinear continua", J. N. Oden, McGraw-Hill, New York,1971.
4. "Finite element procedures", K. J. Bathe, Prentice-Hall,1996.

Course Code	ADVANCED MECHANISMS		L	T	P	C
21D150402			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To develop student understanding of the theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.
- To introduce students to basic and advanced computer-based tools for analysis and synthesis of mechanisms.
- To provide an opportunity for students to use theory and application tools through a major mechanism design project.
- To improve student ability to communicate understanding of the subject through professional technical reports and oral presentations.

UNIT–I (12 Hours)

Introduction: Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms- spherical trigonometry.

Kinematics of plane motion- I: The Inflection circle; Euler – Savary Equation; Analytical and graphical determination of d_i ; Bobillier's Construction ; Collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

UNIT–II (12 Hours)

Kinematics of plane motion - II: Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; determination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter –Hall circle; The circling – point curve for the Coupler of a four bar mechanism.

UNIT–III (12 Hours)

Introduction to Synthesis-Graphical Methods: The Four bar linkage; Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve.

Function generation- General discussion; Function generation: Relative –rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT–IV (10 Hours)

Introduction to Synthesis - Analytical Methods: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.

UNIT–V (12 Hours)

Manipulator kinematics: D-H notation, D-H convention of assignment of co-ordinate frames and link parameters table;D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

Differential kinematics Formulation of Jacobian for planar serial manipulators and spherical manipulator; Singularity analysis.

TEXT BOOKS:

1. "Kinematics and Dynamics of plane mechanisms", Jeremy Hirschhorn, McGraw Hill, 1962.
2. "Modelling and control of Robot manipulators", L.Sciavicco and B.Siciliano, Springer -Verlag,London,2000,Second edition,.
3. "Theory of Mechanisms and Machines", Amitabh Ghosh and Ashok Kumar Mallik, E.W.P.Publishers.

REFERENCES:

1. "Kinematics and Linkage Design", Allen, S.Hall Jr., ,PHI,1964.
2. "Theory of Machines and Mechanisms", J.E Shigley and J.J, Uicker Jr., McGraw-Hill,1995.
3. "A Robot Engineering Text book", Mohsen Shahinpoor, Harper& Row Publishers, New York,1987.
4. "Analysis of mechanisms and Robot manipulators", Joseph Duffy, Edward Arnold,1980

Course Code	ADVANCED MECHANICS OF SOLIDS		L	T	P	C
21D150403			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Fundamental Concept, Introduction to Cartesian Tensors, Two- and Three-Dimensional Theories of Stress and Strain (Method of Continuum Mechanics, Theory of Elasticity), Generalized Hooke's Law (Linear Stress-Strain-Temperature), Energy Principal in Solid Continuum, Application of Energy Methods, Inelastic Material Behavior, Theories of Failure, Application of Elasticity

UNIT–I (10 Hours)

Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

UNIT–II (12 Hours)

Curved beam theory: Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads- stresses in chain links.

Torsion : Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

UNIT–III (12 Hours)

Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

UNIT–IV (12 Hours)

Two Dimensional Elasticity Problems: Plane stress & Plain strain-Problems in Rectangular Co- ordinates, bending of cantilever loaded at the end, bending of a beam by

uniform load.general equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

UNIT–V (10 Hours)

Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatically bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

TEXTBOOKS:

1. "Advanced Mechanics of materials", Boresi& Sidebottom-Wiely International.
2. "Theory of elasticity", Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers3/e

REFERENCES:

1. "Advanced strength of materials", Den HortogJ.P.
2. "Theory of plates", Timoshenko.
3. "Strength of materials & Theory of structures", B.C Punmia, Vol I &II
4. "Strength of materials", Sadhu singh

Course Code	COMPUTER APPLICATIONS IN DESIGN		L	T	P	C
21D150501			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

UNIT–I (10 Hours)

INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS: Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

UNIT–II (12 Hours)

CURVES AND SURFACES MODELLING: Introduction to curves - analytical curves: line, circle and conics – synthetic curves: hermite cubic spline- bezier curve and b-spline curve – curve manipulations. Introduction to surfaces - analytical surfaces: plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: hermite bicubic surface- bezier surface and b-spline surface- surface manipulations.

UNIT–III (12 Hours)

NURBS AND SOLID MODELING: NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

UNIT–IV (10 Hours)

VISUAL REALISM: Hidden – line – surface – solid removal algorithms shading – coloring. introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

UNIT–V (12 Hours)

ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE: Assemblymodeling - interferences of positions and orientation - tolerances analysis - mass property calculations -

mechanism simulation. Graphics and computing standards– open gl data exchange standards – iges, step etc– communication standards..

TEXT BOOKS:

1. "Principles of Computer Graphics",William M Neumann and Robert F.Sproul Mc Graw Hill Book Co. Singapore,1989.
2. "Computer Graphics", Donald Hearn and M. Pauline Baker ,Prentice Hall, Inc.,1992.
3. "Mastering CAD/CAM" –Ibrahim Zeid- McGraw Hill, International Edition,2007

REFERENCES:

1. "Computer graphics principles & practices", Foley, Wan Dam, Feiner and Hughes – Pearson Education –2003.
2. "Mathematical elements for computer graphics" David F. Rogers, James Alan Adams, second edition, Tata McGraw-Hill Publishers

Course Code	MATERIALS TECHNOLOGY		L	T	P	C
21D150502			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Classify the sub branches and domains of Materials & Metallurgical Engineering stream.
- To analyze the possible opportunities in the domains of Materials & Metallurgical Engineering.
- To understand all basic principles involved in the theory of Elasticity and Plasticity

UNIT–I (12 Hours)

Elasticity in metals and polymers: Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening.

UNIT–II (12 Hours)

Poly phase mixture, precipitation: particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material. Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue and creep.

UNIT–III (12 Hours)

Modern metallic Materials: Dual phase steels, micro alloyed, high strength low alloy (HSLA) Steel, transformation induced plasticity (TRIP) Steel, maraging steel, intermetalics, Ni and Ti aluminides

UNIT–IV (12 Hours)

Smart materials: shape memory alloys, metallic glass, quasi crystal and nano crystalline materials.

Non metallic materials: Polymeric materials and their molecular structures, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers.

UNIT–V (12 Hours)

Advanced structural ceramics : WC, TiC, TaC, Al2O3, SiC, Si3 N4, CBN and diamond-properties, processing and applications.

Advance structural composites: Introduction, reinforcement, types of composite materials, - properties, processing and application, and mechanics of composite materials.

TEXT BOOKS:

1. "Mechanical behavior of materials", Thomas H. Courtney, 2nd Edition, McGraw-Hill, 2000
2. "Mechanical Metallurgy", George E.Dieter/McGraw Hill, 1998

REFERENCES:

1. "Selection and use of Engineering Materials", 3e/Charles J.A/Butterworth Heiremann.

Course Code	QUALITY CONCEPTS IN DESIGN		L	T	P	C
21D150503			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To impart knowledge on various concepts in engineering design and principles of implementing quality in a product or service through tools such as quality houses, control charts, statistical process control method, failure mode effect analysis and various strategies of designing experiments, methods to uphold the status of six sigma and improve the reliability of a product.
- To gather knowledge on fundamentals of design and its methods, robust design, embodiment principles, various methods in design of experiments, reliability, statistical tools and six sigma techniques.

UNIT–I (12 Hours)

DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION:

Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding

UNIT–II (12 Hours)

DESIGN FOR QUALITY

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process- Identification of control factors, noise factors, and performance metrics - developing the experimental plan-experimental design –testing noise factors- Running the experiments – Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT–III (12 Hours)

FAILURE MODE EFFECT ANALYSIS AND DESIGN FOR SIX SIGMA

Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling - Basis of SIX SIGMA-Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and

small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services

UNIT–IV (12 Hours)

DESIGN OF EXPERIMENTS:

Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments- Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT–V (12 Hours)

STATISTICAL CONSIDERATION AND RELIABILITY

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.- Reliability-Survival and Failure-Series and parallel systems-Mean time between failure- Weibull distribution

TEXTBOOKS:

1. "Engineering Design - A Materials and Processing Approach", Dieter, George E., McGraw Hill, International Editions, Singapore,2000.
2. "Product Design Techniques in Reverse Engineering and New Product Development", Kevin Otto & Kristin Wood, Pearson Education (LPE),2001.
3. "Product Design And Development", Karl T. Ulrich, Steven D. Eppinger, Tata McGraw-Hill- 3rd Edition,2003.
4. "The Management and control of Quality", James R. Evens, William M Lindsay Pubs in south-western, 6th edition (www.swlearning.com)

Course Code	TRIBOLOGY IN DESIGN		L	T	P	C
21D150504			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Majority of mechanical equipment / mechanisms involve relative motion of links or parts. The course intends to impart concepts of friction, wear and lubrication and application of tribology in design of mechanical components is also introduce

UNIT–I (10 Hours)

Introduction: Nature of surfaces and contact-Surface topography-friction and wear mechanisms and effect of lubricants- methods of fluid film formation.

Selection of rolling element bearings: Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load- bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulsemethod.

UNIT–II (12 Hours)

Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number- performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings- fixed tilting pads, single and multiple pad bearings-optimum condition with largest minimum film thickness.

UNIT–III (12 Hours)

Hydrostatic Bearings: Thrust bearings – pad coefficients- restriction- optimum film thickness- journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.

UNIT–IV (10 Hours)

Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants- additives-lubrication systems and their selection – selection of pump, filters, piping design- oil changing and oil conservation.

UNIT–V (12 Hours)

Seals: different type-mechanical seals, lip seals, packed glands, soft piston seals, Mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves – selection of mechanical seals.

Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography.

TEXT BOOKS:

1. "Hydrostatic and Hybrid bearing design", Rowe WW& O' Dionoghue, Butterworths & Co. Publishers Ltd, 1983.
2. "Mechanical Fault diagnosis and condition monitoring", Collacott R.A Chapman and Hall, London1977.
3. "Fundamentals of fluid film lubricant", Bernard J. Hamrock, Mc Graw-Hill Co.,1994.

REFERENCES:

1. "Tribology hand Book", Neale MJ, (Editor), Neumann Butterworths,1975.
2. "Standard hand book of lubrication engineers" Connor and Boyd JJO (Editors) ASLE, Mc Graw Hill Book &Co.,1968
3. "Mechanical Engineering Design", Shigley J, E Charles, McGraw Hill Co.,1989

Course Code	GEAR ENGINEERING		L	T	P	C
21D150505			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- This course introduces all varieties of Circuit Breakers and Relays for protection of Generators, Transformers and feeder bus bars from over voltages and other hazards. It emphasizes on Neutral grounding for overall protection.

UNIT–I (12 Hours)

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT–II (8 Hours)

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT–III (8 Hours)

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT–IV (12 Hours)

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.

Gear failures: Analysis of gear tooth failures, Nomenclature of geartooth wear and failure, tooth breakage, pitting, scoring, wear, overloading,gear-casing problems, lubricationfailures

UNIT–V (12 Hours)

Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

TEXT BOOKS:

1. "Machine Design", Maleev and Hartman, C.B.S. Publishers, India.
2. "Gear engineering", Henry E.Merrit, Wheeler publishing, Allahabad,1992.
3. "Practical Gear design", Darle W. Dudley, McGraw-Hill book company

REFERENCES:

1. "Analytical mechanics of gears", Earle Buckingham, Dover publications, New York, 1949.
2. "Hand book of gear design", G.M.Maitha, Tata McGraw Hill publishing company Ltd., NewDelhi,1994.

Course Code	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS		L	T	P	C
21D150506			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Power in Industry. Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems. It helps students to get knowledge on the need, use and application of fluid power and make

UNIT–I (10 Hours)

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS: Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT–II (8 Hours)

CONTROL AND REGULATION ELEMENTS: Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT–III (12 Hours)

HYDRAULIC CIRCUITS: Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

UNIT–IV (12 Hours)

PNEUMATIC SYSTEMS AND CIRCUITS: Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT–V (10 Hours)

INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS: Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro

pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

TEXT BOOKS:

1. "Fluid Power with Applications", Antony Espossito, Prentice Hall,1980.
2. "Basic fluid power", Dudleyt, A. Pease and John J. Pippenger, Prentice Hall,1987.

REFERENCES:

1. "Hydraulic and Pneumatics" (HB), Andrew Parr, Jaico Publishing House, 1999.
2. "Pneumatic and Hydraulic Systems", Bolton. W., Butterworth –Heinemann, 1997.
3. "Hydraulic and Pneumatic Controls: Understanding made Easy", S. Chand & Co Book publishers, New Delhi, 2006 (Reprint2009).

Course Code	SIMULATION LABORATORY		L	T	P	C
21D150404			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

I. Modeling

1. Surface modelling
2. Solid modeling
3. Drafting
4. Assembling

II. Structural Analysis using any FEA Package for different structures that can be discretised with,2-D & 3-Delements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites
7. Fracture mechanics

III. Thermal Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-Delements

1. Steady state thermal analysis
2. Transient thermal analysis

IV. Transient analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-Delements

1. Linear
2. Non-Linear (Geometrical Non-linearity)

REFERENCES:

1. User manuals of ANSYS package Version 10.0 PRO/E,I-DEAS Package /UNIGRAPHICS, CATIA

Course Code	ADVANCED OPTIMIZATION TECHNIQUES		L	T	P	C
21D151102			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To model and solve real-world problems.
- A deeper understanding of the key concepts, theory, and algorithms of linear optimization, integer optimization, and some modern convex optimization
- More advanced modeling techniques
- Ways to assess the quality of sub-optimal solutions.

UNIT–I (8 Hours)

Integer programming- cutting plane method and branch and bound technique, mixed integer programming

UNIT–II (12 Hours)

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

UNIT–III (12 Hours)

Genetic algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation,
termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, solving differential equations using GP.

UNIT–IV (10 Hours)

Multi-Objective Decision making: Introduction to goal programming , Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of

multi-objective problems. Introduction to Analytical hierarchical process, analytical network process.

UNIT–V (12 Hours)

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS:

1. "Optimal design", Jasbir Arora, Mc Graw Hill (International)Publishers
2. "Optimization for Engineering Design", Kalyanmoy Deb, PHI Publishers
3. "Engineering Optimization", S.S.Rao, New Age Publishers
4. "Operation Research", Hamdy A. Taha, Person publications

REFERENCES:

1. "Genetic algorithms in Search, Optimization, and Machine learning", D.E.Goldberg, Addison-Wesley Publishers
2. "Genetic Programming", Koza
3. "Multi objective Genetic algorithms", Kalyanmoy Deb, PHI Publishers

Course Code	FRACTURE FATIGUE & CREEP DEFORMATION		L	T	P	C
21D150405			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Provide an understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.
- Provide a thorough introduction to the principles of fracture mechanics.
- Provide practical examples of the application of fracture mechanics to design and life prediction methods and reporting.
- Provide a basis for the use of fractography as a diagnostic tool for structural failures.

UNIT–I (12 Hours)

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter- granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, The ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.

Griffiths analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

UNIT–II (12 Hours)

Linear Elastic Fracture Mechanics, (LEFM). Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor.

The effect of Constraint, definition of plane stress and plane strain and the effect of component thickness. The plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size. Limits on the applicability of LEFM.

UNIT–III (12 Hours)

Elastic-Plastic Fracture Mechanics; (EPFM). The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.

The effect of Microstructure on fracture mechanism and path, cleavage and ductile failure, factors improving toughness,

UNIT–IV (12 Hours)

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodmans rule and Miners rule. Micromechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

UNIT–V (10 Hours)

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro- mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller

TEXT BOOKS:

1. "Fracture Mechanics Fundamentals and Applications", T.L. Anderson, 2nd Ed. CRC press, (1995)
2. "Fracture of Brittle Solids", B. Lawn, Cambridge Solid State Science Series 2nd edition, 1993.
3. "Fundamentals of Fracture Mechanics", J.F. Knott, Butterworths (1973)
4. "Worked examples in Fracture Mechanics", J.F. Knott, P Withey, Institute of Materials.

REFERENCES:

1. "Fracture Mechanics", Edward Arnold (1984)
2. "Fatigue of Materials", S. Suresh, H.L. Ewald and R.J.H. Wanhill Cambridge University Press (1998).
3. "Thin Film Materials", L.B. Freund and S. Suresh, Cambridge University Press (2003)
4. "Mechanical Metallurgy", G. E. Dieter, McGraw Hill (1988)
5. "Inelastic Deformation of Metals", D.C. Stouffer and L.T. Dame, Wiley (1996)
6. "The Physics of Creep", F.R.N. Nabarro, H.L. deVilliers, Taylor and Francis (1995)

Course Code	INDUSTRIAL ROBOTICS & EXPERT SYSTEM		L	T	P	C
21D150406			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Create a team name and choose roles for each person on the team. You may use the roles we have in the class or create roles as a team. An explanation of roles must be described of your journal. Give an example of a task that role would perform and a quote of what they might say. (Be specific to robotics.) A list of who is assigned to each role will be on page 3 of the journal. Remember, your grade will be based on how well you work together. All students have contributed equally.
- This course involves a cognitive understanding of the process of designing a robot. This class gives students a real life experience on what it takes to be a professional engineer.

UNIT–I (12 Hours)

INTRODUCTION AND ROBOT KINEMATICS: Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT–II (10 Hours)

ROBOT DRIVES AND CONTROL: Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT–III (10 Hours)

ROBOT SENSORS: Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT–IV (8 Hours)

ROBOT CELL DESIGN AND APPLICATION: Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT–V (10 Hours)

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS: Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TEXT BOOKS:

1. "Robotics Control, Sensing, Vision and Intelligence", K.S.Fu, R.C. Gonzalez and C.S.G. Lee, Mc Graw Hill, 1987.

REFERENCES:

1. "Robotics for Engineers", Yoram Koren," Mc Graw-Hill,1987.
2. "Industrial Robots", Kozyrey, Yu. MIR Publishers Moscow,1985.
3. "Robotics Engineering – An Integrated Approach", Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, Prentice-Hall of India Pvt. Ltd., 1984.
4. "Robotics Technology and Flexible Automation", Deb, S.R. Tata Mc Graw-Hill,1994.
5. "Industrial Robotics Technology, Programming and Applications", Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,Mc Graw-Hill, Int.1986.
6. "Expert Systems and Robotics", Timothy Jordanides et al, Springer –Verlag, New York, May1991.

Course Code	MECHANICAL VIBRATIONS		L	T	P	C
21D150407			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand basic and intermediate concepts necessary for the analysis of the dynamics of complex structures under various loading conditions.
- To Explain and correlate the structural properties of complex structures to the overall vibration characteristics in order to design systems having required dynamical properties.
- Apply theoretical and numerical procedures to predict the dynamic response of discrete or continuous structural systems under the most diverse loading conditions.
- Develop reduced order models to treat systems with a large number of DOF. Understand and implement approximate methods for the numerical solution of distributed parameter systems. Understand the main features of the dynamics of nonlinear lumped parameter systems.

UNIT–I (12 Hours)

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation; Vibration isolation and transmissibility .

Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT–II (8 Hours)

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

Two degree freedom systems: Principal modes – undamped and damped free and forced vibrations; undamped vibration absorbers;

UNIT–III (12 Hours)

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

UNIT–IV (8 Hours)

Numerical Methods: Rayliegh's, stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

UNIT–V (12 Hours)

Continuous systems: Free vibration of strings – longitudinal oscillations of bars-traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

TEXT BOOKS:

1. "Elements of Vibration Analysis" byMeirovitch.
2. "Mechanical Vibrations" by G.K.Groover.

REFERENCES:

1. "Vibrations" by W.T.Thomson
2. "Mechanical Vibrations", – Schaumseries.
3. "Vibration problems in Engineering", by S.P.Timoshenko.
4. "Mechanical Viabrations", – V.RamMurthy.

Course Code	EXPERIMENTAL STRESS ANALYSIS		L	T	P	C
21D150507			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To bring awareness on experimental method of finding the response of the structure to different types of load.

UNIT–I (12 Hours)

Introduction: Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Three-dimensional stress strain relations.

Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits, effect of poission ratio strain gauge results, measurements of residual strain general applications.

UNIT–II (12 Hours)

Brittle coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

UNIT–III (12 Hours)

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

UNIT–IV (8 Hours)

Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics

UNIT–V (12 Hours)

Three dimensional Photo elasticity : Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses,

the shear- difference method in three dimensions, applications of the Frozen-stress method, the scattered- light method.

Birefringent Coatings: Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

TEXT BOOKS:

1. "Theory of Elasticity", Timoshenke and GoodierJr
2. "Experimental stress analysis", Dally and Riley, McGraw-Hill

REFERENCES:

1. "A treatise on Mathematical theory of Elasticity", Love.A.H
2. "Photo Elasticity", Frocht

Course Code	THEORY OF PLASTICITY		L	T	P	C
21D150508			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Student acquires information on elementary theory of plasticity inclusive the relationship between the external loading and non-linear permanent straining of hardened metallic isotropic and anisotropic continuum.
- The student will understand the fundamentals of progressive methods of metal forming process design, namely modeling and finite element simulation.

UNIT–I (12 Hours)

Introduction: Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors. Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses. Elastic strain energy. Mohr's representation of stress in 2 & 3 dimensions. Haigh-Westergaard stress space. Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria.

UNIT–II (12 Hours)

Strain at point: Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations

Principle of virtual work and its rate forms: Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

UNIT–III (12 Hours)

Criteria for loading and unloading: Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic–plastic materials. Expansion of a thick walled cylinder.

Incremental stress strain relationships: Prandtl-Reuss material model. J_2 deformation theory, Drucker-Prager material, General Isotropic materials.

UNIT–IV (12 Hours)

Deformation theory of plasticity: Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

Finite element formulation for an elastic plastic matrix: Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations.

UNIT–V (10 Hours)

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behaviour Theorems of limit analysis: Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorems, examples and problems.

TEXT BOOKS/REFERENCES:

1. "Plasticity for structural engineering", W. F. Chen and D. J. Han, Springerverlag-1987.
2. "Mechanics of Materials –II", Victor E. Saouma

Course Code	APPLIED ENGINEERING ACOUSTICS		L	T	P	C
21D150509			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To impart knowledge on the fundamentals of acoustics, its characteristics, its transmission in different media, usage of sound measuring instruments and the various sound control methods.

UNIT–I (10 Hours)

BASIC CONCEPTS OF ACOUSTICS

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power– Wave motion – Alteration of wave paths –Measurement of sound waves – sound spectra– Sound fields – Interference – Standing waves – Acoustic energy density and intensity – Specific acoustic impedance.

UNIT–II (12 Hours)

CHARACTERISTICS OF SOUND

One dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

UNIT–III (12 Hours)

TRANSMISSION PHENOMENA: Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

UNIT–IV (12 Hours)

INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND

Introduction – Decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness – Loudness, Loudness level, perceived noise, perceived noise level – Equivalent sound level– Identified level – Frequency and Amplitude measurement.

UNIT–V (10 Hours)

BASICS OF NOISE CONTROL: Noise Control at source, path, receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

REFERENCES:

1. "Fundamentals of Acoustics", Lawrence E. Kinsler, Austin R. Frey, John Wiley and Sons Inc.,1986.
2. "Engineering Noise Control – Theory and Practice", Bies, David, A. and Hansen, Colin H., E and FN Spon, Chapman-Hall, Second Edition,1996.
3. "Active Control of Sound and Vibration", Hansen C.H. and Snyder, S.D., E and FN Spon, London1996.

Course Code	DESIGN FOR MANUFACTURING		L	T	P	C
21D150510			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate and flexibility.
- Provide exposure to a range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selected processes.
- Apply physics to understand the factors that control the rate of production and influence the quality, cost and flexibility of processes.
- Understand the impact of manufacturing constraints on product design and process planning.
- Apply an understanding of variation to the factors that control the production rate and influence the quality, cost and flexibility of processes and systems.

UNIT–I (12 Hours)

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT–II (10 Hours)

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT–III (10 Hours)

Metal casting: Appraisal of various casting processes, selection of casting process,- general design considerations for casting-casting tolerance-use of solidification, simulation in casting design- product design rules for sand casting.

UNIT–IV (12 Hours)

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT–V (12 Hours)

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components- design considerations for injectionmoulding.

TEXT BOOKS:

1. "Design for manufacture", John cobert, Adisson Wesley.1995
2. "Design for Manufacture", Boothroyd,

REFERENCES:

1. "ASM Hand book", Vol.20

Course Code	PRESSURE VESSEL DESIGN		L	T	P	C
21D150511			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To give exposure to various types of process equipments and their design.
- To understand the different types of stresses and their effects in pressure vessel. To understand the piping layout and the stresses acting on it.

UNIT–I (12 Hours)

Introduction: Materials-shapes of Vessels-stresses in cylindrical, spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load, bending and torque-ilation of pressure vessels-conical and tetrahedral vessels.

Theory of thick cylinders: Shrink fit stresses in built up cylinders-auto frettage of thick cylinders. Thermal stresses in Pressure Vessels.

UNIT–II (10 Hours)

Theory of rectangular plates: Pure bending-different edge conditions.

Theory circular plates: Simple supported and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

UNIT–III (10 Hours)

Discontinuity stresses in pressure vessels: Introduction, beam on an elastic foundation, infinitely long beam, semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses inflanges.

UNIT–IV (12 Hours)

Pressure vessel materials and their environment: Introduction, ductile material tensile tests, structure and strength of steel, Leuder's lines, determination of stress patterns from plastic flow observations, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack

growth, fatigue life prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.

UNIT–V (12 Hours)

Stress concentrations: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life, thermal stress fatigue, creep and rupture of metals at elevated temperatures, hydrogen embrittlement of pressure vessel steels, brittle fracture, effect of environment on fracture toughness, fracture toughness relationships, criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.

Design features: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subjected to tension, elliptical openings, stress concentration, stress concentration factors for superposition, dynamic and thermal transient conditions, theory of reinforced openings, nozzle reinforcement, placement and shape, fatigue and stress concentration.

TEXT BOOKS:

1. "Theory and design of modern Pressure Vessels", John F.Harvey, Van Nostrand Rainfold, NewYork.
2. "Pressure Vessel Design and Analysis", Bickell, M. B. Ruizcs.

REFERENCES:

1. "Process Equipment design", Beowll & Yound Ett.
2. "Indian standard code for unfired Pressure vessels", IS:2825.
3. "Pressure Vessel Design Hand Book", Henry H. Bednar, P.E., C.B.S. Publishers, New Delhi.

Course Code	MECHANICS OF COMPOSITE MATERIALS		L	T	P	C
21D150512			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behavior and the analysis of laminated plates. The students will undertake a design project involving application of fiber reinforced laminates.

UNIT–I (12 Hours)

Introduction to Composite Materials: Introduction, Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber- Reinforced Composites and nature-made composites, and applications **Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

Processing methods: Autoclave, contact moulding, compression moulding, filament winding, man layup, pultrusion, vaccum assisted RTM.

UNIT–II (12 Hours)

Macromechanical Analysis of a Lamina :Introduction ,Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two- Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a lamina

UNIT–III (12 Hours)

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina: Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory, Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses

and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina

UNIT–IV (10 Hours)

Micromechanical Analysis of a Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi- Empirical Models, Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion.

UNIT–V (12 Hours)

Macromechanical Analysis of Laminates: Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates

Failure, Analysis, and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

TEXT BOOKS:

1. "Engineering Mechanics of Composite Materials", Isaac and M Daniel, Oxford University Press,1994.
2. "Analysis and performance of fibre Composites", B. D. Agarwal and L. J. Broutman, Wiley- Interscience, New York,1980.
3. "Mechanics of Composite Materials", Autar K. Kaw , 2nd Edition, (Mechanical Engineering), Publisher:CRC

REFERENCES:

1. "Mechanics of Composite Materials", R. M. Jones, Mc Graw Hill Company, New York, 1975.
2. "Analysis of Laminated Composite Structures", L. R. Calcote, Van Nostrand Rainfold, New York,1969.

Course Code	MACHINE DYNAMICS LABORATORY		L	T	P	C
21D150408			0	0	4	2
Pre-requisite	NIL	Semester	II			

List of Experiments:

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils
2. Determination of steady state amplitude of a forced vibratory system
3. Static balancing using steel balls
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer
8. Diagnosis of a machine using FFT analyzer.
9. Direct kinematic analysis of a robot
10. Inverse kinematic analysis of a robot
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

Course Code	RESEARCH METHODOLOGY		L	T	P	C
21D110601			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

UNIT – I (10 Hrs)

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT – II (10 Hrs)

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT – III (10 Hrs)

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT – IV (10 Hrs)

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT – V (10 Hrs.)

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

TEXT BOOKS

1. "Research Methodology: Methods And Techniques", C.R.Kothari, 2nd Edition, New Age International Publishers.
2. "Research Methodology: A Step By Step Guide For Beginners", Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. "Research Methodology And Statistical Tools", P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition, Excel Books, New Delhi.

REFERENCE BOOKS

1. "Scientists Must Write", Robert Barrass (Available As Pdf on Internet)
2. "Crafting Your Research Future", Charles X. Ling And Quiang Yang (Available as PDF on Internet)

Course Code	HUMAN VALUES AND PROFESSIONAL ETHICS		L	T	P	C
21D110602			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVE:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT - I (8 Hrs)

Human Values - Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

UNIT - II (10 Hrs)

Engineering Ethics- Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

UNIT - III (10Hrs)

Engineering As Social Experimentation - Engineering As Social experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT - IV (8 Hrs)

Engineers Responsibility For Safety And Risk - Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk Safety and the Engineer- Designing for the safety- Intellectual Property rights (IPR).

UNIT - V (10 Hrs)

Global Issues - Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics.

TEXT BOOKS

1. "Engineering Ethics includes Human Values" by M. Govindarajan, S.Natarajan and V. S. Senthil Kumar-PHI Learning Pvt. Ltd-2009.
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

REFERENCE BOOKS

1. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata Mc Graw Hill– 2003.
2. "Professional Ethics and Morals" by Prof. A. R. Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A. Alavudeen, R.Kalil Rahman and M.Jayakumaran, Laxmi Publications.

Course Code	INTELLECTUAL PROPERTY RIGHTS		L	T	P	C
21D110603			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- To be about current trends in IPR and Govt. steps in fostering IPR

UNIT – I (10 Hours)

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II (10 Hours)

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III (12 Hours)

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV (12 Hours)

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation. Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V (12 Hours)

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS:

1. "Intellectual Property Right", Deborah. E. Bouchoux, Cengage Learing.
2. "Intellectual Property Right" – Nleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

ELECTRONICS AND COMMUNICATION ENGINEERING

(For the batches admitted from the academic year 2021-22)

Vision

- To produce technically competent and research-oriented Electronics and Communication Engineers to meet the Industrial and Social requirements.

Mission

- To impart quality technical education in the field of Electronics and Communication Engineering through state-of-the art facilities and effective teaching learning process.
- To enrich the faculty and students with research and consultancy skills through Industry-Interaction and Training in Emerging areas of Electronics and Communication Engineering.
- To develop lifelong learning, leadership qualities and ethical values in learners to meet the societal and industrial needs.

Institutional Objectives

- To create a conductive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development programmes, Entrepreneurship, and extension activities.
- To introduce demand driven new UG & PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Lifelong Learning:* In the fast changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.

- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff, and students from all social, economic, ethics, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.
- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

M.Tech – ECE – VLSI SYSTEM DESIGN (VLSISD)
(For the batches admitted from the academic year 2021-22)

M.Tech I Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D570401	Structural Digital System Design	4	0	0	4	40	60	100
2	PC	21D570402	Advanced MOSFET Modeling	4	0	0	4	40	60	100
3	PC	21D570403	CMOS Analog IC Design	4	0	0	4	40	60	100
4	PC	21D570404	CMOS Digital IC Design	4	0	0	4	40	60	100
5	PE	21D570501 21D570502 21D570503	**Elective-I** a. VLSI Signal Processing b. Advanced Computer Architecture c. CAD for VLSI	3	0	0	3	40	60	100
6	PE	21D570504 21D570505 21D570506	**Elective-II** a. CPLD and FPGA Architectures and Applications b. ASIC Design c. Optimization Techniques in VLSI Design	3	0	0	3	40	60	100
7	PC	21D570405	Structural Digital System Design Lab	0	0	4	2	40	60	100
8	PC	21D570406	VLSI System Design Lab - I	0	0	4	2	40	60	100
Total							**26**	**320**	**480**	**800**

M.Tech II Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D570407	Low Power VLSI Design	4	0	0	4	40	60	100
2	PC	21D570408	CMOS Mixed signal Design	4	0	0	4	40	60	100
3	PC	21D570409	Embedded System Design	4	0	0	4	40	60	100
4	PC	21D570410	Test and Testability	4	0	0	4	40	60	100
5	PE	21D570507 21D570508 21D570509	**Elective-III** a. System On Chip Architecture b. Semiconductor Memory Design and Testing c. RFIC Design	3	0	0	3	40	60	100
6	PE	21D570510 21D570511 21D570512	**Elective-IV** a. Internet of Things b. Hardware and Software Co-design of Embedded System c. Physical Design Automation	3	0	0	3	40	60	100
7	PC	21D570411	Embedded System Design Lab	0	0	4	2	40	60	100
8	PC	21D570412	VLSI System Design Lab – II	0	0	4	2	40	60	100
Total							**26**	**320**	**480**	**800**

M.Tech III Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	OE	21D110601 21D110602 21D110603	**Elective-V** a. Research Methodology b. Human Values & Professional Ethics c. Intellectual Property Rights	4	0	0	4	40	60	100
2	PE	21D570513	**Elective-VI (MOOCs)**	0	0	0	0	0	0	0
3	PC	21D570413	Comprehensive Viva Voce	0	0	0	2	100	0	100
4	PC	21D570414	Seminar	0	0	0	2	100	0	100
5	PC	21D570415	Teaching Assignment	0	0	0	2	100	0	100
6	PC	21D570416	Project Work Phase I	0	0	0	4	0	0	0
Total							**14**	**340**	**60**	**400**

M.Tech IV Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D570417	Project Work Phase II	0	0	0	12	0	0	0
Total							**12**	**0**	**0**	**0**

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

Course Code	STRUCTURED DIGITAL SYSTEM DESIGN		L	T	P	C
21D570401			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To study and understand structural functionality of different Digital blocks (Both combinational and Sequential)
- To provide an exposure to ASM charts and realize their designs.
- To represent the design of various digital blocks in different modeling styles using VHDL.
- To understand the concept of micro programming and issues related to micro programming

UNIT-I (10 Hrs)

BUILDING BLOCKS FOR DIGITAL DESIGN: Multiplexer, Demultiplexer, Decoder, Encoder, Comparator, Adder, ALU, Carry-look-ahead adder.

BUILDING BLOCKS WITH MEMORY: Clocked building blocks, register building blocks, RAM, ROM, PLA, PAL, Timing devices.

UNIT - II (12 Hrs)

DESIGN METHODS: Elements of design style, top-down design, separation of controller and architecture, refining architecture, and control algorithm, Algorithmic State Machines, ASM chart notations.

UNIT - III (10 Hrs)

REALISING ASMS - Traditional synthesis from ASM chart, multiplexer controller method, one-shot method, ROM based method.

ASYNCHRONOUS INPUTS AND RACES - Asynchronous ASMs, Design for testability, test vectors, fault analysis tools.

UNIT - IV (10 Hrs)

MICRO PROGRAMED DESIGN: Classical Microprogramming with Modem Technology; Enhancing the Control Unit; The 2910 Microprogram Sequencer; Choosing a Microprogram Memory; A Development System for Microprogramming; Designing a Microprogrammed Minicomputer

UNIT - V (08 Hrs)

MODELLING WITH VHDL: CAD tools, simulators, schematic entry, synthesis from VHDL.

DESIGN CASE STUDIES: Single pulse, system clock, serial to parallel data conversion, traffic light controller.

TEXT BOOKS:

1. "The Art of Digital Design", Franklin P. Prosser and David E. Winkel, Prentice Hall.
2. "Digital System Design using VHDL", Roth, Mc. Graw Hill, 2000

REFERENCE BOOKS:

1. "An Engineering Approach to Digital Design", William Fletcher,1st Edition, Prentice-Hall India, 1997.
2. "Digital Systems Engineering", William J Dally and John W Poulton, Cambridge University Press, 2008.
3. "A VHDL Primer", Jayaram Bhasker, 3rd edition, Prentice-Hall India, 2009.
4. "VHDL for Programmable Logic", Kevin Skahill, Cypress Semiconductors

Course Code	ADVANCED MOSFET MODELING		L	T	P	C
21D570402			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Derive mathematical models for advanced MOS devices.
- To Provide solution to overcome short channel issues.
- To develop various compact models suitable for industry.

UNIT - I (12 Hrs)

BASIC DEVICE PHYSICS

Intrinsic and extrinsic semiconductors, direct and indirect semiconductors- Electrons and holes in silicon energy bands: electron and hole densities in equilibrium- Fermi Dirac statistics, carrier concentration, ionization of impurities. Carrier transport in silicon : drift current, diffusion current. pn junctions built in potential, electric field, current voltage characteristics.

UNIT - II (12 Hrs)

MOSFET DEVICES

MOS capacitors surface potential- structure characteristics, electrostatic potential and charge distribution- threshold voltage- polysilicon work function- interface states and oxide traps. Long channel MOSFETs: threshold voltage, substrate bias and temperature dependence of threshold voltage, drain current model, subthreshold characteristics, channel mobility, capacitances.

UNIT - III (10 Hrs)

NANO SCALED MOSFETs

Scaling of MOSFETs: Short channel MOSFETs – short channel effects, velocity saturation, channel length modulation, DIBL, GIDL. Variability in MOSFETs. Reliability of MOSFETs high field effects, hot carrier degradation, negative bias temperature instability, MOSFET breakdown, high k dielectrics. Non classical MOSFETs: SOI MOSFETs Current voltage equations, fully depleted SOI MOSFETs, partially depleted SOI MOSFETs, Heterostructure MOSFETs, strained channel MOSFETs, Power MOSFETs, SiC MOSFETs- Silicon Nanowires- Carbon Nanotubes.

UNIT - IV (8 Hrs)

NOISE MODELING AND PROCESS VARIATION

Noise sources in MOSFET: Flicker noise modeling, Thermal noise modeling- model for accurate distortion analysis- nonlinearities in CMOS devices and modeling- calculation of distortion in analog CMOS circuits. Influence of process variation- modeling of device mismatch for Analog/RF Applications- Benchmark circuits for quality assurance- Automation of the tests.

UNIT - V (8 Hrs)

COMPACT MODELS FOR CIRCUIT SIMULATORS

Introduction to compact models, SPICE Level 1, 2 and 3 MOS models, BSIM model, EKV model, High frequency models- Parameter extraction of MOSFETs.

TEXT BOOKS:

1. "Fundamentals of Modern VLSI Devices", Taur and T. H. Ning, Cambridge University Press, Cambridge, United Kingdom, 1998.
2. "Device Modeling for Analog and RF CMOS Circuit Design", Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, John Wiley & Sons Ltd,2003.
3. "Solid State Electronic Devices", B. G. Streetman and S. Banarjee, 6th edition‖, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2005.
4. "Semiconductor Devices – Modeling and Technology", N. Das Gupta and A. Das Gupta, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2004.

REFERENCE BOOKS:

1. "Compact MOSFET Models for VLSI Design", A. B. Bhattacharyya, John Wiley & Sons Inc., 2009.
2. "Strained silicon hetero structures: materials and devices", C. K. Maiti, N. B. Chakrabarti, S. K. Ray, The Institution of Electrical Engineers, London, United Kingdom, 2001.
3. "BSIM 4 and MOSFET Modeling for IC simulation", Weidong Liuand Chemming Hu‖, World scientific and Publishing Co. Pte. Ltd.2011

WEB REFERENCE BOOKS:

1. www.fairchildsemi.com/products/discretes/fets/
2. www.mosis.com/pages/Technical/Testdata/submicron-spice-parameters
3. en.wikipedia.org/wiki/Carbon_nanotube
4. www.nxp.com/wcm_documents/models/mos-models/model-9/aacd96_sel
5. web.cs.mun.ca/~paul/transistors/node3.html
6. www.elab.ntua.gr/bemos/index.html

Course Code	CMOS ANALOG IC DESIGN		L	T	P	C
21D570403			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand the importance of different biasing methods and apply them for the design of analog ICs.
- To Analyze the functions of Current Mirrors, Current Sinks, Differential amplifiers and Current amplifiers.
- To Design basic building blocks of analog ICs like, current mirrors, current sources, current sinks, two stage CMOS Power amplifiers and comparators.

UNIT – I (10 Hrs.)

MOS Devices and Modeling: The MOS Transistor, Passive Components-Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT – II (10 Hrs)

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage REFERENCE BOOKS, Band gap Reference.

UNIT – III (10 Hrs)

CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures, Mismatch-offset cancellation techniques, Reduction of Noise by offset cancellation techniques, Alternative definition of CMRR.

UNIT – IV (10 Hrs)

CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT – V (10 Hrs)

Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS:

1. "Design of Analog CMOS Integrated Circuits", Behzad Razavi, TMH Edition.
2. "CMOS Analog Circuit Design", Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

REFERENCE BOOKS:

1. "Analog Integrated Circuit Design", David A.Johns, Ken Martin, Wiley Student Edn, 2013.
2. "CMOS: Circuit Design, Layout and Simulation", Baker, Li and Boyce.
3. "Analysis and Design of Analog Integrated Circuits", Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

Course Code	CMOS DIGITAL IC DESIGN		L	T	P	C
21D570404			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Design CMOS inverters with specified noise margins and propagation.
- To Realize and implement basic combinational and sequential elements which are frequently used in digital ICs.
- Should be able to Design basic combinational and sequential circuits using NMOS and CMOS design techniques.
- To Analyze the dynamic performance of CMOS circuits

UNIT-I (10 Hrs)

MOS Design Pseudo NMOS Logic: Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II (10 Hrs)

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT-III (11 Hrs)

Sequential MOS Logic Circuits: Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT-IV (10 Hrs)

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT-V (9 Hrs)

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash

TEXT BOOKS:

1. "Digital Integrated Circuit Design", Ken Martin, Oxford University Press, 2011.
2. "CMOS Digital Integrated Circuits Analysis and Design", Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

REFERENCE BOOKS:

1. "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", Ming-BO Lin, CRC Press, 2011
2. "Digital Integrated Circuits – A Design Perspective", Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.

Course Code	VLSI SIGNAL PROCESSING		L	T	P	C
21D570501			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To acquire knowledge on signal processing system and various techniques of power reduction.
- To Realize various adders and multipliers and optimize their operation by reducing the redundant operations
- To Apply the concept of pipelined architecture for various combinational and sequential circuits.
- Should be able to Design Low Power IIR filters

UNIT-I (9 Hrs)

Transformations for retiming. Folding and unfolding DSP programs.

UNIT-II (11 Hrs)

Bit level arithmetic structures- parallel multipliers, interleaved floor plan and bit plan based digital filters. Bit serial multipliers. Bit serial filter design and implementation. Canonic signed digit arithmetic, Distributed arithmetic.

UNIT-III (10 Hrs)

Redundant arithmetic, redundant number representations, carry free radix 2 addition and subtraction . Hybrid radix 4 addition. Radix 2 hybrid redundant multiplication architectures, data format conversion. Redundant to nonredundant converter. Numerical strength reduction.

UNIT-IV (10 Hrs)

Synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining. Implementation of wave-pipelined systems. Asynchronous pipelining.

UNIT-V (10 Hrs)

Scaling versus power consumption. Power analysis, power reduction techniques, power estimation techniques. Low power IIR filter design. Low power CMOS lattice IIR filter.

TEXT BOOKS:

1. "VLSI Digital Signal Processing systems", K.K. Parhi, John Wiley, 1999.
2. "VLSI and Modern Signal Processing", Kung S. Y, H. J. While House, T. Kailath, 1985, Prentice Hall.

REFERENCE BOOKS:

1. "Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing", Jose E. France, Yannis Tsividis, 1994, Prentice Hall.
2. "VLSI Digital Signal Processing", Medisetti V. K, 1995, IEEE Press (NY), USA.

Course Code	ADVANCED COMPUTER ARCHITECTURE		L	T	P	C
21D570502			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To acquire knowledge in parallel computer models and their network properties.
- To Understand various concepts related to pipelining and super scalar techniques.
- To gain knowledge regarding multi processors and multi computers.

UNIT – I (10 Hrs)

Parallel Computer Models – System attributes to performance, Multiprocessors and Multicomputers, Classifications of Architectures, Multivector and SIMD Computers, Architecture development tracks

UNIT – II (10 Hrs)

Program and Network Properties- Conditions for parallelism, Program partitioning and Scheduling, Program flow mechanisms, System interconnect architectures, Performance metrics and measures, Parallel Processing Applications

UNIT-III (12 Hrs)

Processors and Memory Hierarchy- Advanced Processor Technology, Superscalar and Vector processors, Memory hierarchy technology, Virtual Memory, Backplane bus systems, Cache memory organizations, Shared memory organizations

UNIT – IV (9 Hrs)

Pipelining and Superscalar Techniques Linear Pipeline processors, Nonlinear pipeline processors, Instruction pipeline design, Arithmetic pipeline design, Superscalar and Super Pipeline Design

UNIT- V (9 Hrs)

Multiprocessors and Multicomputers: Multiprocessor System Interconnects, Cache Coherence and Synchronization mechanisms, Three generations of Multicomputers, Message passing mechanisms, Vector Processing principles, Principles of Multithreading

TEXT BOOKS:

1. "Advanced Computer Architecture", Hwang kai, McGraw-Hill, 2001.
2. "Computer Architecture", Patterson**,** Morgn Kaufmann, 2001.

REFERENCE BOOKS:

1. "Computer Organization and Architecture", William Stallings, 8th Edition, Prentice-Hall India, 2010.
2. "Computer Organization and Design", David A Patterson and John L. Hennesey, 4th Edition, Elsevier India, 2011.
3. "Structured Computer Organization", Andrew S Tanenbaum and James R Goodman, 5th Edition Prentice Hall India, 2009.

Course Code	CAD FOR VLSI		L	T	P	C
21D570503			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- To Optimize the implemented design for area, time and power by applying suitable constraints.
- To Gain knowledge on methodologies involved in design, verification and implementation of digital designs on reconfigurable hardware platform (FPGA)
- To Acquire knowledge on the methodologies involved in design, verification and implementation of digital designs on MCMs.
- To Develop various algorithms at various levels of physical design.

UNIT-I (10 Hrs)

VLSI Physical Design Automation VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles, System Packaging Styles.

UNIT-II (10 Hrs)

Partitioning, Floor Planning, Pin Assignment and Placement Partitioning – Problem formulation, Classification of Partitioning algorithms, Kernighan-Lin Algorithm, Simulated Annealing.

Floor Planning – Problem formulation, Classification of floor planning algorithms, constraint based floor planning, Rectangular Dualization, Pin Assignment – Problem formulation, Classification of pin assignment algorithms, General and channel Pin assignments.

UNIT-III (10 Hrs)

Placement – Problem formulation, Classification of placement algorithms, Partitioning based placement algorithms.

UNIT-IV (10 Hrs)

Global Routing and Detailed Routing Global Routing – Problem formulation, Classification of global routing algorithms, Maze routing algorithms, Detailed Routing – Problem formulation, Classification of routing algorithms, Single layer routing algorithms.

UNIT-V (10 Hrs)

Physical Design Automation of FPGAs and MCMs FPGA Technologies, Physical Design cycle for FPGAs, Partitioning, Routing – Routing Algorithm for the Non-Segmented model, Routing Algorithms for the Segmented Model; Introduction to MCM Technologies, MCM Physical Design Cycle.

TEXT BOOKS:

1. "Algorithms for VLSI Physical Design Automation", Naveed Shervani, 3rd Edition, 2005, Springer International Edition.
2. "CMOS Digital Integrated Circuits Analysis and Design", Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

REFERENCE BOOKS:

1. "VLSI Physical Design Automation-Theory and Practice", Sadiq M Sait, Habib Youssef, World Scientific.
2. "Algorithms for VLSI Design Automation", S. H. Gerez, 1999, Wiley student Edition, John Wiley and Sons (Asia) Pvt. Ltd.
3. "VLSI Physical Design Automation", Sung Kyu Lim, Springer International Edition

Course Code	CPLD AND FPGA ARCHITECTURES AND APPLICATIONS		L	T	P	C
21D570504			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Acquire knowledge about various architectures and device technologies of PLD's.
- To Comprehend FPGA Architectures
- To Analyze System Level Design and their application for Combinational and Sequential Circuits
- To Apply knowledge of this subject for various design applications

UNIT-I (12 Hrs)

Introduction to Programmable Logic Devices Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/ Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

UNIT-II (11 Hrs)

Field Programmable Gate Arrays Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

UNIT–III (9 Hrs)

SRAM Programmable FPGAs Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT–IV (8 Hrs)

Anti-Fuse Programmed FPGAs Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT–V (10 Hrs)

Design Applications General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

TEXT BOOKS:

1. "Field Programmable Gate Array Technology", Stephen M. Trimberger, Springer International Edition.
2. "Digital Systems Design", Charles H. Roth Jr, Lizy Kurian John, Cengage Learning.

REFERENCE BOOKS:

1. "Field Programmable Gate Arrays", John V. Oldfield, Richard C. Dorf, Wiley India.
2. "Digital Design Using Field Programmable Gate Arrays", Pak K. Chan/Samiha Mourad, Pearson Low Price Edition.
3. "Digital Systems Design with FPGAs and CPLDs", Ian Grout, Elsevier, Newnes.
4. "FPGA based System Design", Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

Course Code	ASIC DESIGN		L	T	P	C
21D570505			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand different types of ASICs and their libraries.
- To Understands about programmable Asics, I/O modules and their interconnects.
- To Acquire in depth knowledge regarding different methods of software ASIC design their simulation, testing and construction of ASICs.

UNIT - I (10 Hrs)

INTRODUCTION TO ASICs:

Types of ASICs, Design Flow, Case Study, Economics of ASICs, ASIC Cell Libraries, Transistors as resistors, Transistor Parasitic Capacitance, Logical Effort, Library Cell Design, Library Architecture, Gate-Array Design, Standard Cell Design, Data Path Cell Design.

UNIT - II (10 Hrs)

PROGRAMABLE ASICS AND PROGRAMABLE ASIC LOGIC CELLS:

The Anti fuse, Static Ram, EPROM and EEPROM Technology, Practical Issues, Specifications, PREDP Benchmarks, FPGA Economics, Actel ACT, Xilinx LCA, Altera Flex, Altera Max.

UNIT - III (10 Hrs)

I/O CELLS AND INTERCONNECTS & PROGRAMMABLE ASIC DESIGN SOFTWARE:

DC Output, AC Output, DC input, AC input, Clock input, Power input, Xilinx I/O block, Other I/O Cells, Actel ACT, Xilinx LCA, Xilinx EPLD, Altera Max 5000 and 7000, Altera Max 9000, Altera FLEX, Design Systems, Logic Synthesis, The Half gate ASIC.

UNIT - IV (10 Hrs)

LOW LEVEL DESIGN ENTRY AND LOGIC SYNTHESIS:

Schematic Entry, Low level Design Languages, PLA Tools, EDIF, A logic synthesis example, A Comparator/MUX, Inside a Logic Synthesizer, Synthesis of Viterbi Decoder, Verilog and Logic synthesis, VHDL and Logic Synthesis, Finite State Machine Synthesis, Memory Synthesis, The Engine Controller, Performance Driven Synthesis, Optimization of the viterbi decoder.

UNIT - V (10 Hrs)

SIMULATION, TEST AND ASIC CONSTRUCTION:

Types of Simulation, The Comparator/MUX Example, Logic Systems, How Logic Simulation Works, Cell Models, Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation, The importance of test, Boundary Scan Test, Faults, Faults Simulation, Automatic Test Pattern Generator, Scan Test, Built in Self Test, A simple test

Example, Physical Design, CAD Tools, System Partitioning, Estimating ASIC Size, Power Dissipation, FPGA Partitioning, Partitioning Methods

TEXT BOOKS:

1. "Application Specific Integrated Circuits", Michael John Sebastian Smith, Pearson Education, 2003.
2. "Integrated Circuit Engineering", L. J. Herbst, Oxford Science Publications, 1996.

REFERENCE BOOKS:

1. "Advanced ASIC Chip Synthesis using Synopsis Design compiler", Himanshu Bhatnagar, 2nd Edition, Kluwer Academic, 2001.

Course Code	OPTIMIZATION TECHNIQUES IN VLSI DESIGN		L	T	P	C
21D570506			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand the basics of statistical modeling
- To Analyze performance of CMOS circuits with respect to power, area and speed
- To acquire complete knowledge about various algorithms used for optimization of power and area.

UNIT-I (10 Hrs)

Statistical Modeling: Modeling sources of variations, Monte Carlo techniques, Process variation modeling- Pelgrom's model, Principle component based modeling, Quad tree based modeling, Performance modeling- Response surface methodology, delay modeling, interconnect delay models.

UNIT-II (10 Hrs)

Statistical Performance, Power and Yield Analysis Statistical timing analysis, parameter space techniques, Bayesian networks Leakage models, High level statistical analysis, Gate level statistical analysis, dynamic power, leakage power, temperature and power supply variations, High level yield estimation and gate level yield estimation.

UNIT-III (10 Hrs)

Convex Optimization Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floor planning, wire sizing, Approximation and fitting- Monomial fitting, Maxmonomial fitting, Polynomial fitting.

UNIT-IV (10 Hrs)

Genetic Algorithm Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement, routing technology, Mapping for FPGA- Automatic test generation- Partitioning algorithm Taxonomy-Multi-way Partitioning Hybrid genetic-encoding-local improvement-WDFR Comparison of CAS-Standard cell placement GASP algorithm-unified algorithm.

UNIT-V (10 Hrs)

GA Routing Procedures and Power Estimation Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures, Power estimation-application of GA Standard cell placement-GA for ATG-problem encoding- fitness function-GA Vs Conventional algorithm.

TEXT BOOKS:

1. "Statistical Analysis and Optimization for VLSI: Timing and Power", Ashish Srivastava, Dennis Sylvester, David Blaauw, Springer, 2005.
2. "Genetic Algorithm for VLSI Design, Layout and Test Automation", Pinaki Mazumder, E. Mrudnick, Prentice Hall,1998.

REFERENCE BOOKS:

1. "Convex Optimization", Stephen Boyd, Lieven Vandenberghe, Cambridge University Press, 2004.

Course Code	STRUCTURAL DIGITAL SYSTEM DESIGN LAB		L	T	P	C
21D570405			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand about VHDL and Verilog Programming in Different modeling styles
- To understand differences between Verilog and VHDL.
- To represent the different digital blocks in Verilog and VHDL in all available styles of modelling

Using VHDL or Verilog do the following experiments

1. Design of 4-bit adder / subtractor
2. Design of Booth Multiplier
3. Design of 4-bit ALU
4. Design SISO, SIPO, PISO, PIPO Registers
5. Design of Ripple, Johnson and Ring counters
6. Design of MIPS processor
7. Design of Washing machine controller
8. Design of Traffic Light Controller
9. Design “1010” pattern detector using Mealy state Machine
10. Design “1100” recursive pattern detector using Moore state Machine
11. Design simple Security System Using FSM/ASM
12. Mini Project

Tools Required:

VHDL or VERILOG

Hardware Required:

Computers with latest Configuration.

Course Code	VLSI SYSTEM DESIGN LAB - I		L	T	P	C
21D570406			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Understand syntax of various commands available with Verilog and fundamentals associated with design of digital systems
- To design, simulate and implement various digital system like traffic light controller, UART.
- To be Able develop problem solving skills and adapt them to solve real world problems
- Should be able to write scripts using Perl for building digital blocks.

The students are required to design the logic circuit to perform the following experiments using necessary simulator (Xilinx ISE Simulator/Mentor Graphics Questa Simulator) to verify the logical /functional operation and to perform the analysis with appropriate synthesizer (Xilinx ISE Synthesizer/Mentor Graphics Precision RTL) and then verify the implemented logic with different hardware modules/kits (CPLD/FPGA kits).

The students are required to design and implement the Layout of the following experiments of any SIX using CMOS 130nm Technology.

List of Experiments:

1. Inverter Characteristics.
2. Full Adder.
3. RS-Latch, D-Latch and Clock Divider.
4. Synchronous Counter and Asynchronous Counter.
5. Static RAM Cell.
6. Dynamic RAM Cell.
7. ROM
8. Digital-to-Analog-Converter.
9. Analog-to-Digital Converter.
10. “10101” pattern detector using Mealy FSM
11. Analytical Comparator.
12. Mini Project

Lab Requirements:

Software:
Xilinx ISE Suite, Mentor Graphics-Questa Simulator, Mentor Graphics-Precision RTL, Perl Software.

Hardware:
Personal Computer with necessary peripherals, configuration and operating System and relevant VLSI (CPLD/FPGA) hardware Kits.

Course Code	LOW POWER VLSI DESIGN		L	T	P	C
21D570407			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect.
- To Implement Low power design approaches for system level and circuit level measures.
- To Design low power adders, multipliers and memories for efficient design of systems.

UNIT – I (12 Hrs)

Fundamentals:

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT – II (10 Hrs)

Low-Power Design Approaches:

Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT – III (10 Hrs)

Low-Voltage Low-Power Adders:

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT – IV (8 Hrs)

Low-Voltage Low-Power Multipliers:

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT – V (10 Hrs)

Low-Voltage Low-Power Memories:

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM

Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOKS:

1. "CMOS Digital Integrated Circuits – Analysis and Design", Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. "Low-Voltage, Low-Power VLSI Subsystems", Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

REFERENCE BOOKS:

1. "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", Ming-BO Lin, CRC Press, 2011.
2. "Low Power CMOS Design", Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
3. "Low Power CMOS VLSI Circuit Design", Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

Course Code	CMOS MIXED SIGNAL DESIGN		L	T	P	C
21D570408			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To illustrate first order filter with least interference.
- To Extend the concept of phase locked loop for designing PLL application with minimum jitter by considering non-ideal effects.
- To Design different A/D, D/A, modulators, demodulators for real time applications.

UNIT-I (10 Hrs)

Switched Capacitor Circuits Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT-II (10 Hrs)

Phased Lock Loop (PLL) Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs- Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs- PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT-III (10 Hrs)

Data Converter Fundamentals DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT-IV (11 Hrs)

Nyquist Rate A/D Converters Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time- interleaved converters.

UNIT-V (9 Hrs)

Oversampling Converters Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A

TEXT BOOKS:

1. "Design of Analog CMOS Integrated Circuits", Behzad Razavi, TMH Edition, 2002
2. "CMOS Analog Circuit Design", Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. "Analog Integrated Circuit Design", David A. Johns, Ken Martin, Wiley Student Edition, 2013

REFERENCE BOOKS:

1. "CMOS Integrated Analog-to- Digital and Digital-to-Analog converters", Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. "Understanding Delta-Sigma Data converters", Richard Schreier, Wiley Interscience, 2005.
3. "CMOS Mixed-Signal Circuit Design", R. Jacob Baker, Wiley Interscience,2009

Course Code	EMBEDDED SYSTEM DESIGN		L	T	P	C
21D570409			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand the issues related to hardware and software design concepts associated with processor in Embedded Systems.
- To understand the concept of low power microcontrollers.
- To understand hardware software co- design issues pertaining to design of an Embedded System using low power microcontrollers.

UNIT – I (10 Hrs)

Introduction to Embedded Electronic Systems and Microcontrollers:

An Embedded System-Definition, Embedded System Design and Development Life Cycle, An Introduction to Embedded system Architecture, The Embedded Systems Model, Embedded Hardware: The Embedded Board and the von Neumann Model, Embedded Processors: ISA Architecture Models, Internal Processor Design, Processor Performance, Board Memory: Read-Only Memory (ROM), Random-Access Memory (RAM), Auxiliary Memory, Memory Management of External Memory and Performance, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Small Microcontrollers Memory, Embedded Software, Introduction to small microcontroller (MSP430).

UNIT-II (10 Hrs)

MSP430 – I:

Architecture of the MSP430 Processor: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock System, Memory and Memory Organization.

Functions, Interrupts, and Low-Power Mode: Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.

UNIT – III (10 Hrs)

MSP430 – II:

Digital Input, Output, and Displays: Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Interface between Systems, Driving Heavier Loads, Liquid Crystal Displays, Simple Applications of the LCD.

Timers: Watchdog Timer, Timer_A, Timer_A Modes, Timer_B, Timer_B Modes, Setting the Real-Time Clock, State Machines.

UNIT – IV (10 Hrs)

MSP430 Communication:

Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, A Thermometer Using SPI Modes, Inter-integrated Circuit Bus(I^2C) and its operations, State Machines for I^2C Communication, A Thermometer Using I^2C, Asynchronous Serial Communication, Asynchronous Communication with the USCI_A, A Software UART Using Timer_A, Other Types of Communication.

UNIT – V (10 Hrs)

MSP430 Case Studies:

Introduction to Code Composer studio (CC Studio Ver. 6.1) a tutorial, A Study of blinking LED, Enabling LED using Switches, UART Communication, LCD interfacing, Interrupts, Analog to Digital Conversion, General Purpose input and output ports, I2C.

TEXT BOOKS:

1. "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Tammy Noergaard, Elsevier(Singapore) Pvt. Ltd. Publications, 2005.
2. "MSP430 Microcontroller Basics", John H. Davies, Elsevier Ltd Publications, Copyright 2008.

REFERENCE BOOKS:

1. "Introduction to Embedded Systems Using Microcontrollers and the MSP430", Manuel Jiménez Rogelio, Palomera Isidoro Couvertier, Springer Publications, 2014.
2. "Embedded system Design: A Unified Hardware/Software
3. Introduction", Frank Vahid, Tony D. Givargis, John Wily & Sons Inc.2002.
4. "Embedded System Design", Peter Marwedel, Science Publishers, 2007.
5. "Embedded System Design", Arnold S Burger, CMP Books, 2002.
6. "Embedded Systems: Architecture, Programming and Design", Rajkamal, TMH Publications, Second Edition, 2008.

Course Code	TEST AND TESTABILITY		L	T	P	C
21D570410			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Understand various faults associated with logic circuits and types of testing by employing fault models to the logic circuits.
- To Study different methods of simulation and algorithms associated with testing.
- To get in-depth knowledge in different methods of simulation and algorithms associated with testing.

UNIT-I (10 Hrs)

Introduction to Testing

Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT-II (10 Hrs)

Logic and Fault Simulation

Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

UNIT -III (10 Hrs)

Testability Measures

SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT-IV (10 Hrs)

Built-In Self-Test

The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

UNIT-V (10 Hrs)

Boundary Scan Standard

Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

TEXT BOOKS:

1. "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.
2. "Digital Systems and Testable Design", M. Abramovici, M.A.Breuer and A.D Friedman, Jaico Publishing House.

REFERENCE BOOKS:

1. "Digital Circuits Testing and Testability", P.K. Lala, Academic Press.

Course Code	SYSTEM ON CHIP ARCHITECTURE		L	T	P	C
21D570507			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Get complete basics related to SoC architecture and different approaches related to SoC Design.
- Should be able to select an appropriated robust processor for SoC Design
- Should be able to Select an appropriate memory for SoC Design.
- To Realize real time case studies.

UNIT - I (10 Hrs)

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT - II (11 Hrs)

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT - III (9 Hrs)

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

UNIT IV (11 Hrs)

Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT - V (9 Hrs)

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

TEXT BOOKS:

1. "Computer System Design System-on-Chip", Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. "ARM System on Chip Architecture", Steve Furber, 2nd Ed., 2000, Addison Wesley Professional.

REFERENCE BOOKS:

1. "Design of System on a Chip: Devices and Components", Ricardo Reis, 1st Ed., 2004, Springer
2. "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)", Jason Andrews, Newnes, BK and CDROM.
3. "System on Chip Verification – Methodologies and Techniques", Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers

Course Code	SEMICONDUCTOR MEMORY DESIGN AND TESTING		L	T	P	C
21D570508			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Get complete knowledge regarding different types of memories, their architectural and different packing techniques of memories.
- Should be able to build fault models for memory testing.
- To be able to analyze different parameters that leads malfunctioning of memories.
- To Design memories with efficient architecture to improve processes time and power

UNIT-I (10 Hrs)

Random Access Memory Technologies SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, Advanced DRAM design and architecture, Application specific DRAM.

UNIT-II (10 Hrs)

Non-volatile Memories Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture

UNIT-III (10 Hrs)

Memory Fault Modeling Testing and Memory Design for Testability and Fault Tolerance RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modeling and testing, IDDQ fault modeling and testing, Application specific memory testing, RAM fault modeling, BIST techniques for memory

UNIT-IV (10 Hrs)

Semiconductor Memory Reliability and Radiation Effects General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modeling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification, Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures

UNIT-V (10 Hrs)

Advanced Memory Technologies and High-density Memory Packing Technologies Ferroelectric RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging Future Directions.

TEXT BOOKS:

1. "Semiconductor Memories Technology", Ashok K. Sharma, 2002, Wiley.
2. "Advanced Semiconductor Memories – Architecture, Design and Applications", Ashok K. Sharma, 2002, Wiley.

REFERENCE BOOKS:

1. "Modern Semiconductor Devices for Integrated Circuits", Chenming C Hu, 1st Ed., Prentice all.

Course Code	RFIC DESIGN		L	T	P	C
21D570509			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To get in-depth knowledge in Radio Frequency Integrated Circuits.
- To Analyze complex engineering problems for conducting research in RF systems.
- To Solve engineering problems with wide range of solutions in Radio Frequency Integrated circuits.
- To Apply suitable techniques to engineering activities in the field of RFIC Design.

UNIT – I (10 Hrs)

BASIC CONCEPTS IN RF DESIGN

Introduction to RF Design, Units in RF design, Time Variance and Nonlinearity, Effects of nonlinearity, random processes and Noise, Definitions of sensitivity and dynamic range, Passive impedance transformation, Scattering parameters.

UNIT – II (10 Hrs)

TRANSCEIVER ARCHITECTURES

General considerations, Receiver Architectures-Basic Heterodyne receivers, Modern heterodyne receivers, Direct conversion receivers, Image-Reject receivers, Low-IF receivers. Transmitter Architectures-Direct Conversion transmitters, Modern direct conversion Transmitters, Heterodyne Transmitters, Other Transmitter Architectures.

UNIT -III (10 Hrs)

LNA AND MIXERS

General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Mixers-General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

UNIT – IV: (10 Hrs)

OSCILLATORS

Performance parameters, Basic principles, Cross coupled oscillator, Three point oscillators, Voltage Controlled Oscillators, LC VCOs with wide tuning range, phase noise, Mathematical model of VCOS, Quadrature Oscillators.

UNIT – V (10 Hrs)

PLL AND POWER AMPLIFIER

PLLS-Phase detector, Type-I PLLs, Type-II PLLs, PFD/CP Nonidealities, Phase noise in PLLs, Loop Bandwidth. Power Amplifiers-General considerations, Classification of power amplifiers, High- Efficiency power amplifiers, Cascode output stages, Large signal impedance matching, Linearization techniques.

TEXT BOOKS:

1. "RF Microelectronics", B. Razavi, Prentice-Hall PTR, 2nd Edition, 1998.

REFERENCE BOOKS:

1. "The Design of CMOS Radio-Frequency Integrated Circuits", T.H.Lee, Cambridge University Press, 2nd Edition, 1998.
2. "CMOS Circuit Design, Layout and Simulation", R. Jacob Baker, Harry W.Li, D.E. Boyce, Prentice Hall of India, 1998.

Course Code	INTERNET OF THINGS		L	T	P	C
21D570510			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Should be able to understand the application areas in IOT
- Should be able to realize the revolution of Internet in Mobile Devices, Cloud &Sensor Networks
- Should be able to understand building blocks of Internet of Things and characteristics.

UNIT - I (10 Hrs)

Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

UNIT - II (8 Hrs)

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

UNIT - III (12 Hrs)

M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG.

UNIT - IV (10 Hrs)

Developing Internet of Things & Logical Design using Python: Introduction, IOT Design Methodology, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages.

UNIT - V (10 Hrs)

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, and Programming& IOT Devices.

TEXT BOOKS:

1. "Internet of Things", Vijay Madisetti, Arshdeep Bahga
2. "A Hands-On- Approach", 2014, ISBN:9780996025515

REFERENCE BOOKS:

1. "Designing the Internet of Things", Adrian Mc Ewen, Wiley Publishers, 2013, ISBN:978-1-118-43062-0
2. "The Silent Intelligence: The Internet of Things". Daniel Kell mereit, 2013, ISBN0989973700

Course Code	HARDWARE AND SOFTWARE CO-DESIGN OF EMBEDDED SYSTEM		L	T	P	C
21D570511			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To analyze design methodologies.
- To implement and test the fundamental building blocks using hardware and software co-design.
- To Get familiar with modern hardware/software tools for building prototypes and to be able to demonstrate practical models.

UNIT - I (10 Hrs)

NATURE OF HARDWARE AND SOFTWARE

Hardware, Software, Definition of Hardware/Software Co-Design – Driving factors Platform design space – Application mapping – Dualism of Hardware design and software design – Concurrency and parallelism, Data flow modeling and Transformation – Data Flow Graph – Tokens, actors and queues, Firing rates, firing rules and Schedules – Synchronous data flow graph – control flow modeling – Adding time and resources – Transformations.

UNIT - II (10 Hrs)

DATA FLOW IMPLEMENTATION IN SOFTWARE AND HARDWARE

Software Implementation of Data Flow – Converting queues and actors into software, Dynamic Scheduler – Hardware Implementation of Data Flow – single rate SDF graphs into hardware, Pipelining – Analysis of control flow and data flow – construction of control and data flow graph – Translating C into hardware – Designing data path and controller.

UNIT - III (10 Hrs)

DESIGN SPACE OF CUSTOM ARCHITECTURES

Finite state machines with data path – FSMD design example, Limitations – Microprogrammed Architecture – Microprogrammed control, microinstruction encoding, Microprogrammed data path, microprogrammed machine – General purpose Embedded Core – RISC pipeline, Program organization – SoC interfaces for custom hardware – Design Principles in SoC Architecture

UNIT - IV (10 Hrs)

HARDWARE/ SOFTWARE INTERFACES

Principles of Hardware/software communication – synchronization schemes, communication constrained versus Computation constrained, Tight and Loose coupling - On-chip buses – Memory mapped interfaces – coprocessor interfaces – custom instruction interfaces – Coprocessor hardware interface – Data and control design, programmer's model.

UNIT - V (10 Hrs)

CASE STUDIES Trivium Cripto coprocessor – Trivium stream cipher algorithm, Trivium for 8-bit platforms – AES coprocessor, CORDIC coprocessor – algorithm and implementation.

TEXT BOOKS:

1. "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Ralf Niemann, Kluwer Academic Pub, 1998.
2. "Hardware/Software Co-Design: Principles and Practice", Jorgen Staunstrup, Wayne Wolf, Kluwer Academic Pub, 1997.

REFERENCE BOOKS:

1. "Reading in Hardware/Software Co-Design", Giovanni De Micheli, Rolf Ernst Morgon, Kaufmann Publishers, 2001.
2. "A Practical Introduction to Hardware/Software Codesign", Patrick Schaumont, 2nd Edition, Springer, 2010.

Course Code	PHYSICAL DESIGN AUTOMATION		L	T	P	C
21D570512			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To Understand relation between automation algorithms and constraints posed by VLSI technology.
- To Adopt algorithms to meet critical design parameters.
- To Design area efficient logics by employing different routing algorithms.
- To Simulate and synthesize different combinational and sequential logics

UNIT-I (10 Hrs)

VLSI design automation tools: algorithms and system design. Structural and logic design. Transistor level design. Layout design. Verification methods. Design management tools.

UNIT-II (10 Hrs)

Layout compaction, placement and routing, Design rules, symbolic layout. Applications of compaction. Formulation methods. Algorithms for constrained graph compaction. Circuit representation. Wire length estimation. Placement algorithms. Partitioning algorithms.

UNIT-III (10 Hrs)

Floor planning and routing: floor planning concepts. Shape functions and floor planning sizing. Local routing. Area routing. Channel routing, global routing and its algorithms.

UNIT-IV (10 Hrs)

Simulation and logic synthesis: gate level and switch level modeling and simulation. Introduction to combinational logic synthesis. ROBDD principles, implementation, construction and manipulation. Two level logic synthesis.

UNIT-V (10 Hrs)

High-level synthesis: hardware model for high level synthesis. Internal representation of input algorithms. Allocation, assignment and scheduling. Scheduling algorithms. Aspects of assignment. High level transformations.

TEXT BOOKS:

1. "Algorithms for VLSI Design Automation", S.H. Gerez, John Wiley ,1998.
2. "Algorithms for VLSI Physical Design Automation", N.A.Sherwani, (3/e), Kluwer,1999.

REFERENCE BOOKS:

1. "VLSI Physical Design Automation", S.M. Sait , H. Youssef, World scientific, 1999.
2. "Introduction to VLSI Physical Design", M. Sarrafzadeh, McGraw Hill (IE), 1996

Course Code	EMBEDDED SYSTEM DESIGN LAB		L	T	P	C
21D570411			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To Design and implement basic circuits that are used in Embedded systems.
- To Develop code using appropriate software tools.
- To Test the circuit performance with standard circuits.

List of Experiments

PART – A

Using Embedded C

Note: Any 10 Programs form the following

1. Write a simple program to print "hello world"
2. Write a simple program to show a delay.
3. Write a loop application to copy values from P1 to P2
4. Write a c program for counting the no of times that a switch is pressed & released.
5. Illustrate the use of port header file (port M) using an interface consisting of a keypad and liquid crystal display.
6. Write a program to create a portable hardward delay.
7. Write a c program to test loop time outs.
8. Write a c program to test hardware based timeout loops.
9. Develop a simple EOS showing traffic light sequencing.
10. Write a program to display elapsed time over RS-232 link.
11. Write a program to drive SEOS using Timer 0.
12. Develop software for milk pasteurization system.

PART – B

Note. Any 6 Programs from the following (Experiment – 1 is mandatory)

1. A Study of Code Composer Studio (CC Studio Latest Version)
2. Flashing a light by a software delay.
3. Displaying Characters on LCD.
4. Serial Communication using UART.
5. Basic Input and Output using MSP430 UART.
6. Interrupt Handling using MSP430.
7. Analog to Digital Conversion using MSP430.
8. Interfacing external Devices to GPIO Ports

Equipment's Required:

1. Computers with latest configuration.
2. Code Composer Studio v6.1 (Preferably Latest version)
3. MSP430/ARM based Hardware kits and add-on boards.

Course Code	VLSI SYSTEM DESIGN LAB - II		L	T	P	C
21D570412			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

To perform any Six of the following experimental concepts with suitable complexity mixed-signal application-based circuits (circuits consisting of both analog and digital parts) using necessary software tools.

List of experimental Concepts:

1. Analog circuit simulation.
2. Digital circuit simulation.
3. Mixed signal simulation.
4. Layout Extraction.
5. Parasitic values estimation from layout
6. Layout Vs Schematic.
7. Net List Extraction.
8. Design Rule Checks.

Lab Requirements:

Software: Xilinx ISE Suite 13.2 Version, Mentor Graphics-Questa Simulator, Mentor Graphics-Precision RTL, Mentor Graphics Back End/Tanner Software tool, Mixed Signal simulator

Hardware: Personal Computer with necessary peripherals, configuration and operating System and relevant VLSI (CPLD/FPGA) hardware Kits.

Course Code	RESEARCH METHODOLOGY		L	T	P	C
21D110601			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

UNIT - I (9 Hrs)

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT - II (11 Hrs)

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT - III (8 Hrs)

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT - IV (11 Hrs)

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT - V (11 Hrs)

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

TEXT BOOKS:

1. "Research Methodology: Methods And Techniques", C.R.Kothari, 2nd Edition, New Age International Publishers.
2. "Research Methodology: A Step By Step Guide For Beginners", Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. "Research Methodology And Statistical Tools", P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition, Excel Books, New Delhi.

REFERENCE BOOKS:

1. "Scientists Must Write", Robert Barrass (Available As Pdf on Internet)
2. "Crafting Your Research Future", Charles X. Ling And Quiang Yang (Available as PDF on Internet)

Course Code	HUMAN VALUES AND PROFESSIONAL ETHICS		L	T	P	C
21D110602			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT - I (10 Hrs)

HUMAN VALUES: Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

UNIT - II (10 Hrs)

ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

UNIT - III (10 Hrs)

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT - IV (10 Hrs)

ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk Safety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UNIT - V (10 Hrs)

GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

TEXT BOOKS:

1. "Engineering Ethics includes Human Values" by M. Govindarajan, S.Natarajan and V. S. Senthil Kumar-PHI Learning Pvt. Ltd-2009.
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

REFERENCE BOOKS:

1. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata Mc Graw Hill– 2003.
2. "Professional Ethics and Morals" by Prof. A. R. Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A. Alavudeen, R.Kalil Rahman and M.Jayakumaran, Laxmi Publications.

Course Code	INTELLECTUAL PROPERTY RIGHTS		L	T	P	C
21D110603			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- To create awareness about current trends in IPR and Govt. steps in fostering IPR

UNIT – I (10 Hrs)

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II (9 Hrs)

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III (11 Hrs)

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV (10 Hrs)

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V (10 Hrs)

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits. International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS:

1. "Intellectual Property Right", Deborah. E. Bouchoux, Cengage Learing.
2. "Intellectual Property Right", Nleashmy
3. "The Knowledge Economy", Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

COMPUTER SCIENCE AND ENGINEERING

(For the batches admitted from the academic year 2022-23)

Vision

- To produce technically competent and research-oriented computer science Engineers to meet the Industrial and Social requirements.

Mission

- To impart quality technical education in the field of computer science and Engineering through state-of-the art facilities and effective teaching learning process.
- To enrich the faculty and students with research and consultancy skills through Industry-Interaction and Training in Emerging areas of computer science and Engineering.
- To develop lifelong learning, leadership qualities and ethical values in learners to meet the societal and industrial needs.

Institutional Objectives

- To create a conductive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development programmes, Entrepreneurship, and extension activities.
- To introduce demand driven new UG & PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Lifelong Learning:* In the fast changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.
- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff, and students from all social, economic, ethics, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit

their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.

- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

M.Tech – CSE

(For the batches admitted from the academic year 2022-23)

M.Tech I Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D050401	Advanced Data Structures and Algorithms	4	0	0	4	40	60	100
2	PC	21D050402	Advanced Computer Networks	4	0	0	4	40	60	100
3	PE	21D050501 21D050502 21D050503	**Elective – I** a. Machine Learning b. Object Oriented Software Engineering c. Digital Image &Video Processing	4	0	0	4	40	60	100
4	PE	21D050504 21D050505 21D050506	**Elective – II** a. Data Science b. Design Patterns c. Information Security	4	0	0	4	40	60	100
5	PC	21D050403	Advanced Data Structures and Algorithms Lab	0	0	4	2	40	60	100
6	PC	21D050404	Advanced Computer Networks Lab	0	0	4	2	40	60	100
7	MC	21D000001	Research Methodology and IPR	4	0	0	4	40	60	100
8	AC	21D110201 21D110202 21D110203	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	2	0	0	2	40	60	100
Total							**26**	**320**	**480**	**800**

M.Tech II Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D050405	Advanced Operating Systems	4	0	0	4	40	60	100
2	PC	21D050406	Internet of Things	4	0	0	4	40	60	100
3	PE	21D050507 21D050508 21D050509	**Elective – III** a. Deep Learning b. Service Oriented Architecture c. Computer Vision	4	0	0	4	40	60	100
4	PE	21D050510 21D050511 21D050512	**Elective – IV** a. Data Visualization Techniques b. Distributed Systems c. Privacy Preserving Data Publishing	4	0	0	4	40	60	100
5	PC	21D050407	Advanced Operating Systems Lab	0	0	4	2	40	60	100
6	PC	21D050408	Internet of Things Lab	0	0	4	2	40	60	100
7	PC	21D050414	Technical seminar	0	0	4	2	100	-	100
8	AC	21D110204 21D110205 21D110206	**Audit Course – II** a. Pedagogy Studies b. Stress Management for Yoga c. Personality Development through Life Enlightenment Skills	2	0	0	2	40	60	100
Total							**24**	**380**	**420**	**800**

M.Tech III Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PE	21D050513 21D050514 21D050515	**Elective – V** a. Software Defined Networks b. Reinforcement Learning c. Data Analytics	4	0	0	4	40	60	100
2	PE	21D050516	**Elective – VI (MOOCs)**	0	0	0	0	-	-	-
3	OE	21D110604 21D110605 21D110606	a. Industrial Safety b. Business Analytics c. Optimization Techniques	4	0	0	4	40	60	100
4	PC	21D050415	Teaching Assignment	0	0	0	2	100	-	100
5	PC	21D050416	Project Work Phase – I	0	0	0	4	-	-	-
6	PC	21D050417	Comprehensive Viva Voce	0	0	0	2	100	-	100
Total							**16**	**280**	**120**	**400**

M.Tech IV Semester

S. No	Category	Course Code	Course Title	Hours per Week			Credits	CIE	Sem End Exam	Total Marks
				L	T	P/D				
1	PC	21D570418	Project Work Phase – II	0	0	0	12	0	0	0
Total							**12**	**0**	**0**	**0**

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS		L	T	P	C
21D050401			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand concepts of dictionaries and hash tables.
- To implement lists and trees.
- To analyze usage of B trees, Splay trees and 2-3 trees.
- To understand the importance of text processing and computational Geometry.

UNIT-I: (10 Hrs)

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries, Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing..

UNIT – II: (12 Hrs)

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists, Trees: Binary Search Trees (BST), AVL Trees, Red Black Trees: Height of a Red Black Tree, Red Black Trees Bottom-Up Insertion, Top-Down Red Black Trees, Top-Down Deletion in Red Black Trees, Analysis of Operations.

UNIT – III: (10 Hrs)

2-3 Trees , Advantage of 2-3 trees over Binary Search Trees, Search and Update Operations on 2-3 Trees, Analysis of Operations, B-Trees: Advantage of B- trees over BSTs, Height of B-Tree, Search and Update Operations on 2-3 Trees, Analysis of Operations, Splay Trees: Splaying, Search and Update Operations on Splay Trees, Amortized Analysis of Splaying.

UNIT – IV: (10 Hrs)

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem

UNIT – V: (08 Hrs)

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

TEXT BOOKS:

1. "Data Structures and Algorithm Analysis in C++", Mark Allen Weiss, 2nd Edition, Pearson, 2004.
2. "Introduction to Algorithms", T.H. Cormen, C.E. Leiserson R. L. Rivest, 3rd Edition Prentice Hall, 2009

REFERENCE BOOKS:

1. "Algorithm Design", Michael T. Goodrich, Roberto Tamassia, 1st Edition, Wiley, 2006.

Course Code	ADVANCED COMPUTER NETWORKS		L	T	P	C
21D050402			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand computer network architectures, protocols, and interfaces.
- The OSI reference model and the Internet architecture network applications.
- The course will expose students to the concepts of traditional as well as modern day computer networks - wireless and mobile, multimedia-based.
- Students completing this course will understand the key concepts and practices employed in modern computer networking

UNIT – I: (12 Hrs)

Network Architecture, Performance: Bandwidth and Latency, High Speed Networks, Network-Centric View, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks, Overlay Networks: Routing Overlays, Peer-to-Peer Networks and Content Distribution Networks, Client-Server Networks, DelayTolerant Networks

UNIT – II: (12 Hrs)

Switching: Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Message-Switched Networks, Asynchronous Transfer Mode: Evolution, Benefits, Concepts, Exploring Broadband Integrated Services Digital Network, Layer and Adaptation Layer, IPv4: Address Space, Notations, Classful, Classless, Network Address Translation, Datagram

UNIT – III: (10 Hrs)

Fragmentation and Checksum IPv6 Addresses: Structure, Address Space, Packet Format and Extension Headers, ICMP, IGMP, ARP, RARP, Congestion Control and Resource Allocation: Problem, Issues, Queuing, TCP Congestion Control, Congestion-Avoidance Mechanisms and Quality of Service

UNIT – IV: (8 Hrs)

Internetworking: Intra-Domain and Inter-Domain Routings, Unicast Routing Protocols: RIP, OSPF and BGP, Multicast Routing Protocols: DVMRP, PIM-DM, PIM-SM, CBT, MSDP and MOSPF, Spanning Tree Algorithm, Optical Networking: SONET/SDH Standards, Traffic Engineering: Requirement, Traffic Sizing, Characteristics, Protocols, Time and Delay Considerations, Connectivity, Availability, Reliability and Maintainability and Throughput.

UNIT – V: (8 Hrs)

Multimedia Over Internet: Transmission, IP Multicasting and VoIP, Domain Name System: Name Space, Domain Name Space, Distribution, Domains, Resolutions and Dynamic Domain Name

System, SNMP, Security: IPSec, SSL/TLS, PGP and Firewalls, Datacenter Design and Interconnection Networks.

TEXT BOOKS:

1. "Computer Networks: A System Approach", Larry L. Peterson and Bruce S. Davie, 5th Edition, Morgan Kaufmann, Elsevier, 2012.
2. "Data Communications and Networking", Behrouz A. Forouzan, McGraw Hill, 5th Edition, 2017.
3. "Introduction to Computer Networks and Cyber Security", Chwan-Hwa (John) Wu, J. David Irwin, CRC press, Taylor & Francis Group, 2014
4. "Computer Networks", Andrew S. Tanenbaum, David J. Wetherall, Pearson, 5th Edition, 2014.

REFERENCE BOOKS:

1. "Advanced Computer Networking: Concepts and Applications", Satish Jain

Course Code	MACHINE LEARNING		L	T	P	C
21D050501			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand various key paradigms for machine learning approaches.
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques.

UNIT – I: (10 Hrs.)

Introduction: Definitions, Datasets for Machine Learning, Different Paradigms of Machine Learning, Data Normalization, Hypothesis Evaluation, VC-Dimensions and Distribution, Bias-Variance Tradeoff, Regression

UNIT – II: (10 Hrs)

Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions. Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation

UNIT – III: (10 Hrs)

Discriminative Methods: Distance-based methods, Linear Discriminant Functions, Decision Tree, Random Decision Forest and Boosting Feature Selection and Dimensionality Reduction: PCA, LDA, ICA, SFFS, SBFS

UNIT – IV: (10 Hrs)

Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labelled and unlabelled data.

UNIT – V: (10 Hrs)

Kernel Machines: Kernel Tricks, SVMs (primal and dual forms), K-SVR, K-PCA (6 Lectures) Artificial Neural Networks: MLP, Backprop, and RBF-Net.

TEXT BOOKS:

1. "Understanding Machine Learning: From Theory to Algorithms", Shalev-Shwartz,S., Ben-David,S., (2014), Cambridge University Press

2. "Pattern Classification", R. O. Duda, P. E. Hart, D. G. Stork (2000), Wiley-Blackwell, 2nd Edition.

REFERENCE BOOKS:

1. "Machine Learning Methods in the Environmental Sciences - Neural Networks", William W Hsieh, Cambridge Univ Press. 2.
2. "Pattern classification", Richard o. Duda, Peter E. Hart and David G. Stork, John Wiley & Sons Inc.,2001 3.
3. "Neural Networks for Pattern Recognition", Chris Bishop, Oxford University Press, 1995

Course Code	OBJECT ORIENTED SOFTWARE ENGINEERING		L	T	P	C
21D050502			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To learn and understand various O-O concepts along with their applicability contexts.
- Given a problem, identify domain objects, their properties, and relationships among them.
- How to identify and model/represent domain constraints on the objects and (or) on their relationships
- To learn various modelling techniques to model different perspectives of object-oriented software design (UML)

UNIT-I: (10 Hrs)

Introduction to Software Engineering - Software Development process models – Agile Development - Project & Process - Project management - Process& Project metrics - Object Oriented concepts, Principles & Methodologies.

UNIT-II: (10 Hrs)

Software Requirements Specification, Software prototyping - Software project planning - Scope - Resources - Software Estimation - Empirical Estimation Models – Planning - Risk Management - Software Project Scheduling - Object Oriented Estimation & Scheduling.

UNIT-III: (11 Hrs)

Analysis Modelling - Data Modelling - Functional Modelling& Information Flow – Behavioural Modelling Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behaviour Model, Design modelling with UML

UNIT-IV: (10 Hrs)

Design Concepts & Principles - Design Process - Design Concepts - Modular Design - Design Effective Modularity - Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Object Oriented Design - System design process- Object design process - Design Patterns.

UNIT-V: (9 Hrs)

Top - Down, Bottom-Up, object oriented product Implementation & Integration. Software Testing methods White Box, Basis Path-Control Structure - Black Box - Unit Testing - Integration testing - Validation & System testing - Testing Tools – Software Maintenance &Reengineering

TEXT BOOKS:

1. "Software Engineering Concepts", Fairley R, 2nd edition, Tata McGraw Hill, New Delhi, 2003.
2. "An Integrated Approach to Software Engineering", Jalote P, 3rd edition, Narosa Publishers, New Delhi, 2013.

REFERENCE BOOKS:

1. "The Unified Modeling Language User Guide", Grady Booch, James Rumbaugh, Ivar Jacobson, Addison Wesley, 1999.
2. "Object Oriented Systems Development", Ali Bahrami, 1st Edition, The McGraw-Hill Company, 1999

Course Code	DIGITAL IMAGE AND VIDEO PROCESSING		L	T	P	C
21D050503			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To study the image fundamentals and mathematical transforms necessary for image Processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.

UNIT – I:

Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing. Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms

UNIT – II:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering. Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind de-convolution

UNIT-3:

Image Segmentation: Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour Image Compression: Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

UNIT-4:

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT-5:

2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

TEXT BOOKS:

1. "Digital Image Processing", Gonzalez and Woods, 3rd Ed., Pearson.
2. "Video Processing and Communication", Yao Wang, Joem Ostermann and Ya–quin Zhang.1st Ed., PH Int.

REFERENCE BOOKS:

1. "Digital Image processing", S. Jayaraman, S. Esakkirajan and T. Veera Kumar, Tata McGraw Hill publishers, 2009

Course Code	DATA SCIENCE		L	T	P	C
21D050504			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Produce Python code to statistically analyse a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data

UNIT-I:

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT-II:

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

UNIT-III:

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance ,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes

UNIT-IV:

Data visualization: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings

UNIT-V:

Applications of Data Science, Technologies for visualisation, Bokeh (Python) Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science

TEXT BOOKS:

1. “Doing Data Science”, Cathy O’Neil and Rachel Schutt, Straight Talk From The Frontline. O’Reilly.

2. "Mining of Massive Datasets", Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press

REFERENCE BOOKS:

1. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy, MIT Press, 2013.
2. "Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking", Foster Provost and Tom Fawcett, O′Reilly, 2013.
3. "Elements of Statistical Learning", Trevor Hastie, Robert Tibshirani and Jerome Friedman, 2nd Edition. Springer, 2009.
4. "Foundations of Data Science", Avrim Blum, John Hopcroft and Ravindran Kannan, 2018.
5. "Data Mining and Analysis: Fundamental Concepts and Algorithms", Mohammed J. Zaki and Wagner Miera Jr., Cambridge University Press, 2014.
6. "Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber and Jian Pei. 3rd Edition. Morgan Kaufmann, 2011

Course Code	DESIGN PATTERNS		L	T	P	C
21D050505			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Understand the concept of Design patterns and its importance.
- Understand the behavioural knowledge of the problem and solutions.
- Relate the Creational, Structural, behavioural Design patterns.
- Apply the suitable design patterns to refine the basic design for given context

UNIT-I:

Introduction : What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT-II:

A Case Study : Designing a Document Editor : Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary

UNIT-III:

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns. Structural Pattern Part-I : Adapter, Bridge, Composite.

UNIT-IV:

Structural Pattern Part-II : Decorator, Façade, Flyweight, Proxy. Behavioural Patterns Part-I : Chain of Responsibility, Command, Interpreter, Iterator.

UNIT-V:

Behavioral Patterns Part-II : Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns.

TEXT BOOKS:

1. “Design Patterns”, Erich Gamma, Pearson Education

REFERENCE BOOKS:

1. "Design Patterns: Elements of Reusable Object-Oriented Software", Erich Gamma , Richard Helm, Ralph Johnson, John Vlissides , Grady Booch

Course Code	INFORMATION SECURITY		L	T	P	C
21D050506			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To understand basics of Cryptography and Network Security.
- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a Data
- To understand various protocols for network security to protect against the threats in the networks.

UNIT-I:

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

UNIT-II:

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.

UNIT-III:

Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

UNIT-IV:

Email privacy: Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management

UNIT-V:

Email privacy: Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management

TEXT BOOKS:

1. "Network Security Essentials (Applications and Standards)", William Stallings, Pearson Education.
2. "Hack Proofing your network", Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permeh, wiley Dream tech,
3. "Cryptography and network Security", 3rd edition, Stallings, PHI/Pearson

REFERENCE BOOKS:

1. "Network Security and Cryptography", Bernard Menezes ,Cengage Learning.
2. "Cryptography and Security", C.K. Shymala, N. Harini and Dr. T.R. Padmanabhan, Wiley-India.
3. "Applied Cryptography", Bruce Schiener, 2nd edition, John Wiley & Sons.
4. "Cryptography and Network Security", Atul Kahate, TMH.
5. "Introduction to Cryptography", Buchmann, Springer.
6. "Number Theory in the Spirit of Ramanujan", Bruce C. Berndt, University Press
7. "Introduction to Analytic Number Theory", Tom M. Apostol, University Press

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS LAB		L	T	P	C
21D050403			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Implement linear and non linear data structures.
- Analyze various algorithms based on their time complexity.
- Choose appropriate data structure and algorithm design method for a specific application.
- Identify suitable data structure to solve various computing problems

LIST OF EXPERIMENTS:

1. To implement functions of Dictionary using Hashing (division method, Multiplication method, Universal hashing).
2. To perform various operations i.e., insertions and deletions on AVL trees.
3. To perform various operations i.e., insertions and deletions on 2-3 trees.
4. To implement operations on binary heap.
5. To implement operations on graphs
6. To implement Depth First Search for a graph non-recursively.
7. To implement Breadth First Search for a graph non-recursively.
8. To implement Prim's algorithm to generate a min-cost spanning tree.
9. To implement Krushkal's algorithm to generate a min-cost spanning tree.
10. To implement Dijkstra's algorithm to find shortest path in the graph

Course Code	ADVANCED COMPUTER NETWORKS LAB		L	T	P	C
21D050404			0	0	4	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To provide advanced background on relevant computer networking topics
- To have a comprehensive and deep knowledge in computer networks

LIST OF EXPERIMENTS:

1. Implementation of client server programs for different network applications
2. Study and analysis of the network using Wireshark network protocol analyser
3. Implementation of topology generation for network simulation
4. Implementation of queuing management
5. Implementation of MAC-layer protocols
6. Implementation of routing protocols
7. Implementation of transport-layer protocols
8. Implementation of network security mechanisms

Course Code	RESEARCH METHODOLOGY AND IPR		L	T	P	C
21D000001			4	0	0	4
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-III:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs

TEXT BOOKS:

1. "Research methodology: an introduction for science & engineering students", Stuart Melville and Wayne Goddard
2. "Research Methodology: An Introduction", Wayne Goddard and Stuart Melville

REFERENCE BOOKS:

1. "Research Methodology: A Step by Step Guide for beginners", Ranjit Kumar, 2nd Edition,
2. "Resisting Intellectual Property", Halbert, Taylor & Francis Ltd ,2007.
3. "Industrial Design", Mayall, McGraw Hill, 1992
4. "Product Design", Niebel, McGraw Hill, 1974
5. "Introduction to Design", Asimov, Prentice Hall, 1962.
6. "Intellectual Property in New Technological Age", Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016

Course Code	ADVANCED OPERATING SYSTEMS		L	T	P	C
21D050405			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To be able to read and understand sample open source programs and header files.
- System calls which explore networking and security Applications..
- To acquire the knowledge in the implementation of interprocess communication.

UNIT-I:

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types – Inodes -Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT-II:

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT-III:

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Files systems – Filesystem Type Registration – Filesystem Handling - Namespaces - Mounting – Unmounting - Implementation of VFS System Calls

UNIT-IV:

Windows Operating system - versions, Concepts and tools, Windows internals, System Architecture, Requirements and design goals, Operating system model, Architecture overview. Key system components. System mechanisms - Trap dispatching, object manager, Synchronization, System worker threads, Windows global flags, Local procedural calls, Kernel event tracing.

UNIT-V:

what is android, basic building blocks – activities, services, broadcast receivers & content, ui components views & notifications, components for communication -intents & intent filters,

android api levels launching emulator editing emulator settings emulator shortcuts log cat usage, Applications of Android

TEXT BOOKS:

1. "Understanding the Linux Kernel", Daniel P. Bovet and Marco Cesati, 3rd Edition, O'Reilly Publications, 2005.
2. “Structure and Interpretation of Computer Programs”, Harold Abelson, Gerald Jay Sussman and Julie Sussman, 2nd Edition, Universities Press, 2013.

REFERENCE BOOKS:

1. “Microsoft Windows Internals”, Mark E. Russinovich and David A. Solomon, 4th Edition, Microsoft Press, 2004

Course Code	INTERNET OF THINGS		L	T	P	C
21D050406			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To expose the student to a variety of embedded boards and IoT Platforms
- To create a basic understanding of the communication protocols in IoT communications.
- To familiarize the student with application program interfaces for IoT.
- To enable students to create simple IoT applications.

UNIT-I:

Overview of IoT: The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things? Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances. Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

UNIT-II:

Embedded Devices: Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

UNIT-III:

Communication in the IoT: Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

UNIT-IV:

Business Models: A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups. Manufacturing: What are you producing, Designing kits, Designing printed circuit boards

UNIT-V:

Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software. Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions

TEXT BOOKS:

1. "Designing the Internet of Things", Adrian McEwen, Hakim Cassimally, Wiley Publications, 2012

REFERENCE BOOKS:

1. "Fundamentals of IoT and Wearable Technology Design", Haider Raad, Wiley Publications, 2020.
2. "Internet of Things (IoT) Concepts and Applications", Kashish Ara Shakil, Samiya Khan, Springer Publications, 2020.

Course Code	DEEP LEARNING		L	T	P	C
21D050507			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To present the mathematical, statistical and computational challenges of building neural networks.
- To teach the concepts of deep learning.
- To introduce dimensionality reduction techniques.
- To enable the students to know deep learning techniques to support real-time applications.
- To explain the case studies of deep learning techniques.

UNIT-I:

Introduction: Introduction to machine learning- Linear models (SVMs and Perceptron's, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT-II:

Deep Networks: History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks - Generative Adversarial Networks (GAN), Semisupervised Learning .

UNIT-III:

Dimensionality Reduction: Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

UNIT-IV:

Optimization and Generalization: Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT-V:

Case Study and Applications: Image net- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection Bioinformatics- Face Recognition- Scene Understanding-Gathering Image Captions

TEXT BOOKS:

1. "Deep Learning", Ian Goodfellow, Yoshua Bengio , Aaron Courville, MIT Press 2016.

REFERENCE BOOKS:

1. "Neural Networks and Deep Learning A Text Book", Charu C Aggarwal, Springer International Publishing AG, Part of Springer Nature 2018.

Course Code	SERVICE ORIENTED ARCHITECTURE		L	T	P	C
21D050508			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To understand SOA and evolution of SOA.
- To understand web services and primitive, contemporary SOA.
- To understand various service layers.
- To understand service-oriented analysis and design based on guidelines.

UNIT-I:

Introducing SOA: Fundamental SOA, Common Characteristics of Contemporary SOA, Common Tangible Benefits of SOA, Common Pitfalls of Adopting SOA. The Evolution of SOA: An SOA Timeline, The Continuing Evolution of SOA, The Roots of SOA.

UNIT-II:

Web Services and Primitive SOA: The Web Services Frame Work, Services, Service Descriptions, Messaging. Web Services and Contemporary SOA (Part I-Activity management and Composition): Message Exchange Patterns, Service Activity, Coordination, Atomic Transactions, Orchestration, and Choreography. Web Services and Contemporary SOA (Part-II-Advanced Messaging, Metadata and Security): Addressing, Reliable Messaging, Correlation, Policies, Metadata exchange, Security.

UNIT-III:

Principles of Service-Orientation: Service–Orientation and the Enterprise, Anatomy of SOA, Common Principles of Service–Orientation, Interrelation between Principles of Service-Orientation, Service Orientation and Object Orientation, Native Web Services Support for Principles of Service-Orientation. Service Layers: Service-Orientation and Contemporary SOA, Service Layer abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Agnostic Services, Service Layer Configuration Scenarios

UNIT-IV:

SOA Delivery Strategies: SOA Delivery Lifecycle Phases, The Top-Down Strategy, The Bottom-up Strategy, The Agile Strategy. Service Oriented Analysis (Part I-Introduction): Introduction to Service Oriented Analysis, Benefits of a Business Centric SOA, Deriving Business Services. Service Oriented Analysis (Part-II-Service Modelling): Service Modelling, Service Modelling Guidelines, Classifying Service Model Logic, Contrasting Service Modelling Approaches. Service Oriented Design (Part I-Introduction): Introduction to Service-Oriented Design, WSDL Related

XML Schema Language Basics, WSDL Language Basics, Service Interface Design Tools. Service Oriented Design (Part II-SOA Composition Guidelines): SOA Composing Steps, Considerations for Choosing Service Layers, Considerations for Positioning Core SOA Standards, Considerations for Choosing SOA Extensions.

UNIT-V:

Service Oriented Design (Part III- Service Design): Service Design Overview, Entity- Centric Business Service Design, Application Service Design, Task-Centric Business Service Design, Service Design Guidelines. Service Oriented Design (Part IV-Business Process Design): WS-BPEL Language Basics, WS- Coordination Overview, Service Oriented Business Process Design.

TEXT BOOKS:

1. "Service-Oriented Architecture-Concepts, Technology and Design", Thomas Erl, Pearson Education, 2006.
2. "Understanding SOA with Web Services", Eric Newcomer, Greg Lomow, Pearson Education, 2005

REFERENCE BOOKS:

1. "Service Oriented Architecture Concepts Technology & Design", Thomas Erl, Pearson Education Limited; 2015, ISBN-13: 9788131714904.
2. "Service Oriented Architecture An Integration Blueprint", Guido Schmutz, Peter Welkenbach, Daniel Liebhart, Shroff Publishers & Distributors; 2010, ISBN-13: 9789350231081

Course Code	COMPUTER VISION		L	T	P	C
21D050509			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks

UNIT-I:

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

UNIT-II:

Edge detection, Edge detection performance, Hough transform, corner detection

UNIT-III:

Segmentation, Morphological filtering, Fourier transform

UNIT-IV:

Feature extraction, shape, histogram, colour, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing

UNIT-V:

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods

TEXT BOOKS:

1. "Computer Vision: Algorithms and Applications", Richard Szeliski.

REFERENCE BOOKS:

1. "Deep Learning", Goodfellow, Bengio, and Courville.
2. "Dictionary of Computer Vision and Image Processing", Fisher et al

Course Code	DATA VISUALIZATION TECHNIQUES		L	T	P	C
21D050510			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.

UNIT-I:

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT-II:

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT-III:

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence

UNIT-IV:

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

UNIT-V:

Plotting Geospatial Data: Introduction to Geoplotlib, Design Principles of Geoplotlib, Geospatial Visualizations, Plotting Geospatial Data on a Map Web-Based Visualizations: Concepts of Bokeh,

Interfaces-Plotting and Model Interfaces, Output, Bokeh Server, Presentation, Integrating – HTML Document and Bokeh Applications

TEXT BOOKS:

1. "Visualizing data: Exploring and explaining data with the processing environment", Ben Fry, O'Reilly, 2008.
2. "Data Visualization with Python", Mario Dobler, Tim Grobmann, O'Reilly, 1st Edition, 2019

REFERENCE BOOKS:

1. "Information dashboard design: Displaying data for at-a-glance monitoring", Stephen Few, 2nd edition, Analytics Press, 2013.

Course Code	DISTRIBUTED SYSTEMS		L	T	P	C
21D050511			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment
- To provide insight into related research problems

UNIT-I:

Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

UNIT-II:

DISTRIBUTED DATABASE DESIGN Alternative design strategies; Distributed design issues; Fragmentation; Data Allocation SEMANTICS DATA CONTROL View management; Data security; Semantic Integrity Control QUERY PROCESSING ISSUES Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

UNIT-III:

Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms TRANSACTION MANAGEMENT The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models CONCURRENCY CONTROL Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

UNIT-IV:

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

UNIT-V:

PARALLEL DATABASE SYSTEMS Parallel architectures; parallel query processing and optimization; load balancing ADVANCED TOPICS Mobile Databases, Distributed Object Management, Multi-databases

TEXT BOOKS:

1. "Principles of Distributed Database Systems", M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.

REFERENCE BOOKS:

1. "Distributed Database Systems", D. Bell and J. Grimson, Addison-Wesley, 1992.

Course Code	PRIVACY PRESERVING DATA PUBLISHING		L	T	P	C
21D050512			4	0	0	4
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To decide, given an application, if it should be formulated as a data privacy problem.
- To formally define the problem and state what properties can be guaranteed by applying differential privacy.
- To understand how (and why) randomness (or uncertainty) provides privacy protection.
- To analyse real-world privacy problems, identify which privacy-preserving methods are appropriate, and implement the private algorithms in code.
- To evaluate and compare privacy-preserving algorithms

UNIT-I:

Fundamentals of defining privacy and developing efficient algorithms for enforcing privacy, challenges in developing privacy preserving algorithms in real-world applications, privacy issues, privacy models,

UNIT-II:

Anonymization operations, information metrics, Anonymization methods for the transaction data, trajectory data, social networks data, and textual data, Collaborative Anonymization,

UNIT-III:

Access control of outsourced data, Use of Fragmentation and Encryption to Protect Data Privacy, Security and Privacy in OLAP systems.

UNIT-IV:

Extended Data publishing Scenarios, Anonymization for Data Mining, publishing social science data

UNIT-V:

Continuous user activity monitoring (like in search logs, location traces, energy monitoring), social networks, recommendation engines and targeted advertising.

TEXT BOOKS:

1. "Introduction to Privacy Preserving Data Publishing: Concepts and Techniques", Benjamin C.M. Fung, Ke Wang, Ada Wai-Chee Fu and Philip S. Yu, 1st Edition, Chapman & Hall/CRC, 2010

REFERENCE BOOKS:

1. "Privacy-Preserving Data Publishing", Bee-Chung Chen, Daniel Kifer, Ashwin Machanavajjhala, Kristen LeFevre, Now Publishers Inc, 2009.

Course Code	ADVANCED OPERATING SYSTEMS LAB		L	T	P	C
21D050407			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- To understand how program execution happens in Linux

LIST OF EXPERIMENTS:

1. Write programs using the following system calls of UNIX operating system: 40 fork, exec, getpid, exit, wait, close, stat, opendir, readdir
2. Write programs using the I/O system calls of UNIX operating system (open, read, write, etc)
3. Write C programs to simulate UNIX commands like ls, grep, etc.
4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)
5. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)
6. Developing Application using Inter Process communication (using shared memory, pipes or message queues)
7. Implement the Producer – Consumer problem using semaphores (using UNIX system calls)

Course Code	INTERNET OF THINGS LAB		L	T	P	C
21D050408			0	0	4	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To know the different real time sensors used to measure the different electrical parameters
- To control the different devices from anywhere through IOT.

LIST OF EXPERIMENTS:

1. Exercise on Eclipse IoT Project.
2. Experiments on few Eclipse IoT Projects.
3. Any Experiment on architecture of IoT Toolkit.
4. Exercise on smart object API Gateway service reference implementation in IoT Toolkit.
5. Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT Toolkit.
6. Experiment on Gate way as a service deployment in IoT Toolkit.
7. Experiment on application framework and embedded software agents for IoT Toolkit

Course Code	SOFTWARE DEFINED NETWORKS		L	T	P	C
21D050513			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program
- To control the behaviour of an entire network.

UNIT-I:

Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

UNIT-II:

SDN data plane: Data plane Functions, Data plane protocols, Open flow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- Open Flow Protocol

UNIT-III:

SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- Open Day light-REST- Cooperation and Coordination Among Controllers

UNIT-IV:

SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring Security- Data Centre Networking- Mobility and Wireless.

UNIT-V:

Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements-NFV Reference Architecture: NFV Management and Orchestration

TEXT BOOKS:

1. "Software Defined Networks: A Comprehensive Approach", Paul Goransson, Chuck Black, Timothy Culver, Morgan Kaufmann, 2016.

2. "Network Function Virtualization", Ken Gray, Thomas Nadeau, Morgan Kaufmann, 2016.

REFERENCE BOOKS:

1. "Software-Defined Networks: A Systems Approach", Larry Peterson , Carmelo Cascone , Bruce Davie, 2021

Course Code	REINFORCEMENT LEARNING		L	T	P	C
21D050514			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To introduce statistical learning techniques where an agent explicitly takes actions and interacts with the world

UNIT-I:

Introduction: Introduction to Reinforcement Learning (RL) – Difference between RL and Supervised Learning, RL and Unsupervised Learning. Elements of RL, Markov property, Markov chains, Markov reward process (MRP)

UNIT-II:

Evaluative Feedback - Multi-Arm Bandit Problem: An n-Armed Bandit Problem, Exploration vs Exploitation principles, Action value methods, Incremental Implementation, tracking a non-stationary problem, optimistic initial values, upper-confidence-bound action selection, Gradient Bandits. Introduction to and proof of Bellman equations for MRPs

UNIT-III:

Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations. Dynamic Programming (DP): Overview of dynamic programming for MDP, principle of optimality, Policy Evaluation, Policy Improvement, policy iteration, value iteration, asynchronous DP , Generalized Policy Iteration

UNIT-IV:

Monte Carlo Methods for Prediction and Control: Overview of Monte Carlo methods for model free RL, Monte Carlo Prediction, Monte Carlo estimation of action values, Monto Carlo Control, On policy and off policy learning, Importance sampling. Temporal Difference Methods: TD Prediction, Optimality of TD(0), TD Control methods - SARSA, Q-Learning and their variants.

UNIT-V:

Eligibility traces: n-Step TD Prediction, Forward and Backward view of TD(λ), Equivalence of forward and backward view, Sarsa(λ),, Watkins's Q(λ), Off policy eligibility traces using importance of sampling. Function Approximation Methods: Value prediction with function approximation, gradient descent methods, Linear methods, control with function approximation.

TEXT BOOKS:

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition, The MIT Press.
2. "Algorithms for Reinforcement Learning", Csaba Szepesvari, Morgan & Claypool, 2010

REFERENCE BOOKS:

1. "Reinforcement Learning", Richard S. (University Of Alberta) Sutton, Andrew G. (Co-Director Autonomous Learning Laboratory), Barto

Course Code	DATA ANALYTICS		L	T	P	C
21D050515			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To explore the fundamental concepts of data analytics.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To understand the various search methods and visualization techniques.

UNIT-I:

Introduction: What is Data Science? Big Data and Data Science hype and getting past the hype, Why now?, Datafication, Current landscape of perspectives, Skill sets, Life cycle of Data Science, Different phases.

UNIT-II:

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm), Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means.

UNIT-III:

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web, Feature Generation and Feature Selection (Extracting Meaning From Data), Motivating application: user (customer) retention,

UNIT-IV:

Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms: Filters; Wrappers; Decision Trees; Random Forests, Recommendation Systems: Building a UserFacing Data Product: Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

UNIT-V:

Data Visualization: Basic principles, ideas and tools for data visualization, Case study on industry projects, Exercise: create your own visualization of a complex dataset, Data Science and Ethical Issues: Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists

TEXT BOOKS:

1. "Doing Data Science, Straight Talk From The Frontline", Cathy O'Neil and Rachel Schutt, O'Reilly, 2014.
2. "Mining of Massive Datasets", Jure Leskovek, Anand Rajaraman and Jerey Ullman, Cambridge University Press, 2014.

REFERENCE BOOKS:

1. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy, MIT Press, 2013.
2. "Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking", Foster Provost and Tom Fawcett, O′Reilly, 2013.
3. "Elements of Statistical Learning", Trevor Hastie, Robert Tibshirani and Jerome Friedman, 2nd Edition, Springer, 2009
4. "Foundations of Data Science", Avrim Blum, John Hopcroft and Ravindran Kannan, 2018.
5. "Data Mining and Analysis: Fundamental Concepts and Algorithms", Mohammed J. Zaki and Wagner Miera Jr., Cambridge University Press, 2014.
6. "Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber and Jian Pei, 3rd Edition. Morgan Kaufmann, 2011.

Course Code	ENGLISH FOR RESEARCH PAPER WRITING		L	T	P	C
21D110201			2	0	0	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

UNIT-I:

Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy - Avoiding Ambiguity

UNIT-II:

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT-III:

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings – Discussion Conclusions- Recomm

UNIT-IV:

Key skills needed for writing a Title, Abstract, and Introduction

UNIT-V:

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

SUGGESTED READING:

1. "Writing for Science", Goldbort R (2006), Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. "How to Write and Publish a Scientific Paper", Day R (2006), Cambridge University Press
3. "Handbook of Writing for the Mathematical Sciences", Highman N (1998), SIAM. Highman's book
4. "English for Writing Research Papers", Adrian Wallwork , Springer New York Dordrecht Heidelberg London, 2011

Course Code	DISASTER MANAGEMENT		L	T	P	C
21D110202			2	0	0	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-V:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

SUGGESTED READING:

1. "Disaster Management in India: Perspectives, issues and strategies", R. Nishith, Singh A K, New Royal book Company.
2. "Disaster Mitigation Experiences And Reflections", Sahni, Pardeep Et. Al. (Eds.), Prentice Hall Of India, New Delhi.
3. "Disaster Administration And Management Text And Case Studies", Goel S., Deep & Deep Publication Pvt. Ltd., New Delhi

Course Code	SANSKRIT FOR TECHNICAL KNOWLEDGE		L	T	P	C
21D110203			2	0	0	2
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancient literature

UNIT-I:

Alphabets in Sanskrit,

UNIT-II:

Past/Present/Future Tense, Simple Sentences

UNIT-III:

Order, Introduction of roots

UNIT-IV:

Technical information about Sanskrit Literature

UNIT-V:

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

SUGGESTED READING:

1. "Abhyaspustakam", Dr. Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit", Prathama Deeksha, Vempati Kutumbshastri, Rashtriya Sanskrit Santhanam, New Delhi Publication
3. "India's Glorious Scientific Tradition", Suresh Soni, Ocean books (P) Ltd., New Delhi

Course Code	PEDAGOGY STUDIES		L	T	P	C
21D110204			2	0	0	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Review existing evidence on there view topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

SUGGESTED READING:

1. "Classroom interaction in Kenyan primary schools", Ackers J, Hardman F, (2001), Compare, 31 (2): 245-261.
2. "Curricular reform in schools: The importance of evaluation", Agrawal M, (2004), Journal of

Curriculum Studies, 36 (3): 361-379.
3. "Teacher training in Ghana - does it count?", Akyeampong K, (2003), Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?", Akyeampong K, Lussier K, Pryor J, Westbrook J, (2013), International Journal Educational Development, 33 (3): 272–282.
5. "Culture and pedagogy: International comparisons in primary education", Alexander RJ (2001), Oxford and Boston
6. "Read India: A mass scale, rapid, 'learning to read' campaign", Blackwell, Chavan M (2003)
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Code	STRESS MANAGEMENT BY YOGA		L	T	P	C
21D110205			2	0	0	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To achieve overall health of body and mind
- To overcome stress

UNIT-I:

Definitions of Eight parts of yoga.(Ashtanga)

UNIT-II:

Yam and Niyam

UNIT-III:

Do`s and Don't'sin life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

i)Various yoga poses and their benefits for mind &body

ii)Regularization of breathing techniques and its effects-Types of pranayam

SUGGESTED READING:

1. "Yogic Asanas for Group Training-Part-I", Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Raja yoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS		L	T	P	C
21D110206			2	0	0	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT-I:

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom), Verses-29,31,32(pride &heroism), Verses-26,28,63,65(virtue)

UNIT-II:

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's), Verses-71,73,75,78(do's)

UNIT-III:

Approach to day to day work and duties.
Shrimad Bhagwad Geeta: Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35, Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT-IV:

Statements of basic knowledge.
Shrimad Bhagwad Geeta: Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT-V:

Chapter2-Verses 17, Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

SUGGESTED READING:

1. "Srimad Bhagavad Gita", Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Code	INDUSTRIAL SAFETY		L	T	P	C
21D110604			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

UNIT-I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods

UNIT-II:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

UNIT-III:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricantstypes and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

UNIT-V:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS:

1. "Maintenance Engineering Handbook", Higgins & Morrow, Da Information Services.
2. "Maintenance Engineering", H. P. Garg, S. Chand and Company

REFERENCE BOOKS:

1. "Pump-hydraulic Compressors", Audels, McGraw Hill Publication.
2. "Foundation Engineering Handbook", Winterkorn, Hans, Chapman & Hall London.

Course Code	BUSINESS ANALYTICS		L	T	P	C
21D110605			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To give the student a comprehensive understanding of business analytics methods.

UNIT-I:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT-II:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT-III:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT-IV:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT-V:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism

TEXT BOOKS:

1. “Business Analysis”, James Cadle et al.
2. “Project Management: The Managerial Process”, Erik Larson and Clifford Gray

REFERENCE BOOKS:

1. "Business analytics Principles, Concepts, and Applications", Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. "Business Analytics", James Evans, Pearson Education.

Course Code	OPTIMIZATION TECHNIQUES		L	T	P	C
21D110606			4	0	0	4
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- Enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems.
- Learn classical optimization techniques and numerical methods of optimization.
- Know the basics of different evolutionary algorithms.
- Explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas

UNIT-I:

LINEAR PROGRAMMING (L.P): Revised Simplex Method, Duel simplex Method, Sensitivity Analysis

DYNAMIC PROGRAMMING (D.P): Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method, tabular method, LP as a case of D.P.

UNIT-II:

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method

UNIT-III:

MODERN METHODS OF OPTIMIZATION:

GENETIC ALGORITHM (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, Genetic Operators- reproduction, crossover, mutation GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA &GP, Random population generation. Fuzzy Systems: Fuzzy set Theory, Optimization of Fuzzy systems

UNIT-IV:

INTEGER PROGRAMMING: Graphical Representation, Gomory's Cutting Plane Method, Balas' Algorithm for Zero–One Programming, Branch-and-Bound Method

UNIT-V:

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Formulation of model- optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS:

1. "Engineering Optimization", S. S. Rao, (4th Edition), New Age International

REFERENCE BOOKS:

1. "Optimization for Engineering Design", Kalyanmoy Deb, PHI Publishers
2. "Genetic algorithms in Search, Optimization, and Machine learning", D. E. Goldberg, Addison-Wesley Publishers
3. "Operations Research", Hillar and Liberman, TMH Publishers
4. "Optimal design", Jasbir Arora, McGraw Hill (International) Publisher