KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

CURRICULUM AND SYLLABUS

PG

(3rd & 4th Semester)

(REGULATIONS 2023)

ACADEMIC YEAR 2024-2025

KCG COLLEGE OF TECHNOLOGY (AUTONOMOUS)
REGULATIONS 2023
M.E. AERONAUTICAL ENGINEERING REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM
III & IV SEMESTERS CURRICULAM AND SYLLABUS

III SEMESTER

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective IV	PEC	3	0	0	3	3
2.		Professional Elective V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICAL								
4.	23AEP321	Project Work I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**12**	**21**	**15**

IV SEMESTER

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1.	23AEP421	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 76

PROFESSIONAL ELECTIVE COURSES

SEMESTER III , ELECTIVE – IV

SL. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODSPE RWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23AEP048	Vibration Isolation and Control	PEC	3	0	0	3	3
2.	23AEP049	Non-Destructive Evaluation	PEC	3	0	0	3	3
3.	23AEP050	Component Design of Aircraft Engines	PEC	3	0	0	3	3
4.	23AEP051	Aircraft Systems Engineering	PEC	3	0	0	3	3
5.	23AEP052	Aircraft Design	PEC	3	0	0	3	3
6.	23AEP053	Composite Product Processing Methods	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE – V

SL. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODSPE RWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23AEP054	Helicopter Aerodynamics	PEC	3	0	0	3	3
2.	23AEP055	High Speed Jet Flows	PEC	3	0	0	3	3
3.	23AEP056	Smart Materials and Structural Health Monitoring	PEC	3	0	0	3	3
4.	23AEP057	Artificial Intelligence and Machine Learning	PEC	3	0	0	3	3
5.	23AEP058	Aircraft Guidance and Control	PEC	3	0	0	3	3

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	23AXP091	English for Research Paper Writing	2	0	0	0
2.	23AXP092	Disaster Management	2	0	0	0
3.	23AXP093	Constitution of India	2	0	0	0
4.	23AXP094	நற்றமிழ் இலக்கியம்	2	0	0	0

Summary

Sl. No	Name of the Programme					
	Subject Area	Credits per Semester				Total Credits
	Semester	I	II	III	IV	
1.	FC – Foundation Course	4				4
2.	PCC – Program Core Course	15	17			32
3.	PEC – Program Elective Course	3	6	6		15
4.	RMC – Research Methodology Course	2				2
5.	OEC – Open Elective Course			3		3
6.	EEC – Employee Enhancement Course		2	6	12	20
7.	Non Credit/Audit Courses	-	-	-	-	0 (2 courses)
	Total Credit	**24**	**25**	**15**	**12**	**76**

SUMMARY

SEMESTER	FC	PCC	PEC	RMC	OEC	EEC	AC	Total
Semester I	4	15	3	2			**0 (1 course)**	**24**
Semester II		17	6			2	**0 (1 course)**	**25**
Semester III			6		3	6		**15**
Semester IV						12		**12**
Total – KCG Model curriculum		**Not Applicable**						
AICTE		**20**	**15**	**2**	**3**	**28**		**68**
Anna University	**4**	**31**	**15**	**2**	**3**	**20**		**75**
M. E – Aeronautical Engineering	**4**	**32**	**15**	**2**	**3**	**20**		**76**

M.E AERONAUTICAL ENGINEERING
SEMESTER III – ELECTIVE-IV

VIBRATION ISOLATION AND CONTROL **L T P C**

COURSE OBJECTIVES: **3 0 0 3**

This course will enables students

1. To get insight into the basic aspects of vibration theory.
2. To get in-depth knowledge on different types of isolators and its effectiveness.
3. To provide the basic knowledge on dynamic vibration absorber.
4. To realize the importance of materials selection for appropriate applications.
5. To get knowledge on the principles of active vibration control.

UNIT I BASIC VIBRATION THEORY **9**

Free Vibration Theory – Determination of Natural Frequency of a Single Degree Of Freedom – System– Response of a Damped Single Degree of Freedom System – Role of Damping – Forced Vibrations of Discrete Systems – Continuous Systems – Vibrations of Beams and Shafts – Idealization of a Real System Into a Discrete Model – Resonance – An Overview of the Different Methods of Vibration Control

UNIT II VIBRATION ISOLATION **9**

Transmissibility – Numerical Examples – Necessity of Vibration Isolation – Vibration Reduction at Source – System Redesign – Different Types of Isolators & Their Effectiveness – Pneumatic Suspension – Excitation Reduction at Source and Factors Affecting Vibration Level – Source Classification – Control of Flow Induced & Self-Excited Systems

UNIT III DYNAMIC VIBRATION ABSORBER **9**

Dynamic Vibration Neutralizers – Self-tuned Pendulum Neutralizer - Optimum Design of Damped Absorbers – Absorber with ideal spring and viscous dashpot – Gyroscopic vibration absorbers – Impact Absorbers – Absorbers attached to continuous systems – Field Balancing of Rotors – Resonance: Detuning and Decoupling – Remedial Measures

UNIT IV SELECTION OF MATERIALS **9**

Dynamic Properties of Viscoelastic Material – Selection of Materials – Damping-Stress Relationship – Selection Criteria for Linear Hysteretic Material – Design for enhanced material damping – Linear Viscoelastic Model – Constrained Layer Damping – Relaxation – Frequency and Temperature Dependence of the Complex Modulus – Overview and Role of Smart Materials

UNIT V PRINCIPLES OF ACTIVE VIBRATION CONTROL **9**

Conceptual Understanding – Shape Memory Actuators for Vibration Control – Shape Memory Materials – Tuned Vibration Absorbers using SMA – Basics of Electro-and Magneto-Rheological Fluids – Active Vibration Isolation using ERF and MRF – Methods of Active Vibration Control Using Piezoelectric Materials – Derivation of Governing Equations – Response of the Structure.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able

CO1: To realise the importance of vibration theory & its practical applications
CO2: To work out response calculations
CO3: To analyse and compare the different methods of vibration control
CO4: To exposure on vibration control using smart materials
CO5: To design a vibration control unit.

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	2	2	2	1
CO2	2	2	2	2	2	1
CO3	3	3	3	3	3	1
CO4	1	1	1	1	1	1
CO5	3	3	3	3	3	3
	2.2	2.2	2.2	2.2	2.2	1.4

REFERENCES:

1. Malcolm J. Crocker, "Handbook of Noise and Vibration Control", Wiley; 1st edition, 2007.
2. Mallik, AK, "Principles of Vibration Control",Affiliated East-West Press, India, 1990.
3. Mead,DJ, "Passive Vibration Control", Wiley, 1st edition, 1999.
4. Preumont,A"Vibration Control of Active Structures", Springer Netherlands, 3rd edition, 2011.

NON-DESTRUCTIVE EVALUATION **L T P C**
3 0 0 3

COURSE OBJECTIVES:
This course will make students

1. To impart knowledge on the fundamentals of nondestructive testing methods and techniques, aircraft inspection methodology using NDT methods
2. To get insights into the basic aspects of electron microscopy.
3. To learn modern NDT techniques like acoustic emission, ultrasonic and thermographic testing methods.
4. To inspect the aircraft structures using NDT techniques.
5. To get basic knowledge on the structural health monitoring of aerospace structures.

UNIT I INTRODUCTION **9**

Need for non-destructive evaluation (NDT) – Applications – Structural inspection – Structural deterioration due to corrosion and fatigue – Crack growth – Fabrication defects – Overloading – Detailed visual inspection – Aircraft wing and fuselage inspection using various NDT techniques – Overview and relative comparison of NDT methods – Jet engine inspection – Critical locations –

UNIT II ELECTRON MICROSCOPY **9**

Fundamentals of optics – Optical microscope and its instrumental details – Variants in the optical microscopes and image formation – Polarization light effect – Sample preparation and applications of optical microscopes – Introduction to Scanning electron microscopy (SEM) – Instrumental details and image formation of SEM – Introduction to transmission electron microscopy (TEM) – Imaging techniques and spectroscopy – Sample preparation for SEM and TEM

UNIT III ACOUSTIC EMISSION AND ULTRASONICS **9**

Sources of acoustic emission – Physical principals involving acoustic emission and ultrasonics – Configuration of ultrasonic sensors – Phased array ultrasonics – Instrument parts and features for acoustic emission and ultrasonics – Defect characterization – Inspection of cracks and other flaws in metals and composites – Interpretation of data – Image processing – Concepts and application

UNIT IV AIRCRAFT INSPECTION **9**

Inspection Levels – General Visual Inspection – During pre, or post flight – Detailed Visual Inspection (DET) – Periodic inspection – Special Detailed Inspection (SDET) – Uses of NDT Methods – Jet Engine Inspection – Engine overhaul – Fluorescent penetrate inspection – Airframe Loading – Fuselage Inspection – Critical Locations – Comparison of different methods of NDT – Visual – Radiography – Eddy Current Testing – Liquid Penetrant Testing – Remote Testing - Landing Gear Inspection

UNIT V STRUCTURAL HEALTH MONITORING 9

An Overview of Structural Health Monitoring – Structural Health Monitoring and Role of Smart Materials – Structural Health Monitoring versus Non-Destructive Evaluation – A Broad Overview of Smart Materials Applications – Notable Applications of SHM in Aerospace Engineering – Structural health monitoring of composites – Repair investigation using SHM – Current limits and future trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able

CO1: To realize the importance of various NDT techniques.
CO2: To identify suitable NDT technique for a particular application.
CO3: To demonstrate the physical principles involved in acoustic emission and ultrasonics.
CO4: Tohave knowledge on the physical principles involved in the various other techniques of NDT.
CO5: To realise the state-of-the-art in NDT testing and structural health monitoring.

REFERENCES:

1. Cullity, BD & Stock, SR, "Elements of X-ray diffraction", Prentice Hall, Inc. USA, 2001.
2. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", Wiley- ISTE, 2006.
3. Douglas E Adams, "Health Monitoring of Structural Materials and Components-Methods with Applications", John Wiley and Sons, 2007.
4. Douglas B. Murphy, "Fundamentals of light microscopy and electronic imaging", Wiley-Liss, Inc. USA, 2001.
5. Richard Brundle. C, Charles A. Evans, Jr., Shaun Wilson, "Encyclopedia of Materials Characterization, Surfaces, Interfaces, Thin Films", Butterworth-Heinemann, Boston, USA, 1992.
6. Williams, DB & Barry Carter,C, "Transmission electron microscopy, vol. 4", Springer, USA, 1996.
7. Non-destructive Testing Handbook – ASNT Series – Volume 1 – 6.

COMPONENT DESIGN OF AIRCRAFT ENGINES **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. This course provides the fundamental principles of fluid mechanics and thermodynamics on jet engine design.
2. This course brings out the differences in the design of various types of gas turbine engines.
3. This course imparts knowledge on the effect of inlet design on aerodynamic and propulsive aspects of aircrafts.
4. This course also addresses the problems associated with the design of combustion chambers.
5. This course deals with the practical difficulties in the matching of compressor and turbine.

UNIT I DESIGN FUNDAMENTALS OF GAS TURBINE ENGINE 8

Design Process - Constraint Analysis - Preliminary estimates - Aircraft weight and fuel consumption data- Mission analysis – Performance cycle analysis – Engine installation drag and sizing – Current challenges in gas turbine technology.

UNIT II INLET DESIGN 9

Elements of an Inlet - Engine Integration – Subsonic inlet - Engine Operational Requirements - Supersonic Inlet - Engine Operational Requirements - Engine Impact on Inlet Design - Inlet Impact on Engine Design- Validation of Inlet-Engine System.

UNIT III DESIGN OF ROTATING COMPONENTS 10

Fan and Compressor Aerodynamics - Diffusion factor - Aerofoil geometry – Flow path dimensions - Radial variation - Turbine Aerodynamics – Constant axial velocity – adiabatic - selected Mach number - Mean line stage Design tage pressure ratio – Airfoil geometry - Radial variation - Turbine cooling - Engine life - Design Examples.

UNIT IV COMBUSTION CHAMBER DESIGN 10

Combustion system components- Chemical reactor theory - Combustor Stability map-Stirring and mixing-Total pressure loss-Fuels-Ignition-Combustion Systems of Main Burner Design: Air partitioning- Main burner component Design: Diffuser-types of burner-inner and outer casing Design-Fuel- nozzle-Dome and liner-Primary zone- swirler-Secondary holes-Dilution holes- Transition duct-Example Design calculation: Design of Afterburners-Design parameters- Components-Diffuser-Fuel injection-Ignition-Flame stabilization-Flame spread and after burner length-Example design calculations.

UNIT V EXHAUST NOZZLE DESIGN 8

Different types of Nozzles – design of nozzles - Jet control methods for reduction of infrared signature on military aircrafts - Simple design problem - One dimensional nozzle flow.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able

CO1: To successfully design a gas turbine engine for given requirements.

CO2: To have thorough knowledge with the operational behavior of the major components of gas turbine engines.

CO3: To identify the factors those limit the performance of the components of gas turbine engines.

CO4: To find solutions for the compressor and turbine matching in gas turbine engines.

CO5: To overcome the problems associated with inlet on aircrafts.

REFERENCES:

1. Cumpsty,N, "Jet Propulsion: A Simple Guide to the Aerodynamics and Thermodynamics Design and Performance of Jet Engines", Cambridge University Press, 2nd edition, 2003.
2. Mattingly.JD,Heiser,WH and Pratt,DT,"Aircraft Engine Design", 2nd Edition, AIAA Education Series, 2002.
3. Oates. GC,"Aircraft Propulsion Systems Technology and Design", AIAA Education Series, 1989.
4. Saravanamuttoo, HIH andRogers,GFC,"Gas Turbine Technology", Pearson Education Canada, 6th edition, 2008.
5. Treager,IE,"Aircraft Gas Turbine Engine Technology", 3rd edition, Glencoe McGraw-Hill, Inc.1995.

AIRCRAFT SYSTEMS ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

This course will make students

1. To provide exposure to basic concepts of Aircraft product system engineering and design
2. To provide exposure to different fault and failure analysis methods in aircraft systems.
3. To provide exposure on systems engineering process, System Architecture and integration
4. To provide exposure on the importance of Maintainability, reliability and availability of the product.
5. To provide exposure importance of formal planning and documentation in systems engineering.

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview of Systems Engineering- Systems Engineering Concept Map-Systems Definition-The seven steps Systems Engineering-Conceptual System Design- System Engineering Process- Requirements and Management-Trade Studies-Integrated Product And Process Development.

UNITII THE AIRCRAFT SYSTEMS AND DESIGN 9

Introduction- Everyday Examples of Systems- Aircraft Systems –Generic Systems-Product Life Cycle- Different Phases-Whole Life Cycle Tasks- Systems Analysis-Design Drivers in the Project, Product, Operating Environment- Interfaces with the Subsystems-Mission analysis

UNIT III SYSTEM ARCHITECTURE SAND INTEGRATION 9

Introduction- Systems Architectures –Modeling and Trade-Offs Evolution of Avionics Architectures- Systems Integration Definition-Examples of Systems Integration-Integration Skills-Management of Systems Integration.

UNITIV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

Stakeholders- Communications- Criticism- Configuration Control Process-Portrayal of a System- Varying Systems Configurations- Compatibility-Factors Affecting Compatibility–Systems Evolution. Considerations and Integration of Aircraft Systems- Risk Management.

UNITV SYSTEMS RELIABILITYAND MAINTAINABILITY 9

Systems and Components-Analysis- Influence, Economics, Design for Reliability-Fault and Failure Analysis-System Life Cycle cost-Case Study-Maintenance Types-Program-Planning and Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

CO1: Describe the importance of systems engineering process in product development

CO2: Categorize different aircraft systems and will be able to differentiate the avionics architectures

CO3: Outline the different stages of product development and factors influencing in each stage

CO4: Analyze the different alternatives during design process

CO5: Plan, organize and document the task related to product design, development and testing.

References:

1. Andrew P.Sage& James E.Armstrong, "Introduction to Systems Engineering", 1st edition, 2000.
2. Erik Aslaksen& Rod Belcher, "Systems Engineering", Prentice Hall, 1992.
3. Ian Moir&Allan Seabridge, "Design and Development of Aircraft Systems", Wiley, 2nd edition, 2012.
4. Ian Moir& Allan Seabridge, "Aircraft Systems Mechanical, electrical, and avionics subsystems integration", John Wiley &Sons Ltd, 2011.
5. Peter. Sydenham, "Systems Approach to Engineering Design",Artechhouse,Inc,London, 2003.

AIRCRAFT DESIGN **L T P C**

COURSE OBJECTIVES: **3 0 0 3**

This course will enable students

1. To get in-depth knowledge about the preliminary concepts of aircraft design.
2. To provide with the basic knowledge on various aircraft loads.
3. To learn the design of aircraft wing.
4. To get exposed to different kinds of landing gear and its design.
5. To provide with the basic knowledge on integration of wing, fuselage, empennage and power plant.

UNIT I PRELIMINARY CONCEPTS **8**

Aircraft Design Requirements - Specifications - Role of user - Aerodynamic and Structural considerations - Importance of weight fractions - Airworthiness requirements and standards - Classification of airplanes - Special features of an airplane- Airplane performance aspects - Range and endurance - Take-off and landing - Climbing performance - Engine Performance

UNIT II AIRCRAFT LOADS **10**

Ground loads - Flight Loads - Symmetrical loads in flight - Basic flight loading conditions - Load factor calculation during a manouever - Velocity - Load factor diagram - Gust load and its estimation - Structural limits - Airplane weight estimation based on type of airplane - Trends in wing loading - Weight-estimation based on mission requirements - iterative approach - Span wise load distribution - Wing Loading

UNIT III WING DESIGN **10**

Selection of airfoil selection - Influencing factors - Planform shapes of an airplane wing - Stalling, takeoff and landing considerations - Wing drag estimation - High lift devices - Supercritical Airfoils

- Cockpit and aircraft passenger cabin layout for different aircraft - types of associated structure - structural layout - features of light airplanes using advanced composite materials - Structural design aspects - Bending moment and shear force diagram for wing and fuselage - Design principles of all metal stressed skin construction for civil and military applications

UNIT IV LANDING GEAR **8**

Different kinds of landing gears and associated arrangement for civil and military airplanes - Preliminary calculations for locating main and nose landing gears - Integration of Structure and Power Plant - Estimation of Horizontal and Vertical tail volume ratios - Choice of power plant and various options of locations - Considerations of appropriate air-intakes- Power Plant Loading

UNIT V INTEGRATION OF WING, FUSELAGE, EMPENNAGE AND POWER 9

Estimation of center of gravity - Introduction to advanced concepts - Aircraft Stability - Relaxed static stability - Controlled configured vehicles - V/STOL aircraft & rotary wing vehicles - Design and layout of flying controls and engine controls - Design of a wing-fuselage joint

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will

CO1: Haveoverall knowledge of preliminary aircraft design.

CO2: Havebasic knowledge of aircraft rules and airworthiness requirements imposed by governing bodies.

CO3: Be able to calculate and estimate aircraft loads under different loading conditions.

CO4: Be able to configure an aircraft wing based on aerodynamic considerations.

CO5: Be exposed the role of aircraft stability in the aircraft design process.

REFERENCES:

1. Conway, HG, "Landing Gear Design", Chapman & Hall; 1st edition, 1958.
2. Daniel P Raymer, "Aircraft Design: A conceptual approach", AIAA Educational Series, 5th edition 2012.
3. DarrolStinton ,"The Design of Airplane", Wiley publishers,, 2nd edition, 2001.
4. John D Anderson,"Airplane Performance and Design", McGraw Hill, 1st edition,1999.
5. Nicholai,LM, "Fundamentals of airplane Design", Univ. of Dayton DHIO, 1975.
6. Torenbeek, Egbert, "Synthesis of Subsonic Airplane Design", Springer publishers, 1982.

COMPOSITE PRODUCT PROCESSING METHODS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

This course will make students

1. To impart knowledge on the material selection for fabricating composite products.
2. To impart an idea about the product development and manufacturing of composites.
3. To acquire adequate knowledge about the manufacturing of thermoset composites.
4. To acquire adequate knowledge about the manufacturing of thermoplastic composites.
5. To gain knowledge on joining, machining and cutting of composites.

UNIT I MATERIAL SELECTION **9**

Reinforcements - Glass Fiber Manufacturing - Carbon Fiber Manufacturing - Aramid Fiber Manufacturing - Matrix Materials - Thermoset Resins - Thermoplastic Resins - Fabrics – Prepregs - Preforms - Molding Compound - Honeycomb and Other Core Materials - The Need for Material Selection - Reasons for Material Selection - Material Property Information - Steps in the Material Selection Process - Material Selection Methods.

UNIT II PRODUCT DEVELOPMENT AND DESIGN FOR MANUFACTURING **9**

Product Development Process - Reasons for Product Development - Importance of Product Development - Concurrent Engineering - Product Life Cycle - Phases of Product Development - Design Review - Failure Modes and Effects Analysis (FMEA) - Design Problems - DFM - DFM Implementation Guidelines - Design Evaluation Method - Design for Assembly (DFA).

UNIT III MANUFACTURING PROCESSES FOR THERMOSET COMPOSITES **9**

Prepreg Lay-Up Process - Wet Lay-Up Process - Spray-Up Process - Filament Winding Process - Pultrusion Process - Resin Transfer Molding Process - Structural Reaction Injection Molding (SRIM) Process - Compression Molding Process - Roll Wrapping Process - Injection Molding of Thermoset Composites.

UNIT IV MANUFACTURING PROCESSES FOR THERMOPLASTIC COMPOSITIES **9**

Thermoplastic Tape Winding - Thermoplastic Pultrusion Process - Compression Molding of GMT - Hot Press Technique - Autoclave Processing - Diaphragm Forming Process - Injection Molding.

UNIT V JOINING, MACHINING AND CUTTING OF COMPOSITES **9**

Adhesive Bonding - Failure Modes in Adhesive Bonding - Basic Science of Adhesive Bonding - Types of Adhesives - Advantages of Adhesive Bonding over Mechanical Joints - Disadvantages of Adhesive Bonding - Adhesive Selection Guidelines - Surface Preparation Guidelines - Design Guidelines for Adhesive Bonding- Theoretical Stress Analysis for Bonded Joints - Mechanical Joints - Preparation for the Bolted Joint-Purposes of Machining - Challenges during Machining of Composites - Failure Mode during Machining of Composites - Cutting Tools - Types of Machining Operations - Cutting Operation - Drilling Operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able

CO6: To select the suitable material for making composite products.

CO7: To gain knowledge on product development and manufacturing of composites.

CO8: To select the most appropriate manufacturing process for fabricating thermoset composite components.

CO9: To select the most appropriate manufacturing process for fabricating thermoplastic composite components.

CO10: To gain knowledge about the joining, machining and cutting of composites.

REFERENCES:

1. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, 2nd Edition, 2004.
2. Autar K Kaw, "Mechanics of Composite Materials", CRC Press, 2nd edition, 2005.
3. Lubing, "Handbook on Advanced Plastics and Fibre Glass", Von Nostran Reinhold Co., New York, 1989.
4. Sanjay K. Mazumdar, "Composites Manufacturing : Materials, Product, and Process Engineering", CRC Press, Washington, D.C, 2002.

SEMESTER III, ELECTIVE-V

HELICOPTER AERODYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. This course will make students to provide with introductory concepts of types of rotorcraft.
2. This course imparts knowledge on the fundamental aspects of helicopter aerodynamics and performance of helicopters.
3. This course will provide basic knowledge on the performance of helicopters.
4. This course presents stability and control aspects of helicopters.
5. This course will explorethe basic aerodynamic design aspects of helicopters.

UNIT I INTRODUCTION **9**

Types of rotorcraft – autogyro, gyrodyne, helicopter, Main rotor system – articulated, semi rigid, rigid rotors, Collective pitch control, cyclic pitch control, anti torque pedals.

UNIT II HELICOPTER AERODYNAMICS **10**

Momentum / actuator disc theory, Blade element theory, combined blade element and momentum theory, vortex theory, rotor in hover, rotor model with cylindrical wake and constant circulation along blade, free wake model, Constant chord and ideal twist rotors, Lateral flapping, Coriolis forces, reaction torque, compressibility effects, Ground effect.

UNIT III PERFORMANCE **9**

Hover and vertical flight, forward level flight, Climb in forward flight, optimum speeds, Maximum level speed, rotor limits envelope – performance curves with effects of altitude

UNIT IV STABILITY AND CONTROL **9**

Helicopter Trim, Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability.

UNIT V AERODYNAMIC DESIGN **9**

Blade section design, Blade tip shapes, Drag estimation – Rear fuselage upsweep, vibration problem of Helicopter blades.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO1: Describe and compare possible helicopter structures and configurations.
CO2: Identify features of aerodynamic components of rotary wing aircraft and its performance.
CO3: Describe the aerodynamic characteristics that affect rotary wing flight.
CO4: Idea about the factors that influence helicopter stability.
CO5: Gain knowledge of helicopter controls and vibration analysis of helicopter blades.

REFERENCES:

1. Gessow.A and Meyers,GC,"Aerodynamics of the Helicopter", Macmillan and Co., New York,1982.
2. John Fay, "The Helicopter", Himalayan Books, New Delhi, 1995.
3. Lalit Gupta, "Helicopter Engineering", Himalayan Books, New Delhi, 1996.
4. Lecture Notes on Helicopter Technology, Department of Aerospace Engineering, IIT – Kanpur and Rotary Wing aircraft R&D center, HAL, Bangalore, 1998.
5. Seddon,J,"Basic Helicopter Aerodynamics", AIAA Education series, Blackwell scientific publications, U.K, 1990.

HIGH SPEED JET FLOWS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

This course will make students

1. To get insight into the basic aspects of jets and types of jets.
2. To learn the basic properties of jets and its characteristics.
3. To get knowledge on various active and passive jet control methods.
4. To gain knowledge into the basic aspects of jet acoustics
5. To acquire in-depth knowledge on how and what type of control methods can be implemented practically.

UNIT I INTRODUCTION **9**

Properties of Turbulent Jets-Fundamental Concepts, Submerged Jets- Velocity Profiles in a Submerged Jet- Spread of a turbulent submerged jet- Lines of Constant Velocity in a Submerged Jet. Velocity Variation along the Axis of a Submerged jet, Velocity, Temperature, and Concentration Profiles in a Turbulent Jet Spreading into an External Stream of Fluid- Spread of a Turbulent Jet into a Co-flowing or Counter-flowing External Stream- Turbulence Characteristics in a Free Jet.

UNIT II JETS **9**

Types of Jets-Plane free-jets. Round jets. Plane jets in a co-flowing stream. Round jet in Co flowing stream- Swirling jets-Radial jets- Wall jets- Jet Characteristics & Entrainment, Mathematical treatment of jet profiles- Semi-empirical Theories. Mixing Layers-Computational and Experimental Techniques for Studying the Jets.

UNIT III ACTIVE JETCONTROL METHODS **9**

Active control methods- Actuators-Fluidic, Thermal, Acoustic, Piezoelectric, Electromagnetic, MEMS,Synthetic Jets, Controls and Sensors, Applications.

UNIT IV PASSIVE JET CONTROL METHODS **9**

Passive control techniques- Tabs, Grooves, Chevrons, non-circular nozzles, Notches & wires, vortex generators. Optical Flow Visualization, Applications.

UNIT V JET ACOUSTICS **9**

Introduction to Jet Acoustics – Types of jet noise – Source of generation- Travelling wave solution, standing wave solution – multi-dimensional acoustics-Theoretical Concepts of Jet Noise Generation and Suppression–Jet Noise suppression techniques – applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able

CO1: To acquire knowledge on the unique features of jet flows.
CO2: To analyse the characteristics of jets.
CO3: To have through knowledge on active and passive control methods of jets.
CO4: To acquire knowledge on jet acoustics and methods for suppression of jet noise.
CO5: To demonstrate various experimental techniques to determine jet characteristics.

REFERENCES:

1. Ethirajan Rathakrishnan, "Applied Gas Dynamics", John Wiley, New York, 2010.
2. Liepmann and Roshko, "Elements of Gas Dynamics", Dover Publishers, 2017.
3. Rathakrishnan E., "Gas Dynamics", Prentice Hall of India, New Delhi, 5th edition, 2014.
4. Shapiro, AH, "Dynamics and Thermodynamics of Compressible Fluid Flow, Vols. I & II", Ronald Press, New York, 1953.

SMART MATERIALS AND STRUCTURAL HEALTH MONITORING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

This course will enables students

1. To get basic idea on the fundamentals of structural health monitoring.
2. To impart knowledge in the areas of vibration based techniques in structural health monitoring, fibre optics and piezo electric sensors.
3. To gain knowledge on the fundamentals of fabrication, modelling, analysis, and design of smart materials and structures.
4. To get exposed to the state of the art of smart materials and systems,
5. To impart knowledge on spanning piezoelectrics, shape memory alloys, electro active polymers, mechanochromic materials and fibre optics.

UNIT I STRUCTURAL HEALTH MONITORING **8**

An Overview of Structural Health Monitoring, Structural Health Monitoring and Smart Materials, Structural Health Monitoring versus Non Destructive Evaluation A broad Overview of Smart Materials Overview of Application Potential of SHM Notable Applications of SHM – Aerospace Engineering. Structural health monitoring of composites – Repair investigation using SHM.

UNIT II OVERVIEW OF SMART MATERIALS **10**

Introduction to Smart Materials, Principles of Piezoelectricity, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance Effect, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rheological Fluids.

UNIT III SMART COMPOSITES **10**

Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion, Finite Element Modelling of Smart Composite Beams , Vibration Control using SHM –introduction to FE formulation Constitutive Relationship - Element Stiffness Matrix for High Precision Finite Element -Element Mass Matrix for High Precision Finite Element - Developing Actuator and Sensor Influence Matrix .Delamination Sensing using Piezo Sensory Layer.

UNIT IV INTELLIGENT SYSTEMS AND NEURAL NETWORKS **9**

Operational evaluation -.Data acquisition- Feature extraction-Statistical model development for feature discrimination -Data Cleansing – Normalization-Data Fusion – Compression – Statistical model building - Supervised pattern recognition - Unsupervised pattern recognition – Signal processing – Fuzzy C means- K means – Kohenon's Self organization mapping- Fundamentals of Wavelet analysis –Life Prediction.

UNIT V ADVANCES IN SMART STRUCTURES & MATERIALS 8

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design of Chemical and Bio- Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able

CO1: To familiarize with the fundamentals of history of SHM.
CO2: To provide a systematic approach to SHM process.
CO3: To have knowledge of the various smart materials used for aerospace applications.
CO4: To familiarize with the non-destructive test techniques relevant to SHM.
CO5: To provide hands-on experience with experimental modal analysis.

REFERENCES:

1. Brian Culshaw, "Smart Structures,and Materials", Artech House, 2000.
2. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", Wiley - ISTE, 2006.
3. Douglas E Adams, "Health Monitoring of Structural Materials and Components-Methods with Applications", John Wiley and Sons, 2007.
4. Gandhi and Thompson, "Smart Materials and Structures", Springer Netherlands, 1992.
5. Laurene Fausett**,** "Fundamentals Of Neural Networks", Pearson publishers, 1994
6. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To gain knowledge on artificial intelligence.
2. To understand the concepts of Machine Learning.
3. To appreciate supervised learning and their applications.
4. To appreciate the concepts and algorithms of unsupervised learning.
5. To understand the theoretical and practical aspects of Probabilistic Graphical Models.

UNIT I ARTIFICIAL INTELLIGENCE 9

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.

UNIT II INTRODUCTION TO MACHINE LEARNING 9

Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

UNIT III SUPERVISED LEARNING 9

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.

UNIT IV UNSUPERVISED LEARNING 9

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

UNIT V PROBABILISTIC GRAPHICAL MODELS 9

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields (CRFs).

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- Optimize the robots using Artificial Intelligence.
- Design a learning model appropriate to the application.
- Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Identify applications suitable for different types of Machine Learning with suitable justification.

1-low, 2-medium, 3-high, '-"- no

correlation REFERENCES:

1. Christopher Bishop,"Pattern Recognition and Machine Learning" Springer, 2007.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall, CRC Press, Second Edition,2014.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
5. Tom Mitchell, "Machine Learning", McGraw-Hill,1997.

AIRCRAFT GUIDANCE AND CONTROL L T P C

COURSE OBJECTIVES: **3 0 0 3**

This course will make students

1. To learn about the aircraft equations of motion and method of linearization.
2. Toimpart knowledge on the operating principle of guidance law.
3. To gain knowledge onvarious augmentation systems.
4. To get familiarize with the concepts of longitudinal stability and to design the longitudinal autopilot.
5. To study lateral stability and to design the lateral autopilot.

UNIT I INTRODUCTION **8**

Introduction to Guidance and control-Definition, Historical background – Coordinate Frame - Equations of motion – Linearization

UNIT II AUGMENTATION SYSTEMS **8**

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Design of Limited authority and Full Authority Augmentation systems - Gain scheduling concepts.

UNITIII LONGITUDINAL AUTOPILOT **9**

Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNITIV LATERAL AUTOPILOT **10**

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, AutomaticlateralBeamGuidance.IntroductiontoFly-by-wireflightcontrol systems, Lateral control law design using back stepping algorithm.

UNITV MISSILEAND LAUNCHVEHICLEGUIDANCE **10**

Operating principles and design of guidance laws, homing guidance laws-short range, Medium range and BVR missiles, Launch Vehicle-Introduction, Mission requirements, Implicitguidance schemes, Explicit guidance, Q guidance schemes

TOTAL: 45PERIODS

COURSE OUTCOMES:

Upon completion of this course students will be able to

CO1: Explain the equations governing the aircraft dynamics and the process of linearizing them.

CO2: Define the various guidance schemes & requirements for aircrafts and missiles.

CO3: Explain the principle of stability and control augmentation systems.

CO4: Explain the oscillatory modes and methods of suppressing them

CO5: Design the controller for lateral, longitudinal and directional control of aircrafts.

REFERENCES:

1. BlakeLock,JH, "AutomaticcontrolofAircraftandmissiles",JohnWileySons,NewYork, 1990.
2. CollinsonRPG,"IntroductiontoAvionics",ChapmanandHall,India,1996.
3. Garnel.P&EastDJ, "GuidedWeaponcontrolsystems",PergamonPress,Oxford, 1977.
4. Michael V Cook, "Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control", Elsevier, 2013.
5. NelsonRC, "Flightstability&AutomaticControl",McGrawHill,1989.
6. Pierre T. Kabamba, Anouck R. Girard, "Fundamentals of Aerospace Navigation and Guidance", Cambridge university press, 2014.
7. Stevens BL and Lewis FL, "Aircraft control &simulation",JohnWileySons, NewYork,1992.
8. Thomas R Yechout, Steven L Morris, David E Bossert, Wayne F Hallgren, James K Hall, "Introduction to Aircraft Flight Mechanics", AIAA Education series, 2014.

AUDIT COURSES

ENGLISH FOR RESEARCH PAPER WRITING **L T P C**

OBJECTIVES **2 0 0 0**

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, 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 PRONE AREAS IN INDIA **6**

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 IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

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

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi,2001.

CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

- The Constitution of India,1950(Bare Act),Government Publication.
- Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
- M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

KCG COLLEGE OF TECHNOLOGY
M.E. COMMUNICATION SYSTEMS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
III & IV SEMESTERS CURRICULAM AND SYLLABUS

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23ECP301	Optical Communication and Networking	PCC	3	0	0	3	3
2		Professional Elective III	PEC	3	0	0	3	3
THEORY AND PRACTICALS								
3		Professional Elective IV	PEC	3	0	2	5	4
4		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5	23ECP321	Project Work I	EEC	0	0	12	12	6
			TOTAL	12	0	14	26	19

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	23ECP421	Project Work II	EEC	0	0	24	24	12
			TOTAL	0	0	24	24	12

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES

SEMESTER III, ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23ECP041	Ultra Wide Band Communications	PEC	3	0	0	3	3
2	23ECP042	VLSI for Wireless Communication	PEC	3	0	0	3	3
3	23ECP043	MEMS and NEMS	PEC	3	0	0	3	3
4	23ECP044	Advanced Antenna Design	PEC	3	0	0	3	3
5	23ECP045	Software Defined Radios	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23ECP046	Image Processing and Video Analytics	PEC	3	0	2	5	4
2	23ECP047	Radar Signal Processing	PEC	3	0	2	5	4
3	23ECP048	Telecommunication System Modeling and Simulation	PEC	3	0	2	5	4
4	23ECP049	Signal Detection and Estimation	PEC	3	0	2	5	4
5	23ECP050	Real Time Embedded Systems	PEC	3	0	2	5	4

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1	23AXP091	English for Research Paper Writing	2	0	0	0
2	23AXP092	Disaster Management	2	0	0	0
3	23AXP093	Constitution of India	2	0	0	0
4	23AXP094	நற்றமிழ் இலக்கியம்	2	0	0	0

FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1	23MAP171	Linear Algebra, Probability and Queueing Theory	3	1	0	4	4

PROFESSIONAL CORE COURSES (PCC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Sem
			L	T	P		
1	23ECP101	Statistical Signal Processing	3	0	0	3	I
2	23ECP102	Modern Digital Communication Systems	3	0	0	3	I
3	23ECP103	Advanced Wireless Communication	3	0	0	3	I
4	23ECP104	Radiating Systems	3	0	0	3	I
5	23ECP121	Digital Communication Systems Laboratory	0	0	3	1.5	I
6	23ECP122	Advanced Digital Signal Processing Laboratory	0	0	3	1.5	I
7	23ECP201	RF System Design	3	0	0	3	II
8	23ECP211	Microwave Integrated Circuits	3	0	2	4	II
9	23ECP203	Advanced Wireless Networks	3	0	0	3	II
10	23ECP212	Machine Learning	3	0	2	4	II
11	23ECP221	Wireless Communication Laboratory	0	0	4	2	II
12	23ECP222	Optical Communication and Networking	3	0	0	3	III

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Sem
			L	T	P		
1	23RMP101	Advanced Research Methodology and IPR	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Sem
			L	T	P		
1	23ECP222	Term Paper Writing and Seminar	0	0	2	1	II
2	23ECP321	Project Work I	0	0	12	6	III
3	23ECP421	Project Work II	0	0	24	12	IV

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL.NO.	COURSECODE	COURSETITLE	PERIODSPER WEEK			CREDITS
			L	T	P	
1	23OEP901	Principles of Sustainable Development	3	0	0	3
2	23OEP902	Environmental Impact Assessment	3	0	0	3
3	23OEP903	Machine Learning and Deep Learning	3	0	0	3
4	23OEP904	Renewable Energy Technology	3	0	0	3
5	23OEP905	Blockchain Technologies	3	0	0	3
6	23OEP907	Additive Manufacturing	3	0	0	3
7	23OEP908	Electric Vehicle Technology	3	0	0	3
8	23OEP909	Micro and Small Business Management	3	0	0	3

Semester-wise Credit Distribution

SEMESTER	FC	RMC	EEC	PCC	PEC	OEC	AC	Total
Semester I	4	2		15			✓	**21**
Semester II			1	16	6		✓	**23**
Semester III			6	3	7	3	-	**19**
Semester IV			12				-	**12**
ME - CS Department curriculum	**4**	**2**	**19**	**34**	**13**	**3**	-	**75**

FC – Foundation Course

RMC – Research Methodology and IPR Courses

EEC – Employability Enhancement Courses

PCC – Professional Core Courses

PEC – Professional Electives Courses

OEC – Open Electives Courses

AC – Non Credit Audit Course

23MAP103 LINEAR ALGEBRA, PROBABILITY AND QUEUEING THEORY **L T P C 3 1 0 4**

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- Grasp the basic concepts of Probability, Random variables, correlation and regression.
- Characterize the phenomena which evolve with respect to time in a probabilisticmanner.
- Encourage students to develop a working knowledge of the ventral ideas of linearalgebra.
- Acquire skills in analyzing Queueing Models.
- Develop a fundamental understanding of linear programming models and apply thesimplex method for solving linear programming problems.

UNIT - I LINEAR ALGEBRA **12**

Vector spaces – Norms – Inner products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Jordan Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT - II PROBABILITY AND RANDOM VARIABLES **12**

Probability Concepts – Axioms of probability – Conditional probability – Bayes theorem – Randomvariables – Probability functions – Two-dimensional random variables – Joint distributions – Marginal and conditional distributions – Correlation – Linear Regression.

UNIT - III RANDOM PROCESSES **12**

Classification – Stationary random process – Markov process – Markov chain – Poisson process –Gaussian process – Auto correlation – Cross correlation.

UNIT - IV QUEUEING THEORY **12**

Markovian queues – Single and multi-server models – Little's formula – Steady state analysis – Self-service queue.

UNIT - V LINEAR PROGRAMMING **12**

Formulation – Graphical solution – Simplex method – Big M method – Variants of Simplex method

– Transportation problems – Assignment models.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the completion of the course, the student will be able to
Apply various methods in Linear Algebra to solve the system of linear equations.

- Use two-dimensional random variables, correlations and regression in solvingapplication problem.
- Apply the ideas of Random Processes.
- Understand the basic characteristic features of a queueing system and acquireskills in analyzing queueing models.
- Apply the Simplex method for solving linear programming problems.

REFERENCES:

1. Miller,S.L. and Childers D.G., "Probability and Random Processes with Applications toSignal Processing and Communications", Academic Press,2004.
2. Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", Prentice Hall of India, New Delhi,2004.
3. Gross, D., Shortie, J.F., Thompson, J.M and Harris, C.M., "Fundamentals of QueueingTheory", 4th Edition, Wiley,2014.
4. T. Veerarajan, "Probability, Statistics and Random Process with Queueing Theory andQueueing Network, Tata McGraw Hill, 4th Edition,2017.
5. Taha H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education Asia,New Delhi,2016.
6. Richard Bronson, "Matrix Operations" Schaum's outline series, McGraw Hill,2nd Edition, New York,2011.
7. Oliver C. Ibe, " Fundamentals of Applied Probability and Random Processes", AcademicPress, (An Imprint of Elsevier), Boston,2014.

23RMP171 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

UNIT I RESEARCH DESIGN 6

Overview of research process and design, Use of Secondary and exploratory data to answer theresearch question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association.Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTOin IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS 6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL : 30 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”,Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, TradeSecrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools &techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament,“Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

23ECP101 STATISTICAL SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basics of random signal processing
- To learn the concept of estimation and signal modeling
- To know about optimum filters and adaptive filtering and its applications

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation- Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II PARAMETER ESTIMATION THEORY 9

Principle of estimation and applications-Properties of estimates-unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE)-Cramer Rao bound- Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation

UNIT III SPECTRUM ESTIMATION 9

Estimation of spectra from finite duration signals, Bias and Consistency of estimators - Non-Parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation - Detection of Harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms

UNIT IV SIGNAL MODELING AND OPTIMUM FILTERS 9

Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion

– Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIRWiener Filter -– MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

UNIT V ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echocanceller, Adaptive Recursive Filters: RLS adaptive algorithm, Exponentially weighted RLS-sliding window RLS. Matrix inversion Lemma, Initialization, tracking of nonstationarity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Analyze discrete time random processes

CO2: Apply appropriate model for estimation and signal modeling for the given problemCO3: Analyze non-parametric and parametric methods for spectral estimation

CO4: Design optimum filter for the given problem

CO5: Design adaptive filters for different applications

TOTAL:45 PERIODS

REFERENCES:

1. Monson. H. Hayes, Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996 (Reprint 2008)
2. Simon Haykin, Adaptive Filter Theory, Pearson Prentice Hall, 5th edition, 2014
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive SignalProcessing, Artech House Publishers, 2005.
4. Steven. M. Kay, Modern Spectral Estimation, Theory and Application, Pearson India, 2009
5. A.Veloni, N I. Miridakis, E Boukouvala, Digital and Statistical SignalProcessing, CRC Press, 2019
6. S Nandi, D Kundu, Statistical Signal Processing- Frequency Estimation, Springer Nature Singapore, 2ndedition , 2020
7. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing with Applications, PHI, 1996.

23ECP102	MODERN DIGITAL COMMUNICATION SYSTEMS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the coherent and non coherent receivers and their performance underAWGN channel conditions
- To understand the effect of signalling through bandlimited channels and Equalizationtechniques used to overcome ISI
- To understand different channel models, channel capacity and different block coding techniques
- To understand the principle of convolutional coding and different decoding techniques
- To understand the basics of OFDM as a multicarrier communication and CDMA as amultiuser communication technique.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION **9**

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M- DPSK-BER Performance Analysis. Carrier SynchronizationBit synchronization.

UNIT II EQUALIZATION TECHNIQUES **9**

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals- Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION **9**

Architecture and performance – Binary block codes; – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION **9**

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Thresholdmethods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V MULTICARRIER AND MULTIUSER COMMUNICATIONS **9**

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA

systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Differentiate coherent and non coherent receivers and analyse their performance underAWGN channel conditions

CO2: Illustrate the effect of signalling through bandlimited channels and Equalization techniquesused to overcome ISI

CO3: Determine the channel capacity and design various block coding techniques to combatchannel errors

CO4: Construct convolutional coders and analyze the performance of different decoding techniques.

CO5: Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

REFERENCES:

1. John G. Proakis and Masoud Salehi “Digital Communication”, Fifth Edition, Mc Graw Hill Publication, 2014.

2. Simon Haykin, “Digital communication Systems”, John Wiley and sons, 2014.

3. Bernard Sklar and Pabitra Kumar Ray, “Digital Communications Fundamentals & Applications ”, second edition, Pearson Education, 2009.

4. Lathi B P and Zhi Ding, “Modern Digital and Analog communication Systems", Oxford University Press, 2011.

5. Richard Van Nee & Ramjee Prasad, “OFDM for Multimedia Communications” Artech House Publication, 2001.

6. Theodore S.Rappaport, ‘Wireless Communications”, 2nd edition, Pearson Education, 2002.

23ECP103 ADVANCED WIRELESS COMMUNICATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the concepts of wireless communication.
- To know about the various propagation methods, Channel models, capacity calculations
- multiple antennas and multiple user techniques used in the mobile communication.

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space,two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochasticmodel.

UNIT II CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels.Capacity of MISO, SIMO systems.

UNIT III DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT IV MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

UNIT V MULTI USER SYSTEMS 9

Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD Application ofconvex optimization to wireless design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the wireless channel characteristics and identify appropriate channel models

CO2:Understand the mathematics behind the capacity calculation under different channel conditions

CO3: Understand the implication of diversity combining methods and the knowledge of channelCO4: Understand the concepts in MIMO Communications

CO5: Understand mulitiple access techniques and their use in different multi-user scenarios.

REFERENCES :

1. David Tse and Pramod Viswanath, *Fundamentals of wireless communications*, CambridgeUniversity Press, First Edition, 2012
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
3. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley, India, 2003.
4. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006.
5. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education,2007.
6. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
7. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
8. Upena Dalal, "Wireless Communication", Oxford Higher Education, 2009

23ECP104 RADIATING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand Antenna basics
- To learn about Antenna arrays and their characteristics
- To study about operating Antennas
- To familiarize with modern Antennas and Measurement Techniques
- To learn about recent trends in Antenna Design

UNIT I ANTENNA FUNDAMENTALS & WIRE ANTENNAS 9

Introduction –Types of Antennas – Radiation Mechanism – Current distribution on wire antennas – Maxwell's equations – Antenna fundamental parameters – Radiation integrals – Radiation from surface and line current distributions – dipole, monopole, loop antenna

UNIT II ANTENNA ARRAYS 9

Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques – Binomial and Chebyshev distributions; Two dimensional uniform arrays; phased array antennas, smart antennas, switched beam and adaptive arrays, Mutual Coupling in Finite Arrays

UNIT III APERTURE ANTENNAS 9

Field equivalence principle, Radiation from Rectangular and Circular apertures, Babinets principle, Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration. Radiation Mechanism and Excitation techniques, Microstrip dipole; Patch, Rectangular patch, Circular patch – Microstrip array and feed network; Lens Antennas

UNIT IV MODERN ANTENNAS & MEASUREMENT TECHNIQUES 9

Base station antennas, PIFA – Antennas for WBAN – RFID Antennas – Automotive antennas, MIMO Antennas, Diversity techniques – Antenna impedance and radiation pattern measurements

UNIT V RECENT TRENDS IN ANTENNA DESIGN 9

UWB antenna arrays – Vivaldi antenna arrays – Artificial magnetic conductors/High impedancesurfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods

SUGGESTED ACTIVITIES:

1. Design and develop an antenna to receive AM and FM radio
2. Design Yagi-Uda Antenna at very high frequency band
3. Design Microstrip patch antenna for mobile applications
4. Design and develop Microstrip dipole antenna
5. Design reflector antenna for satellite - TV reception

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals behind the different techniques in antenna technology.

CO2: Understand the challenges associated in designing antennas based on different technologies

CO3: Understand the capability and assess the performance of various antennas.

CO4: Identify the antennas specific to the applications, design and characterize.

CO5: Understand the need for optimizing in antenna design and the methodologies forthe same.

REFERENCES:

1. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 3rd Edition,1982.

2. Frank B. Gross, "Frontiers in Antennas", Mc Graw Hill, 2011.

3. S. Drabowitch, A. Papiernik, H.D.Griffiths, J.Encinas, B.L.Smith, "Modern Antennas",Springer Publications, 2nd Edition, 2007.

4. Krauss.J.D, "Antennas", John Wiley and sons, New York, 2nd Edition, 1997.

5. I.J. Bahl and P. Bhartia, "Microstrip Antennas", Artech House,Inc.,1980

6. W.L.Stutzman and G.A.Thiele, "Antenna Theory and Design", John Wiley& Sons Inc., 2ndEdition, 1998.

7. Jim R. James,P.S.Hall ,"Handbook of Microstrip Antennas" IEE Electromagnetic wave series 28, Volume 2,1989.

23ECP122	ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
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COURSE OBJECTIVES:

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods and additive white Gaussian noise (AWGN) channel characterization
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

LIST OF EXPERIMENTS

USE APPROPRIATE SIMULATION TOOLS FOR THE FOLLOWING EXPERIMENTS:

1. Generation of Standard discrete time sequences (Unit Impulse, Unit Step, Unit Ramp, Sinusoidal and exponential signals) and carrying out of arithmetic operations and plot the results
2. Generation of random sequences satisfying the given probability distributions such as Uniform, Gaussian, Rayleigh and Rician.
3. Design of FIR filters for the given specification and plot the frequency response of the designed filter
4. Design of IIR filters for the given specification and plot the frequency response of the designed filter
5. Analysis of finite word length effects of FIR filter coefficients
6. Estimation of power spectrum of the given random sequence using Nonparametric methods (Bartlett, Welch and Blackman Tukey)
7. Estimation of power spectrum of the given random sequence using parametric methods (AR, MA and ARMA)
8. Upsampling the discrete time sequence by L times and plot the spectrum of both thegiven sequence and upsampled sequence
9. Downsampling the discrete time sequence by M times and plot the spectrum of both thegiven sequence and down sampled sequence
10. Design an adaptive filter to extract a desired signal from the given noisy signal bycancelling the noise using LMS Algorithm
11. Design an adaptive filter to extract a desired signal from the given noisy signal bycancelling the noise using RLS Algorithm
12. Implementation of Digital Filter Banks for the given specifications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

- Generate deterministic/Random sequences using simulation tool
- Design and analyze the frequency response of FIR/IIR digital filters for the givenspecifications
- Estimate power spectrum of the given random sequence using parametric/nonparametric estimation methods
- Implement adaptive filters using LMS/RLS algorithm
- Analyze the discrete time systems at various sampling rates

23ECP201 **RF SYSTEM DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Be familiar with RF transceiver system design for wireless communications
- Be exposed to design methods of receivers and transmitters used in communicationsystems
- Design RF circuits and systems using an advanced design tool.
- Exemplify different synchronization methods circuits and describe their block schematic anddesign criteria
- Measure RF circuits and systems with a spectrum analyzer.

UNIT I BASICS OF RADIO FREQUENCY SYSTEM DESIGN **9**

Definitions and models of Linear systems and Non-linear system. Specification parameters: Gain, noise figure, SNR, Characteristic impedance, S-parameters, Impedance matching and Decibels. Elements of digital base band signalling: complex envelope of band pass signals, Average value, RMS value, Crest factor, Sampling, jitter, modulation techniques, filters, pulse shaping, EVM, BER, sensitivity, selectivity, dynamic range and, adjacent and alternate channel power leakages

UNIT II RADIO ARCHITECTURES AND DESIGN CONSIDERATIONS **9**

Superheterodyne architecture, direct conversion architecture, Low IF architecture, band-pass sampling radio architecture, System Design Considerations for an Analog Frontend Receiver in Cognitive Radio Applications, Interference, Near, In-band & wide-band considerations.

UNIT III AMPLIFIER MODELING AND ANALYSIS **9**

Noise: Noise equivalent model for Radio frequency device, amplifier noise model, cascade performance, minimum detectable signal, performance of noisy systems in cascade. Non-Linearity: Amplifier power transfer curve, gain compression, AM-AM, AM-PM, polynomial approximations,Saleh model, Wiener model and Hammerstein model, intermodulation, Single and two tone analyses, second and third order distortions and measurements, SOI and TOI points, cascade performance of nonlinear systems.

UNIT IV MIXER AND OSCILLATOR MODELING AND ANALYSIS **9**

Mixers: Frequency translation mechanisms, frequency inversion, image frequencies, spurious calculations, principles of mixer realizations. Oscillators: phase noise and its effects, effects of oscillator spurious components, frequency accuracy, oscillator realizations: Frequency synthesizers, NCO.

UNIT V APPLICATIONS OF SYSTEMS DESIGN **9**

Multimode and multiband Superheterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmittersystem design.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: understand the specifications of transceiver modules

CO2: understand pros and cons of transceiver architectures and their associated design considerations

CO3: understand the impact of noise and amplifier non-linearity of amplification modules and alsowill learn the resultant effect during cascade connections

CO4: get exposure about spurs and generation principles during signal generation and frequency translations

CO5: understand the case study of transceiver systems and aid to select specification parameters

REFERENCES

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee.Cambridge University Press, 2004.
2. Qizheng Gu, "RF System Design of Transceivers for Wireless Communications", Springer,2005.
3. Kevin McClaning, "Wireless Receiver Design for Digital Communications," Yes Dee Publications, 2012.
5. M C Jeruchim, P Balapan and K S Shanmugam, "Simulation of Communication systems:Modeling, Methodology and Techniques", Kluwer Academic/Plenum Publishers,2 nd Edition, 2000.

23ECP202 ADVANCED WIRELESS NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

The students should be made to:

- study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTE.
- study about wireless IP architecture, Packet Data Protocol and LTE network architecture
- study about adaptive link layer, hybrid ARQ and graphs routing protocol.
- study about mobility management, cellular network, and micro cellular networks

UNIT I INTRODUCTION 9

Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services - Motivation for IP Based Wireless Networks -Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTE-A - Wireless Standards. Network Model-Network Connectivity-Wireless Network Design with Small World Properties

UNIT II WIRELESS IP NETWORK ARCHITECTURES 9

3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context - Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain –LTE network Architecture - Roaming Architecture- Protocol Architecture- Bearer Establishment Procedure -Inter-Working with other RATs.

UNIT III ADAPTIVE LINK AND NETWORK LAYER 9

Link Layer Capacity of Adaptive Air Interfaces-Adaptive Transmission in *Ad Hoc* Networks- Adaptive Hybrid ARQ Schemes for Wireless Links-Stochastic Learning Link Layer Protocol- Infrared Link Access Protocol-Graphs and Routing Protocols-Graph Theory-Routing with Topology Aggregation-Network and Aggregation Models

UNIT IV MOBILITY MANAGEMENT 9

Cellular Networks-Cellular Systems with Prioritized Handoff-Cell Residing Time Distribution-Mobility Prediction in Pico- and Micro-Cellular Networks

UNIT V QUALITY OF SERVICE 9

QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes -QoS Attributes - Management of End-to-End IP QoS - EPS Bearers and QoS in LTE networks

TOTAL:45 PERIODS

REFERENCES

1. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif, “Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach”, John Wiley & Sons, 2014.
2. Crosspoint Boulevard, “Wireless and Mobile All-IP Networks”, Wiley Publication, 2005.

3. Jyh-Cheng Chen and Tao Zhang, “IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols”, John Wiley & Sons, Inc. Publication,2006.
4. Minoru Etoh, “Next Generation Mobile Systems 3G and Beyond,” Wiley Publications,2005.
5. Savo Glisic,” Advanced Wireless Networks-Technology and Business Models”, Third Edition, John Wiley & Sons, Ltd, 2016
6. Savo Glisic,”Advanced Wireless Networks-4G Technologies”, John Wiley & Sons,Ltd,2006.
7. Stefania Sesia, IssamToufik and Matthew Baker, “LTE – The UMTS Long Term Evolution From Theory to Practice”, John Wiley & Sons, Inc. Publication, Second Edition, 2011.

23ECP211 MICROWAVE INTEGRATED CIRCUITS **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To familiarize different transmission lines used at Microwave frequencies
- To design impedance matching networks using lumped and distributed elements
- To design and analyze different microwave components
- To use SMITH chart to analyze the region of stability and instability for designing amplifiersand oscillators
- To simulate and to test the microwave components under laboratory conditions

UNIT I PLANAR TRANSMISSION LINES AND COMPONENTS **9**

Review of Transmission line theory – S parameters-Transmission line equations – reflection coefficient – VSWR – Microstrip lines: Structure, waves in microstrip, Quasi- TEM approximation,Coupled lines: Even mode and odd mode analysis – Microstrip discontinuities and components –Strip line – Slot line – Coplanar waveguide – Filters – Power dividers and Couplers

UNIT II IMPEDANCE MATCHING NETWORKS **9**

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements

UNIT III MICROWAVE AMPLIFIER AND OSCILLATOR DESIGN **9**

Characteristics of microwave transistors – Stability considerations in active networks – GainConsideration in Amplifiers – Noise Coansideration in active networks – Broadband Amplifier design – Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.

UNIT IV MIXERS AND CONTROL CIRCUITS **9**

Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers –Single Balanced Mixers – Sub Harmonic Diode Mixers, Microwave Diodes, Phase Shifters – PIN Diode Attenuators

UNIT V MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES **9**

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology – Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Study of transmission line parameters – Impedance analysis
2. Design of impedance matching networks
3. Design of low pass and high pass filter
4. Design of band-pass and band-stop filters
5. Design of branch line couplers
6. Design of phase shifters
7. Design of Mixers
8. Design of Power dividers

TOTAL: 45 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able

toCO1 : understand the concepts of planar transmission line

CO2: Design impedance matching circuits using LC components and stubs.

CO3: Design and analyze microwave components.

CO4: Perform stability analysis and be able to design amplifiers and oscillatorsat microwave frequencies.

CO5: Perform simulations, fabricate and test microwave devices.

TOTAL: 75 PERIODS

REFERENCES

1. Jia Sheng Hong, M. J. Lancaster, "Microstrip Filters for RF/Microwave Applications", John Wiley & Sons, 2001 David M. Pozar, "Microwave Engineering", John Wiley & Sons, 4th edition 2012
2. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory andApplications", Pearson Education Asia, First Edition,2001.
3. Thomas H.Lee, "Planar Microwave Engineering", Cambridge University Press, 2004
4. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, 2002

		L T P C
23ECP212	**MACHINE LEARNING**	**3 0 2 4**

COURSE OBJECTIVES:

- To understand the concepts and mathematical foundations of machine learning and types ofproblems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

UNIT II SUPERVISED LEARNING 9

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares - Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours

- Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

UNIT IV PROBABILISTIC METHODS FOR LEARNING 9

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

UNIT V NEURAL NETWORKS AND DEEP LEARNING 9

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network

– Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning–Convolution Neural Networks – Recurrent Neural Networks – Use cases

45 PERIODS

SUGGESTED ACTIVITIES:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES: 30 PERIODS

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbours. In this question, you will use the scikit-learn's KNN classifer to classify real vs. fake news headlines. The aim of this question is for you to read the scikit- learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.
    a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
    b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
    c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
    d. You must properly provide references to any work that is not your own in the write-up.
    e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

TOTAL:75 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random forest for an application

CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyzethe results.

CO4: Use a tool to implement typical Clustering algorithms for different types of applications.

CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

REFERENCES

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC,2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation andMachine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data",First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory toAlgorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning",Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,
    Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

23ECP221	WIRELESS COMMUNICATION LABORATORY	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods, wireless and AWGN channel characterization, application of adaptive filter algorithms for communication system design, coding and modulation design, synchronization aspects and the overall baseband system design.
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.
- To enable the student to appreciate the practical aspects of baseband system design and understand the associated challenges.

LIST OF EXPERIMENT:

1. Spectral Characterisation of communication signals (using Spectrum Analyzer)
2. Design and Analysis of Spectrum Estimators (Bartlett , Welch)
3. Design and analysis of digital modulation techniques on an SDR platform
4. Carrier and Symbol timing Synchronization using SDR platform
5. CDMA signal generation and RAKE receiver design using DSP/MATLAB/ SIMULINK
6. Design and performance analysis of error control encoder and decoder (Block and Convolutional Codes)
7. Wireless Channel equalizer design using DSP (ZF / LMS / RLS)
8. Wireless Channel Estimation and Diversity Combining
9. Design and simulation of Microstrip patch antenna
10. Analysis of Antenna Radiation Pattern and measurement

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advancedbaseband signal conditioning methods.

CO2: The student would be capable of applying communication engineering principles and designtools and will be well practiced in design skills.

CO3: The student would be able to comprehensively record and report the measured data, writereports, communicate research ideas and do oral presentations effectively.

CO4: The student would be capable of analyzing and interpreting the experimental measurement
data and produce meaningful conclusions

23ECP222 TERM PAPER WRITING AND SEMINAR L T P C

0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place itin logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.Activities to be carried out

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			

Collecting Information about your area& topic	1. List 1 Special Interest Groups orprofessional society 2. List 2 journals 3. List 2 conferences, symposia orworkshops 4. List 1 thesis title 5. List 3 web presences (mailing lists,forums, news sites) 6. List 3 authors who publishregularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must bearea specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & thenfilter	• You have to provide a complete listof references you will be using- Based on your objective - Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are inthe same field so that you can write a meaningful survey out of them, • Favour papers from well-knownjournals and conferences, • Favour "first" or "foundational"papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships withrespect toeach other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are	4th week	**6%** (the list of standardpapers and reason for selection)

	being considered		
Reading and notes for first 5papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of thearticle? • What was/were the main issue(s)the author said they want to discuss? • Why did the author claim it wasimportant? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions doesthe author claim to be making? • What did the author do? • How did the author claim they weregoing to evaluate their work and compare it to others? • What did the author say were thelimitations of their research? • What did the author say were theimportant directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th week	**8%** (the table given should indicate your understanding of thepaper and the evaluation is based on your conclusions about each paper)

Reading and notes for next5papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based onyour conclusions about each paper)
Reading and notes for final 5papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based onyour conclusions about each paper)
Draft outline 1and Linking papers	Prepare a draft Outline, your survey goals,along with a classification / categorization diagram	8th week	**8%** (this component willbe evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give apresentation	9th week	**6%** (Clarity, purpose andconclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of thepaper	Write the sections of your paper based on the classification / categorization diagramin keeping with the goals of your survey	11thweek	**10%** (this component willbe evaluated based on the linking and classification among the papers)

Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity andlinking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15thweek	**10%** (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

23ECP301	OPTICAL COMMUNICATION AND NETWORKING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To enable the student to understand the basic principles of operation of optical system components, the different network architectures and issues associated with network design.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and thenetwork management and protection methods in vogue.

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN **9**

Optical System Components – MZIM, Multiplexers; filters; switches; wavelength converters; optical amplifiers – EDFA, Raman Amplifiers and hybrid; Transmission system Engineering – System Model, Aimer penalty – transmitter, receiver, cross talk, dispersion compensation, wavelength stabilization, FWM.

UNIT II COHERENT SYSTEMS **9**

Basic principles of Coherent detections – Practical constraints – Injection laser line width state ofpolarization, local oscillator power, fiber limitations; Modulation formats – ASK, FSK, PSK, DPSKand polarization shift keying (POL SK); Demodulation schemes – Homodyne, Heterodyne – Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherentdetection.

UNIT III OPTICAL NETWORK ARCHITECTURES **9**

Introduction to Optical Networks; First Generation optical networks –SONET / SDH Network, Second Generation (WDM) Optical Networks, Need for Multilayered Architecture-, Layers and Sub- layers, Spectrum partitioning, Optical Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.

UNIT IV NETWORK CONNECTIONS **9**

Connection Management and Control; Static Networks, Wavelength Routed Networks; Linear Lightwave networks; Logically Routed Networks; Routing and Wavelength Assignment , Traffic Grooming in Optical Networks

UNIT V OPTICAL NETWORK SURVIVABILITY **9**

Protection and Restoration Objectives, Fault Protection and Restoration Techniques in the Logical Layer – Point-to-Point Systems, SONET Self-Healing Rings, Interconnection Techniques, Architectures with Arbitrary Mesh Topologies ,Optical-Layer Protection: Point-to-Point and Ring Architectures, Mesh Architectures

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: demonstrate an understanding of the differences and challenges involved in the design ofoptical systems and networks.

CO2: apply his knowledge for designing a fiber optic system addressing the channel impairments.

CO3: Familiar with the architectures and the protocol stack in use.in optical networks and would beable to identify a suitable backbone infrastructure for our present and future communicationneeds.

CO4: understand how connections are managed in the network and the pros and cons of thedifferent approaches

CO5: appreciate the need for network survivability and the methodologies used.

TOTAL:45 PERIODS

REFERENCES

1. Max Ming-Kang Liu, "Principles and Applications of Optical Communication", Tata McGraw Hill Education Pvt., Ltd., New Delhi. 2010
2. Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks - Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009.
3. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective",Harcourt Asia Pte Ltd., Second Edition 2006.

23ECP031 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To gain broad conceptual understanding of the various aspects of electromagnetic (EM)interference and compatibility
- To develop a theoretical understanding of electromagnetic shielding effectiveness
- To understand ways of mitigating EMI by using shielding, grounding and filtering
- To understand the need for standards and to appreciate measurement methods
- To understand how EMI impacts wireless and broadband technologies

UNIT I INTRODUCTION & SOURCES OF EM INTERFERENCE **9**

Introduction - Classification of sources - Natural sources - Man-made sources - Survey of theelectromagnetic environment.

UNIT II EM SHIELDING **9**

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency,magnetic field shielding - Effects of apertures

UNIT III INTERFERENCE CONTROL TECHNIQUES **9**

Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

UNIT IV EMC STANDARDS, MEASUREMENTS AND TESTING **9**

Need for standards - The international framework - Human exposure limits to EM fields -EMCmeasurement techniques - Measurement tools - Test environments.

UNIT V EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES **9**

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:

1. Investigate various case studies related to EMIC. Example: Chernobyl Disaster in 1986.
2. Develop some understanding about the design of EM shields in electronic system design andpackaging.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Demonstrate knowledge of the various sources of electromagnetic interference
CO2: Display an understanding of the effect of how electromagnetic fields couple throughapertures, and solve simple problems based on that understanding
CO3: Explain the EMI mitigation techniques of shielding and grounding
CO4: Explain the need for standards and EMC measurement methods
CO5: Discuss the impact of EMC on wireless and broadband technologies

REFERENCES

1. Christopoulos C, Principles and Techniques of Electromagnetic Compatibility, CRC Press, Second Edition, Indian Edition, 2013.

2. Paul C R, Introduction to Electromagnetic Compatibility, Wiley India, Second Edition,2008.

3. Kodali V P, Engineering Electromagnetic Compatibility, Wiley India, Second Edition,2010.

4. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc,Newyork,2009.

5. Scott Bennett W, Control and Measurement of Unintentional Electromagnetic Radiation, John Wiley& Sons Inc., Wiley Interscience Series, 1997.

23ECP032 **ADVANCED SATELLITE COMMUNICATION AND NAVIGATIONSYSTEMS** **L T P C 3 0 0 3**

COURSE OBJECTIVES:

To enable the students to

- Learn M2M developments and satellite applications
- Understand Satellite Communication In Ipv6 Environment

UNIT I OVERVIEW OF SATELLITE COMMUNICATION **9**

Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.

UNIT II M2M DEVELOPMENTS AND SATELLITE APPLICATIONS **9**

Overview of the Internet of Things and M2M- M2M Applications Examples and Satellite Support- Satellite Roles Context and Applications- Antennas for Satellite M2M Applications- M2M Market Opportunities for Satellite Operators-Ultra HD Video/TV and Satellite Implications-High Throughput Satellites (HTS) and Ka/Ku Spot Beam Technologies- Aeronautical, Maritime and other Mobility Services.

UNIT III SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT **9**

Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence-- Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific Protocol issues in IPv6 – Impact of IPv6 on Satellite Network architecture and services- Detailed transitional plan- IPv6 demonstration over satellites - Key results and recommendations.

UNIT IV SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM **9**

Overview of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, SatelliteSignal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data
, GPS Receiver Operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.

UNIT V DEEP SPACE NETWORKS AND INTER PLANETARY MISSIONS **9**

Introduction – Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and spacecraft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and spacecraft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance.Mangalyaan Mission - Mission and spacecraft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance

COURSE OUTCOMES:

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

CO1: Discuss Satellite navigation and global positioning system

CO2: Understand deep space networks and inter planetary missions

CO3: Demonstrate an understanding of the different interferences and attenuation mechanismsaffecting the satellite link design.

CO4: Demonstrate an understanding of the different communication, sensing and navigationalapplications of satellite.

CO5: Familiar with the implementation aspects of existing satellite based systems.

TOTAL:45 PERIODS

REFERENCES

1. Adimurthy.V,"Concept design and planning of India's first interplanetary mission" Current Science, VOL. 109, NO. 6, 1054 25 SEPTEMBER 2015.
2. 2. Anil K. Maini, Varsha Agrawal, 'Satellite Technology: Principles and Applications', Third Edition, Wiley, 2014.
3. Daniel Minoli' "Innovations in Satellite Communication and Satellite Technology" Wiley,2015
4. Daniel Minoli, "Satellite Systems Engineering in an IPv6 Environment", CRC Press, First Edition, 2009.
5. Hofmann-Wellenhof B., Lichtenegger H., and Elmar Wasle, "Global Navigational Satellite Systems" Springer-Verlag, 2008.
6. Louis J. Ippolito, Jr. "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", Second Edition, 2017
7. http://www.isro.gov.in/pslv-c25-mars-orbiter-mission Jim Taylor, " Deep Space Communications" John Wiley & Sons, 2016.

23ECP033	HIGH SPEED SWITCHING AND NETWORKING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To explore the various space division switches
- To enable the various network performance analysis
- To get the clear idea about the various multimedia application
- To get a clear idea about the traffic and Queuing systems.
- Interpret the basics of security management and the various attacks & its countermeasures

UNIT I SWITCHING ARCHITECTURES 9

Shared medium switches – Shared memory switches – Space division switches – Cross bar basedswitching architecture – Input queued, Output queued and Combined input- output queued switches

– Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks –Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches

UNIT II NETWORK PERFORMANCE ANALYSIS 9

Objectives and requirements for Quality of Service (QoS) in high performance networks. Architecture of high performance networks (HPN), design issues, protocols for HPN, VHF backbone networks, virtual interface architectures, virtual interface for networking, High-speed switching and routing - internet and PSTN IP switching techniques, SRP protocols, SRP authentication, and key exchange, comparison of TCP/IP, FTP, TELNET, queuing systems, network modeling as a graph

UNIT III MULTIMEDIA NETWORKING APPLICATIONS 9

Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP- differentiated services.

UNIT IV PACKET QUEUES AND DELAY ANALYSIS 9

Littles theorem, Birth and Death process, queueing discipline- Control & stability -, Markovian FIFO queueing system, Non-markovian - PollaczekKhinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues – Burkes theorem and Jackson Theorem.

UNIT V NETWORK SECURITY AND MANAGEMENT 9

Principles of cryptography – Elliptic-AES Authentication – integrity – key distribution and certification– Access control and: fire walls – DoS-attacks and countermeasures – security in many layers.Infrastructure for network management – The internet standard management framework – SMI, MIB,SNMP, Security and administration – ASN.1.

COURSE OUTCOMES:

Upon completion the students will be able to

CO1: Understand the fundamental concepts of the switching architecture involved in various switching types.

CO2: Interpret the basics of various protocols and QOS in the network performance.

CO3: Understand the various types of multimedia networking application.

CO4: Recognize the concepts of various analysis method involved in the processing.

CO5: Understand fundamental issues involved in providing the security as well as the.Management.

TOTAL:45 PERIODS

REFERENCES

1. Achille Pattavina, "Switching Theory Architectures and performance in Broadband ATM networks", John wiley & sons Ltd. New York, 2007.

2. Elhanany, Itamar, Hamdi and Mounir, "High Performance Packet Switching Architectures",Springer 2007

3. Walrand .J. Varatya, "High Performance Communication Network", Morgan Kaufmann –Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.

4. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.

5. Nader F.Mir, "Computer and Communication Networks", Pearson Education, 2009.

23ECP034 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs*. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect,dispersion.

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossless models.

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors.

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic

,SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eyediagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis.

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, cancelingparasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: identify sources affecting the speed of digital circuits.

CO2:identify methods to improve the signal transmission characteristics**CO3:** characterise and model multiconductor transmission line

CO4: analyse clock distribution system and understand its design parameters

CO5: analyse nonideal effects of transmission line

REFERENCES

1. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic,Prentice Hall, 1993.
2. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice HallPTR , 2003.
3. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handboo of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.
4. Eric Bogatin , Signal Integrity – Simplified , Prentice Hall PTR, 2003.

TOOLS REQUIRED

1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html

2. HSPICE from synopsis, www.synopsys.com/products/ mixedsignal/hspice/hspice.html

3. SPECTRAQUEST from Cadence, http://www.specctraquest.com or any equivalent opensource tool

23ECP035 **WAVELETS AND SUBBAND CODING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.
- To study signal compression and sub-band coding

UNIT I INTRODUCTION TO WAVELETS **9**

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELETTRANSFORM **9**

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function

and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filterbanks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN **9**

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES **9**

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V SIGNAL COMPRESSION AND SUBBAND CODING **9**

Compression Systems Based on Linear Transforms - Speech and Audio Compression - ImageCompression - Video Compression - Joint Source-Channel Coding

COURSE OUTCOMES:

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

CO1: Understand the fundamental concepts of wavelet transforms

CO2: Apprehend detailed knowledge about wavelet transform

CO3: Understand system design using wavelets

CO4: Compare different wavelet families

CO5: Analyze signal compression and sub-band coding

TOTAL:45 PERIODS

REFERENCES

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, "Introduction to wavelets and wavelet transform", Prentice Hall, 1998.

2. G.Strang and T.Nguyen, "Wavelet and filter banks", Wesley and Cambridge Press, 1996.

3. Metin Akay, "Time frequency and wavelets in biomedical signal processing", Wiley-IEEE Press, October 1997.

4. M.Vetterli and J. Kovacevic, "Wavelets and sub band coding", Prentice Hall, 1995.

5. .P.Vaidyanathan, "Multi rate systems and filter banks", Prentice Hall 1993

6. Raguveer m Rao & Ajith S. Bopardikar, "Wavelet transforms – Introduction to theory and applications", Addison Wesley, 1998

7. S.Mallet, "A Wavelet tour of Signal Processing", Academic Press 1998

23ECP036 MULTIMEDIA COMPRESSION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic ideas of compression algorithms related to multimediacomponents – Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis onunderlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications
- To understand and implement compression standards in detail

UNIT I FUNDAMENTALS OF COMPRESSION 9

Introduction To multimedia – Graphics, Image and Video representations – Fundamental conceptsof video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression

UNIT II TEXT COMPRESSION 9

Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III IMAGE COMPRESSION 9

Image Compression: Fundamentals –– Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.

UNIT IV AUDIO COMPRESSION 9

Audio compression Techniques – law, A-Law companding – Frequency domain and filtering –

Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.

UNIT V VIDEO COMPRESSION 9

Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current Trends in Compression standards.

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students should be able to

CO1: Implement basic compression algorithms familiar with the use of MATLAB and its

equivalentopen source environments
CO2: Design and implement some basic compression standards
CO3: Critically analyze different approaches of compression algorithms in multimedia related miniprojects.
CO4: Understand the various audio,speech compression techniques
CO5: Understand and implement MPEG video coding techniques.

REFERENCES

1. Khalid Sayood: Introduction to Data Compression", Morgan Kauffman Harcourt India, ThirdEdition, 2010.
2. David Solomon, "Data Compression – The Complete Reference", Fourth Edition, SpringerVerlog, New York, 2006.
3. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering,Algorithms and Fundamentals", CRC Press, 2003.
4. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2009.

23ECP037 COGNITIVE RADIO NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Understand the fundamental concepts of cognitive radio networks.
- Develop the cognitive radio, as well as techniques for spectrum holes detection thatcognitive radio takes advantages in order to exploit it.
- Understand the functions of MAC layer and Network layer and its various protocols
- Understand fundamental issues regarding dynamic spectrum access, the radio-resourcemanagement and trading
- Interpret the basics of security management and the various attacks & its countermeasures

UNIT I INTRODUCTION TO COGNITIVE RADIO 9

Cognitive Radio : Techniques and signal processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclo stationary and wavelet based sensing- problem formulation and performance analysis based on probability of detection Vs SNR. Cooperative sensing: different fusion rules, wideband spectrum

UNIT II SPECTRUM SENSING AND TRADING 9

Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques – Other algorithms – Comparison – Performance Measure & Design Trade-Offs : Receiver operating characteristics – Throughput Performance measure –Fundamentallimits and trade-off. Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential)

UNIT III MAC PROTOCOLS AND NETWORK LAYER DESIGN 9

Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN– Centralized and Distributed protocols – Geographical Protocol

UNIT IV DYNAMIC SPECTRUM ACCESS AND MANAGEMENT 9

Spectrum broker, Dynamic spectrum access architecture- centralized dynamic spectrum access, distributed dynamic spectrum access, Inter- and intra-RAN dynamic spectrum allocation, Spectrummanagement, Spectrum sharing, Spectrum mobility issues

UNIT V TRUSTED COGNITIVE RADIO NETWORKS AND RESEARCH CHALLENGES 9

Trust for CRN: Fundamentals – Models – Effects of Trust Management –Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks. Network layer and transport layer issues, cross layer design for cognitive radio networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamental concepts of cognitive radio networks.

CO2: Interpret the basics of various spectrum sensing techniques and algorithms

CO3: Understand the functions of MAC layer and Network layer and its various protocols

CO4: Recognize the concepts of cooperative spectrum sensing and handoff process

CO5: Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.

REFERENCES

1. Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Hüseyin Arslan, Springer, ISBN 978-1-4020-5541-6 (HB), 2007.

2. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

3. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.

4. Cognitive Radio Technology", by Bruce A. Fette, Elsevier, ISBN 10: 0-7506-7952-2, 2006.

5. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles and Practice", Elsevier Inc., 2010.

23ECP038 **SPEECH PROCESSING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce speech production and related parameters of speech.
- To illustrate the concepts of speech signal representations and coding.
- To understand different speech modeling procedures such Markov and theirimplementation issues.
- To gain knowledge about text analysis and speech synthesis.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING **9**

Overview of Digital Signal Processing – Speech Signal Representations – Short time FourierAnalysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing
– Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder, CELP, Vocoders.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – PhoneticModeling – Adaptive Techniques – Confidence Measures
– Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – HomographDisambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification
of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

COURSE OUTCOMES:

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

CO1: Model speech production system and describe the fundamentals of speech.

CO2: Extract and compare different speech parameters.

CO3: Choose an appropriate statistical speech model for a given application.

CO4: Design a speech recognition system.

CO5: Use different text analysis and speech synthesis techniques.

TOTAL:45 PERIODS

REFERENCES

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006

2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons,1999.

3. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introductionto Natural Language Processing, Computational Linguistics, and Speech Recognition",Pearson Education, 2002.

4. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997.

5. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition",Pearson Education, 2003.

6. Steven W. Smith, "The Scientist and Engineer‟s Guide to Digital Signal Processing",California Technical Publishing, 1997.

7. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice",Pearson Education, 2004.

23ECP039 **mm WAVE COMMUNICATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of Millimeter wave devices and circuits.
- To understand the various components of Millimeter wave Communications system.
- To know the antenna design at Millimeter wave frequencies.

UNIT I INTRODUCTION 9

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II mm WAVE DEVICES AND CIRCUITS 9

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

UNIT III mm WAVE COMMUNICATION SYSTEMS 9

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave
link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator,Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

UNIT IV mm WAVE MIMO SYSTEMS 9

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, MultipleTransceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial,
Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V ANTENNAS FOR MM WAVE SYSTEMS 9

Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon completion of the course the student will be able to

CO1: understand the Millimeter wave characteristics and implementation challenges faced.

CO2: understand Millimeter devices and circuits

CO3: apply his knowledge on the Modulation techniques for millimeter wave communications

CO 4: : design antenna for Millimeter wave frequencies

CO5: Familiar with Millimeter wave technology

REFERENCES

1. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press,March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock,"Millimeter Wave Wireless Communication", Prentice Hall, 2014.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.

23ECP040	ANALOG AND MIXED SIGNAL VLSI DESIGN	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To study the concepts of MOS large signal model and small signal model
- To understand the concepts of D/A conversion methods and their architectures.
- To learn filters for ADC.
- To study about the switched capacitor circuits.

UNIT I INTRODUCTION AND BASIC MOS DEVICES 9

Challenges in analog design-Mixed signal layout issues- MOSFET structures and characteristics large signal and small signal model of single stage Amplifier-Source follower- Common gate stage

– Cascode Stage – large and small signal analysis of differential amplifier with active load, pole-zero estimation, zero value time constant method, frequency response of CS, cascade and Cascode amplifiers

UNIT II SUBMICRON CIRCUIT DESIGN 9

Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design,Delay Elements – Adders- OP Amp parameters and Design

UNIT III DATA CONVERTERS 9

Static and dynamic errors in DAC and ADC – Architectures & Characteristics of Sample and HoldDigital to Analog Converters- DAC- R-2R, weighted DAC, multiplying DAC, segmented DAC and sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive approximation ADC, sigma delta ADC.

UNIT IV SNR IN DATA CONVERTERS 9

Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – DecimatingFilters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC

UNIT V SWITCHED CAPACITOR CIRCUITS 9

Resistors, First order low pass Circuit, Switched capacitor Amplifier, Switched Capacitor Integrator– Design of flip around sample and hold circuit – pipelined ADC.

COURSE OUTCOMES:

Upon completion of the course , the student will be able to

CO1: Understand the Basic MOS devices characteristics & Analyze their frequency responses

CO2: Design submicron circuit.

CO3: Apply his knowledge on the DAC & ADC conversions.

CO4: Analyze the SNR in Data converters.

CO5: Design and analyze switched capacitor circuits

TOTAL:45 PERIODS

REFERENCES

1. J. Jacob Wikner, Mikael Gustavsson, Nianxiong Tan "CMOS Data Converters for
Communications" Springer, 2000.
2. Van de Plassche, Rudy J., "CMOS Integrated Analog-to-Digital and Digital-to-Analog
Converters" Springer, 2003.

23ECP041 ULTRA WIDE BAND COMMUNICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To give fundamental concepts related to Ultra wide band
- To understand the channel model and signal processing for UWB.
- To acquire knowledge about UWB antennas and regulations.

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, Benefits and challenges, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wirelessservices.

UNIT II UWB TECHNOLOGIES AND CHANNEL MODELS 9

Impulse Radio, Pulsed Multiband, Multiband OFDM, features: Complexity, Power Consumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM, Performance characterization, Ultra Wide Band Wireless Channels Channel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channel model, Path loss, Delay profiles, Time and frequency modeling.

UNIT III UWB SIGNAL PROCESSING 9

Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel Capacity, UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS LocationError , Locationing with OFDM

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.

UNIT V UWB APPLICATIONS AND REGULATIONS 9

Ultra wideband receiver architecture, Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications, UWB Regulation and standards in various countries , UWB Regulation in ITU, IEEE Standardization

COURSE OUTCOMES:

Upon completion the students will be able to

CO1: Understand the basic concepts of UWB ..

CO2: Understand the basic concepts of UWB technologies.

CO3: Assess the performance of UWB channels.

CO4: Apply the UWB signal processing

CO5: Design UWB antenna for various applications.

TOTAL:45 PERIODS

REFERENCES

1. Homayoun Nikookar and Ramjee Prasad, "Introduction to Ultra Wideband forWireless Communications"1st Edition, Springer Science & Business Media B.V. 2010.
2. Thomas Kaiser, Feng Zheng "Ultra Wideband Systems with MIMO", 1st Edition, John Wiley & Sons Ltd, New York, 2010.
3. W. Pam Siriwongpairat and K. J. Ray Liu, "Ultra-Wideband Communications Systems: Multiband OFDM approach" John Wiley and IEEE press, New York 2008.
4. Huseyin Arslan,Zhi Ning Chen,Maria-Gabriella Di Benedetto "Ultra Wideband Wireless communication" Wiley-Interscience; 1st edition 2006.

23ECP042	VLSI FOR WIRELESS COMMUNICATION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of basic wireless communication concepts.
- To study the parameters in receiver and low noise amplifier design.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of transmitters and power amplifiers in wirelesscommunication.

UNIT I COMMUNICATION CONCEPTS 9

Introduction – Overview of Wireless systems – Standards – Access Methods – Modulationschemes – Classical channel – Wireless channel description – Path loss – Multipath fading –
Standard Translation.

UNIT II RECEIVER ARCHITECTURE & LOW NOISE AMPLIFIERS 9

Receiver front end – Filter design – Non-idealities – Design parameters – Noise figure & Inputintercept point. LNA Introduction – Wideband LNA design – Narrow band LNA design: Impedancematching & Core amplifier.

UNIT III MIXERS 9

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Noise - A Complete Active Mixer. Switching Mixer – Distortion, Conversion Gain & Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain, Distortion, Intrinsic & Extrinsic Noise in Single Ended Sampling Mixer.

UNIT IV FREQUENCY SYNTHESIZERS 9

PLL – Phase detector – Dividers – Voltage Controlled Oscillators – LC oscillators – Ring Oscillators – Phase noise – Loop filters & design approaches – A complete synthesizer design example (DECT) – Frequency synthesizer with fractional divider.

UNIT V TRANSMITTER ARCHITECTURES & POWER AMPLIFIERS 9

Transmitter back end design – Quadrature LO generator – Power amplifier design.

COURSE OUTCOMES:

At the end of this course, the student should be able to

CO1: Able to recollect basic wireless communication concepts.

CO2: To understand the parameters in receiver and design a low noise amplifier

CO3: In a position to apply his knowledge on various types of mixers designed for wirelesscommunication.

CO4: Design PLL and VCO

CO5: Understand the concepts of transmitters and utilize the power amplifiers in wirelesscommunication.

TOTAL:45 PERIODS

REFERENCES

1. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
2. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI wireless design – Circuits & Systems", Kluwer Academic Publishers, 2000.
5. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997.
6. Thomas H.Lee, "The Design of CMOS Radio – Frequency Integrated Circuits", Cambridge University Press ,2003.

23ECP043 **MEMS AND NEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- to introduce the concepts of Micro Electro Mechanical devices.
- to know the fabrication process of microsystems.
- to know the design concepts of micro sensors and micro actuators.
- to familiarize concepts of Quantum Mechanics and Nano systems.

UNIT I OVERVIEW **9**

New trends in Engineering and Science: Micro and Nanoscale systems, introduction to design of MEMS and NEMS, MEMS and NEMS – applications, devices and structures. Materials for MEMS: Silicon, Silicon compounds, polymers, metals

UNIT II MEMS FABRICATION TECHNOLOGIES **9**

Microsystem Fabrication Processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin Film Depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching Techniques: Dry and Wet Etching, Electrochemical Etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-Like) Technology; Packaging: Microsystems Packaging, Essential Packaging Technologies, Selection of Packaging Materials

UNIT III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic Wave Sensors, Resonant Sensor, Vibratory Gyroscope, Capacitive and Piezo Resistive Pressure Sensors- Engineering Mechanics Behind These Microsensors. Case Study: Piezo-Resistive Pressure Sensor.

UNIT IV MICRO ACTUATORS **9**

Design of Actuators: Actuation Using Thermal Forces, Actuation Using Shape Memory Alloys, Actuation Using Piezoelectric Crystals, Actuation using Electrostatic Forces (Parallel Plate, Torsion Bar, Comb Drive Actuators), Micromechanical Motors and Pumps. Case Study: Comb Drive Actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS **9**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: SchrodingerEquation and Wave Function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss micro sensors

CO2: Explain micro actuators

CO3: Outline nanosystems and Quantum mechanics

CO4: Design micro actuators for different applications

CO5: Analyze atomic structures

REFERENCES

1. Chang Liu, "Foundations of MEMS", Pearson Education India Limited, 2006.
2. Marc Madou, "Fundamentals of Microfabrication", CRC Press 1997.
3. Stephen D. Senturia," Micro System Design", Kluwer Academic Publishers,2001
4. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002.
5. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata Mcraw Hill, 2002.

23ECP044 ADVANCED ANTENNA DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the antenna radiation characteristics and arrays.
- To enhance the student knowledge in the area of various antenna design.
- To enhance the student knowledge in the area of antenna for practical applications.

UNIT I FUNDAMENTAL CONCEPTS 9

Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT II THIN LINEAR ANTENNAS AND ARRAYS 9

Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop, N-Element Linear Array, Antenna element spacing without grating lobes, Linear broadside array with non-uniform distributions, Gain of regularly spaced planar arrays with $d = \lambda/2$, Tchebyscheff Array antennas.

UNIT III SECONDARY SOURCES AND APERTURE ANTENNAS 9

Magnetic currents, Duality, Images of electric and magnetic currents, electric and magnetic currents as sheet sources, Impressed and induced current sources, Induction and equivalence theorems, Field of a secondary or Huygens source, Radiation from open end of a coaxial line, Radiation through an aperture in conducting screen, slot antenna.

UNIT IV EFFECT OF MUTUAL COUPLING ON ANTENNAS 9

Accounting for mutual effects for dipole array compensation using open-circuit voltages, compensation using the minimum norm formulation, Effect of mutual coupling- constant Jammers, Constant Signal, Compensation of mutual coupling- constant Jammers, Constant Signal, Result of different elevation angle.

UNIT V ADAPTIVE ARRAY CONCEPT 9

Motivation of using Adaptive Arrays, Adaptive Array problem statement, Signal Environment, ArrayElement Spacing considerations, Array Performance, Concept of optimum Array Processing, Recursive Methods for Adaptive Error Processing.

COURSE OUTCOMES:

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

CO1: Acquire the knowledge about basic antenna parameters.

CO2: Theoretically analyze wire antennas and arrays.

CO3: Identify secondary sources, aperture, broadband and frequency independent antennas.

CO4: Apply the knowledge of mutual coupling on antennas, applications and numerical techniques.

CO5: Acquire brief knowledge about adaptive array concept.

TOTAL:45 PERIODS

REFERENCES

1. Balanis, C., Antennas, John Wiley and sons (2007) 3rd
2. Milligan, Thomas A., Modern Antenna Design 2nd edition, IEEE press, Wiley Interscience (2005).
3. David B. Davidson, Computational Electromagnetics for RF and Microwave Engineering, Cambridge University Press 2005.
4. Neelakanta, Perambur S., and Chatterjee, Rajeswari, Antennas for Information Super Skyways: An Exposition on Outdoor and Indoor Wireless Antennas, Research StudiesPress Ltd. (2004).
5. Godara, Lal Chand, Smart Antennas, CRC Press (2004).
6. Munk, Ben A., Finite Antenna Arrays and FSS, John Wiley and Sons (2003).

23ECP045 SOFTWARE DEFINED RADIOS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn various design principles of software defined radio.
- To understand challenges of receiver design.
- To design smart antennas for SDR.

UNIT I INTRODUCTION TO SOFTWARE RADIO CONCEPTS 9

SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End- to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA. Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems.

UNIT II RADIO FREQUENCY IMPLEMENTATION ISSUES 9

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT III MULTIRATE SIGNAL PROCESSING IN SDR 9

Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digitalreceivers using multirate digital filters.

UNIT IV SMART ANTENNAS 9

Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antennasystems, Smart antenna architectures, Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio.

UNIT V OBJECT ORIENTED REPRESENTATION OF RADIOS ANDNETWORK 9

Networks, Object –oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system. **Case Studies in Software Radio Design:** SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking. Processing, Recursive Methods for Adaptive Error
Processing.

COURSE OUTCOMES:

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

CO1: Demonstrate advanced knowledge in the evolving paradigm of Software defined radio andtechnologies for its implementation.

CO2: Analyse complex problems critically in the domains of Radio frequency implementation issues,

CO3: Apply multirate signal processing in SDR

CO4: Implement Smart antenna techniques for better spectrum exploitation for conducting research.

CO5: Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios.

TOTAL:45 PERIODS

REFERENCES

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.
3. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008
4. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.
5. Dillinger, Madani, Alonistioti (Eds.), Software Defined Radio, Architectures, Systems and Functions, Wiley, 2003
6. Bard, Kovarik, Software Defined Radio, the Software Communications Architecture, Wiley, 2007

23ECP046	IMAGE PROCESSING AND VIDEO ANALYTICS	L T P C 3 0 2 4

COURSE OBJECTIVES:

- To comprehend the relation between human visual system and machine perception andprocessing of digital images
- To provide a detailed approach towards image processing applications like enhancement,segmentation, and compression.
- To also explore the integration principles of communication system working with differentsampling rates.
- To analysis the fundamentals of digital image processing, image and video analysis
- To present the mathematics and algorithms that underlie image analysis techniques.

UNIT I INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS **9**

Introduction: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models.

Image enhancement in Spatial domain: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, Smoothing spatial filtering, Sharpening spatial filtering.

UNIT II IMAGE PROCESSING TECHNIQUES **9**

Image Enhancement: 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 Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

UNIT III VIDEO PROCESSING AND MOTION ESTIMATION **9**

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Blockmatching 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.

UNIT IV INTRODUCTION: VIDEO ANALYTICS **9**

Computer Vision: Challenges- Spatial Domain Processing – Frequency Domain Processing- Background Modeling-Shadow Detection-Eigen Faces - Object Detection -Local Features-Mean Shift: Clustering, Tracking - Object Tracking using Active Contours – Tracking & Video Analysis-Kalman filters, condensation, particle, Bayesian filters, hidden

Markov models, change detection and model based tracking

UNIT V MOTION UNDERSTANDING **9**

Motion estimation and Compensation-Block Matching Method, Motion Segmentation - Thresholding for Change Detection, Estimation of Model parameters - Optical Flow Segmentation-Modified Hough Transform Method- Segmentation for Layered Video Representation-Bayesian Segmentation -Simultaneous Estimation and Segmentation- Motion Field Model - Action
Recognition - Low Level Image Processing for Action Recognition

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Explore of the limitations of the computational methods on digital images.

CO2: Implement the spatial and frequency domain image transforms on enhancement and restoration of images.

CO3: Define the need for compression and evaluate the basic compression algorithms

CO4: Study the techniques to recover the desired signal parameters and information from thesignal corrupted by noisy channel.

CO5: Understand the algorithms available for performing analysis on video data and address the challenges.

CO6: Understand the approaches for identifying and tracking objects and person with motion based algorithms.

REFERENCES

1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson,2008
2. John J. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education,2002.
3. Digital Image Processing and Analysis-Human and Computer Vision Application

with using CVIP Tools - Scotte Umbaugh, 2nd Ed, CRC Press, 2011

4. John C. Russ, F. Brent Neal-The Image Processing Handbook, Seventh Edition, The Kindle edition (2016), CRC Press,Taylor & Francis Group.
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.
6. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
7. Yao Wang, JornOstermann and Ya-Qin Zhang, "Video Processing and Communications",Prentice Hall, 2001.

23ECP047 **RADAR SIGNAL PROCESSIN** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the Radar Signal acquisition and sampling in multiple domains
- To provide clear instruction in radar DSP basics
- To equip the skills needed in both design and analysis of common radar algorithms
- To understand the basics of synthetic aperture imaging and adaptive array processing
- To illustrate how theoretical results are derived and applied in practice

UNIT I INTRODUCTION TO RADAR SYSTEMS **9**

History and application of radar, basic radar function, elements of pulsed radar,review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing

UNIT II SIGNAL MODELS **9**

Components of a radar signal, amplitude models, types of clutters, noise model and signal-tonoise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model

UNIT III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS **9**

Domains and criteria for sampling radar signals, Sampling in the fast time dimension,Sampling in slow time: selecting the pulse repetition interval, sampling the doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.

UNIT IV RADAR WAVEFORMS **9**

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse
compression waveforms, COSTAS Frequency Codes.

UNIT V DOPPLER PROCESSING **9**

Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing

PRACTICAL EXERCISES: 30 PERIODS

1. Matched filtering operation
2. Modeling the Propagation of Radar Signals
3. Modeling of radar targets
4. Density-based algorithm for clustering data.
5. MTI radar design, target detection in noise
6. Estimation of bearing angle in noise, clutter modelling
7. Frequency modulated radar signal generation
8. Doppler shift Signal strength
9. SNR loss measurement in pulse compression
10. detection performance of a radar system

TOTAL PERIODS: 75

COURSE OUTCOMES:

Upon completion of the course, the students will be able

toCO1: perform radar signal acquisition and sampling

CO2: perform algorithm on radar processing

CO3 :design basic radar algorithm

CO4: design on aperture imaging and array processing

CO5: Illustrate theoretical results are derived and applied in practice

REFERENCES

1. Michael O Kolawole, "Radar systems, Peak Detection and Tracking", Elseveir. 2003
2. Introduction To Radar Systems 3/E, Skolnik, McGraw Hill. 2017
3. Radar Principles, Peyton Z. Peebles, Wiley India 2009
4. And Marvin N. Cohen, Fred E. Nathanson, Radar Design Principles-Signal Processing andthe environment PHI, 2nd edition, 2006.

23ECP048 TELECOMMUNICATION SYSTEM MODELING AND SIMULATION

L T P C
3 0 2 4

COURSE OBJECTIVES:

- To enable the student to understand the various aspects of simulation methodology andperformance
- To appreciate the significance of selecting sampling frequency and modeling different typesof signals and processing them
- To expose the student to the different simulation techniques, their pros and cons and enablehim to understand and interpret results using case studies

UNIT I SIMULATION METHODOLOGY **9**

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Lowpass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-
varying systems, Post processing – Basic graphical techniques and estimations

UNIT II RANDOM SIGNAL GENERATION & PROCESSING **9**

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

UNIT III MONTE CARLO SIMULATION **9**

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi -analytic techniques, Case study: Performance estimation of a wireless system

UNIT IV ADVANCED MODELS & SIMULATION TECHNIQUES **9**

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modeling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.

UNIT V EFFICIENT SIMULATION TECHNIQUES **9**

Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

TOTAL: 45 PERIODS

PRACTICALS:

1. Study the spectrum of response of linear and non-linear systems for single tone input
2. Generation of OFDM (multicarrier) signal and plot the spectrum (RF and Low pass equivalent)
3. Generation of uniform / Gaussian random numbers and verification of their probabilitydistribution, autocorrelation and spectrum
4. Generation of uncorrelated and correlated random processes and verification of cross-correlations
5. Generation of PN sequence and verification of properties and spectrum.
6. Application of Monte Carlo simulation for estimation of BER of a wireless communication link
7. Study the impact of non-linearity of amplifier on transmitter symbol constellation with the help ofSaleh model
8. Studying the effect of time invariant (slow fading) frequency selecting channel with the help ofsymbol constellation
9. Studying the effect of time variant flat fading (memoryless) channel with the help of symbolconstellation **TOTAL PERIODS: 75**

COURSE OUTCOMES:

Upon completion of the course the student will be able to:

CO1: Understand the different signal generation and processing methods

CO2: Mathematically model a physical phenomena.

CO3: Simulate a phenomena so as to depict the characteristics that may be observed in a real experiment.

CO4: Apply knowledge of the different simulation techniques for designing a communication systemor channel

CO5: Validate a simulated system performance so as to match a realistic scenario

REFERENCES

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.

2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001

3. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000.

4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992.

5. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.

23ECP049 **SIGNAL DETECTION AND ESTIMATION** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.

UNIT I **REVIEW OF PROBABILITY AND STOCHASTIC PROCESS** **9**

Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete Time Stochastic Processes, Spatial Stochastic Processes, Random Signals, Relationship of PowerSpectral Density and Autocorrelation Function.

UNIT II **SINGLE AND MULTIPLE SAMPLE DETECTION** **9**

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise , Performance of Binary Receivers in AWGN.

UNIT III **FUNDAMENTALS OF ESTIMATION THEORY** **9**

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

UNIT IV **WIENER AND KALMAN FILTERS** **9**

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, Least Squares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter.

UNIT V **APPLICATIONS** **9**

Detector Structures in Non-Gaussian Noise , Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver
Structures and Performance with No Channel Knowledge.

TOTAL: 45 PERIODS

PRACTICALS: **PERIODS - 30**

Suggested List of Experiments

Software Requirement: Matlab / Python / Equivalent

1. Power Spectrum Estimation of a Random Signal
2. Maximum Likelihood Estimation
3. Design of optimum receiver in AWGN channel
4. Wiener Filter Design
5. Adaptive Filter Design using LMS algorithm
6. Minimum Variance Estimation

COURSE OUTCOMES:

Upon completion of the course the student will be

CO1: Able to understand the importance of probability and stochastic process concepts indetection and estimation.

CO2: Able to design optimum detector and estimator for AWGN channel

CO3: Able to design and analyze the various estimators.

CO4: Able to design Wiener and Kalman filters to solve linear estimation problems.

CO5: Able to design and develop novel receiver structures suitable for modern technology.

TOTAL PERIODS: 75

REFERENCES

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2004.

2. Ludeman, Lonnie C. Random processes: filtering, estimation, and detection. John Wiley & Sons, Inc., 2003

3. Sergio Verdu " Multi User Detection" Cambridge University Press, 1998
4. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theory",Prentice Hall Signal Processing Series, Prentice Hall, PTR, NewJersy, 1993.
5. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, NewJersy, 2007.

23ECP050 REAL TIME EMBEDDED SYSTEMS **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the basics of embedded system and ARM architecture
- To understand the RTOS concepts like scheduling and memory management related to theembedded system
- To learn about the programming aspects of RTOS
- To learn the different protocols of embedded wireless application
- To understand concepts involved in the design of hardware and software components for anembedded system

UNIT I INTRODUCTION **9**

Real Time System – Embedded Systems – Architecture of Embedded System – Simple Programming for Embedded System – Process of Embedded System Development – Pervasive Computing – Information Access Devices – Smart Cards – Microcontrollers – ARM Processor -Real Time Microcontrollers.

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM **9**

Operating System Concepts: Processes, Threads, Interrupts, Events - Real Time Scheduling Algorithms - Memory Management – Overview of Operating Systems for Embedded, Real Time Handheld Devices – Target Image Creation – Programming In Linux, Rtlinux, Vxworks, Microcontroller Operating System Overview.

UNIT III CONNECTIVITY **9**

Wireless Connectivity - Bluetooth – Other Short Range Protocols – Wireless Application Environment

– Service Discovery – Middleware.

UNIT IV REAL TIME UML **9**

The Rapid Object-Oriented Process for Embedded Systems (ROPES) Process. MDA and Platform- Independent Models- Scheduling Model-Based Projects- Model Organization Principles- Working withModel-Based Projects - Object Orientation with UML 2.0-Structural Aspects-Object Orientation with UML 2.0-Dynamic Aspects-UML Profile for Schedulability, Performance, and Time. Requirements Analysis – Object Identification Strategies – Object Behaviour – Real Time Design Patterns.

UNIT V SOFTWARE DEVELOPMENT AND APPLICATION **9**

Concurrency – Exceptions – Tools – Debugging Techniques – Optimization – Interfacing DigitalCamera With USB Port. Interfacing of Sensors and Actuators for a Real Time Industrial Application.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Read Input From Switch And Automatic Control/Flash LED for ARM Processor
2. Laboratory Exercises On Task Scheduling
3. Simple Program In Linux, Rtlinux And Vxworks
4. Develop a Real Time Security Monitoing System

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: Make a choice of suitable embedded processor for a given application**CO2:**Design the hardware and software for the embedded system

CO3:Design and develop the real time kernel/operating system functions, task control block structureand analyze different task states

CO4:Implement different types of inter task communication and synchronization techniques

CO5: Know about the aspects embedded connectivity in real time systems

REFERENCES:

1. R.J.a.Buhr, D.L.Bailey, "An Introduction To Real-Time Systems", Prentice-Hall International,1999.
2. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007.
3. C.M.Krishna, Kang G.Shin, "Real Time Systems", Mc-Graw Hill, 2010.
4. B.P.Douglass, "Real Time Uml - Advances In the UML for Real-Time Systems, 3rd EditionAddison-Wesley, 2004.
5. K.V.K. Prasad, "Embedded/Real Time Systems: Concepts, Design And Programming", Dream Tech Press, Black Book, 2005.
6. R.Barnett, L.O.Cull, S.Cox, "Embedded C Programming and the Microchip PIC ", ThomasonLearning, 2004.
7. Wayne Wolf, "Computers As Components - Principles of Embedded Computer System Design",Mergen Kaufmann Publisher, 2006.
8. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill,2004.

AUDIT COURSES

AX	ENGLISH FOR RESEARCH PAPER WRITING	L T P C
		2 0 0 0

COURSE OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of theLiterature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 –Understand that how to improve your writing skills and level of readabilityCO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book1998.

DISASTER MANAGEMENT

L T P C
2 0 0 0

COURSE OBJECTIVES:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice frommultiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevancein specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, 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 PRONE AREAS IN INDIA 6

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-DisasterDiseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

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

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction andhumanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practicefrom multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practicalrelevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues andstrategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice HallOfIndia, New Delhi,2001.

CONSTITUTION OF INDIA **L T P C**
2 0 0 0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood inthe early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before thearrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed theconceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

KCG COLLEGE OF TECHNOLOGY
(AUTONOMOUS)
REGULATIONS 2023
M.E. POWER ELECTRONICS AND DRIVES
CHOICE BASED CREDIT SYSTEM
III & IV SEMESTERS & CURRICULUM

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Professional Elective IV	PEC	3	0	0	3	3
2		Professional Elective V	PEC	3	0	0	3	3
3		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4	23EEP321	Project Work I	EEC	0	0	12	12	6
TOTAL				**9**	**0**	**12**	**21**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	23EEP421	Project Work II	EEC	0	0	24	24	12
TOTAL				**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS: 71

PROFESSIONAL ELECTIVES

SEMESTER III

PROFESSIONAL ELECTIVE IV & V

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**23EEP043**	**Grid Integration of Renewable Energy Sources**	PEC	3	0	0	3	3
2	**23EEP044**	**Renewable EnergyTechnology**	PEC	3	0	0	3	3
3	**23EEP045**	**Wind Energy Conversion System**	PEC	3	0	0	3	3
4	**23EEP046**	**Optimization Techniques**	PEC	3	0	0	3	3
5	**23EEP047**	**Distributed Generation and Micro Grid**	PEC	3	0	0	3	3
6	**23EEP048**	**Energy Management and Auditing**	PEC	3	0	0	3	3
7	**23EEP049**	**Smart Grid**	PEC	3	0	0	3	3
8	**23EEP050**	**HVDC and FACTS**	PEC	3	0	0	3	3

AUDIT COURSES

REGISTRATION FOR ANY OF THESE COURSES IS OPTIONAL TO STUDENTS

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	23AXP091	English for Research Paper Writing	2	0	0	0
2.	23AXP092	Disaster Management	2	0	0	0
3.	23AXP093	Constitution of India	2	0	0	0
4.	23AXP094	நற்றமிழ் இலக்கியம்	2	0	0	0

LIST OF OPEN ELECTIVES FOR M.E – PED PG PROGRAMMES

SL. NO.	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1	23OEP901	Principles of Sustainable Development	3	0	0	3
2	23OEP902	Environmental Impact Assessment	3	0	0	3
3	23OEP905	Blockchain Technologies	3	0	0	3
4	23OEP906	IoT & Cloud	3	0	0	3
5	23OEP907	Additive Manufacturing	3	0	0	3
6	23OEP908	Electric Vehicle Technology	3	0	0	3
7	23OEP909	Micro and Small Business Management	3	0	0	3

SEMESTER-WISE CREDIT DISTRIBUTION – KCG CURRICULUM
M.E. POWER ELECTRONICS AND DRIVES CURRICULUM

SEMESTER	FC	RMC	PCC	PEC	OEC	EEC	AC	Total
Semester I	4	2	15	3			**0**	**24**
Semester II			14	6			**0**	**20**
Semester III				6	3	6		**15**
Semester IV						12		**12**
Total – KCG Curriculum - M.E. PED	**4**	**2**	**29**	**15**	**3**	**18**	**0**	**71**

(Minimum No. of credits to be earned as per AICTE: 70)

Sl. No	Code	Category
1	**FC**	Foundation Courses
2	**RMC**	Research Methodology and IPR Courses
3	**PCC**	Professional Core Courses
4	**PEC**	Professional Elective Courses
5	**OEC**	Open Elective Courses
6	**EEC**	Employment Enhancement Courses
7	**AC**	Audit Courses

REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
M.E. POWER ELECTRONICS AND DRIVES (FULL TIME)
III and IV SEMESTERS SYLLABUS

		L	T	P	C
23EEP043	**GRID INTEGRATION OF RENEWABLE ENERGY SOURCES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To study about the integration of various renewable energy sources into the grid.
- To analyse various grid issues due to renewable energy sources.
- To analyse the dynamics of network due to wind farm
- To provide knowledge about power system stabilizers.
- To provide knowledge about grid connected and standalone PV system.

UNIT I INTRODUCTION **9**

Introduction to renewable energy grid integration - Concept of mini/micro grids and Smart grids - Different types of grid interfaces - Issues related to grid integration of small and large scale of synchronous generator based - induction generator based and converter based sources together - Network voltage management - Power quality management (voltage dips, harmonics, flickers, and reactive power control) - Frequency management - Influence of WECS on system transient response - Interconnection standards and grid code requirements for integration.

UNIT II NETWORK INFLUENCE OF GENERATION TYPE **9**

starting – Network voltage management – Thermal/Active power management – Network power quality management – Transient system performance – Fault level issues – Protection.

UNIT III INFLUENCE OF WIND FARMS ON NETWORK DYNAMIC PERFORMANCE **9**

Dynamic Stability and its Assessment – Dynamic characteristics of Synchronous Generation - A Synchronizing power and Damping power model of a Synchronous Generator – Influence of Automatic Voltage Regulator on Damping – Influence on Damping of Generator Operating Conditions – Influence of Turbine Governor on Generator Operation – Transient Stability – Voltage Stability – Influence of Generation Type on Network Dynamic Stability – Dynamic

Interaction of Wind Farms with the Network – influence of Wind Generation on Network Transient Performance.

UNIT IV POWER SYSTEM STABILIZERS AND NETWORK DAMPING CAPABILITY OF WIND **9**

A Power System Stabilizer for a Synchronous Generator - A Power System Stabilizer for a DFIG - A Power System Stabilizer for a FRC Wind Farm.

UNIT V STAND ALONE AND GRID CONNECTED PV SYSTEM **9**

Solar modules – storage systems – Basics of batteries – Batteries for PV Systems – Charge Controllers – MPPT and Inverters – Power Conditioning and Regulation – protection – Types of Solar PV systems - standalone PV systems design – sizing – PV systems in buildings – design issues for central power stations – safety – Economic aspect – efficiency and performance – International PV programs

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: To explain about the integration of various renewable energy sources into the grid.

CO2: To analyse various grid issues due to renewable energy sources.

CO3: To analyse the dynamics of network due to wind farm

CO4: To Examine and understand the principles and applications of power system stabilizers.

CO5: To design and Analyse grid connected and standalone PV system.

CO6: Apply different MPPT techniques for solar PV system.

REFERENCES:

1. Stuart R.Wenham, Martin A. Green, Muriel E. Watt and Richard Corkish, 'Applied Photovoltaics', Earthscan, UK, 2007.
2. Joshua Earnest, 'Wind power technology', II Edition, PHI, 2015.
3. Olimpo Anaya-Lara, Nick Jenkins, Janaka Ekanayake, Phill Cartwright and Mike Hughes, 'WIND GENERATION Modelling and Control', A John Wiley and Sons, Ltd., Publication, 2009.
4. Brenden Fox, Damian Flynn and Leslie Bryans, 'Wind Power Integration Connection and system operational aspects', Published by The Institute of Engineering and Technology, London, United Kingdom, 2007.
5. Frank S. Barnes & Jonah G.Levine, 'Large Energy Storage Systems Handbook', CRC Press, 2011.
6. S.P. Sukhatme, 'Solar Energy', Tata McGraw Hill, 1987.
7. Chetan Singh Solanki, 'Solar Photovoltaic Technology and Systems' – A Manual for Technicians, Trainees and Engineers, PHI, 2014.

23EEP044	RENEWABLE ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies.
- Standalone operation, grid connected operation of PV Systems.
- Wind Turbine working and Grid Connection Issues in Wind Power Plants.
- Ocean Energy Conversion Techniques, Bio-mass Conversion Techniques and Hydrogen Energy

UNIT-I INTRODUCTION **9**

Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources.

UNIT-II SOLAR PHOTOVOLTAICS **9**

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT-III PHOTOVOLTAIC SYSTEM DESIGN **9**

Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT-IV WIND ENERGY CONVERSION SYSTEMS **9**

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type

A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT-V OTHER RENEWABLE ENERGY SOURCES **9**

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources. **TOTAL: 45 PERIODS**

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: To summarize the environmental aspects of electric energy conversion.

CO2: To Analyze the Solar PV Cell and its Characteristics.

CO3: To make use of the Solar PV system to generate electrical energy.

CO4: To explain various concepts in the wind energy conversion system and its grid connection issues.

CO5: To demonstrate the working of Biomass and Hydrogen Energy.

CO6: To illustrate the operation of Ocean Energy Conversion Techniques.

TEXT BOOKS:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.

REFERENCES :

1. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
2. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.
3. John Twideu and Tony Weir, "Renewable Energy Resources" BSP Publications, 2006
4. Gray, L. Johnson, "Wind energy system", Prentice hall of India, 1995. 7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009

23EEP045 WIND ENERGY CONVERSION SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the basic concepts of wind energy conversion system.
- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed wind energy conversion systems.
- To understand the concepts of Variable speed wind energy conversion systems.
- To model in the grid integration issues.

UNIT-I INTRODUCTION **9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient- Sabinin's theory -Aerodynamics of Wind turbine.

UNIT-II WINDTURBINES **9**

HAWT-VAWT- Power developed -Thrust-Efficiency-Rotor selection -Rotor design considerations- Tip speed ratio-No. Of Blades-Blade profile-Power Regulation-yaw control Pitch angle control- stall control-Schemes for maximum power extraction.

UNIT-III FIXEDSPEEDSYSTEMS **9**

Generating Systems- Constant speed constant frequency systems –Choice of Generators Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor – Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT-IV VARIABLESPEED SYSTEMS **9**

Need of variable speed systems - Power - wind speed characteristics -Variable speed constant frequency systems synchronous generator – DFIG - PMSG – Variable speed generators modeling – Variable speed variable frequency schemes.

UNIT-V GRIDCONNECTED SYSTEMS **9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO 1** Attain knowledge on the basic concepts of Wind energy conversion system.
- **CO 2** Attain the knowledge of the mathematical modeling and control of the Wind turbine.
- **CO 3** Develop more understanding on the design of Fixed speed system.
- **CO 4** Study about the need of Variable speed system and its Modeling.
- **CO 5** Learn about Grid integration issues.
- **CO 6** Expose about current practices of wind interconnections with power system.

TEXT BOOKS:

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall,1990.
2. S.N.Bhadra, D.Kastha,S.Banerjee, "Wind Electrical Systems", Oxford University Press,2010.

REFERENCES:

1. Ion Boldea, "Variable speed generators", Taylor & Francis group,2006.
2. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge,1976.
3. N. Jenkins," Wind Energy Technology" John Wiley &Sons,1997.
4. S.Heir "Grid Integration of WECS", Wiley1998.

23EEP046	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the classification of optimization.
- Study the linear programming models and solution techniques.
- Study the different non-linear programming problem solution techniques.
- Understand the concept of dynamic programming.
- Study the fundamentals genetic algorithm and it applications.

UNIT I INTRODUCTION **9**

Definition, Classification of optimization problems, Classical optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

UNIT II LINEAR PROGRAMMING (LP) 9

Simplex method of solving LPP, revised simplex method, duality, Constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

UNIT III NON LINEAR PROGRAMMING **9**

Steepest descent method, conjugates gradient method, Newton's Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.

UNIT IV DYNAMIC PROGRAMMING (DP) **9**

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm.

UNIT V GENETIC ALGORITHM **9**

Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO 1** Explain about different classifications of optimization problems and techniques.
- **CO 2** Describe about the linear programming concepts.
- **CO 3** Discuss about the application of non-linear programming in optimization techniques.
- **CO 4** Explain the fundamental concepts of dynamic programming.
- **CO 5** Apply the knowledge about Genetic algorithm and its application to power system optimization.
- **CO 6** Analyze the different optimizing techniques and programming models.

REFERENCES :

1. S.S. Rao, "Engineering Optimization – Theory and Practice", John Wiley & Sons, Inc.,2009.
2. Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson, 2016.
3. David G. Luenberger, "Introduction to Linear and Nonlinear Programming", Addison- Wesley, 1973.
4. E. Polak, "Computational methods in Optimization", Academic Press,1971.
5. Pierre D.A., "Optimization Theory with Applications", Wiley Publications,1969.

23EEP047 DISTRIBUTED GENERATION AND MICRO GRID

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the concept of Distributed Generation
- To expose the various distributed energy resources
- To focus on the planning and protection of Distributed Generation
- To study the concept of Micro Grid and to analyse the impact of Micro Grid
- To understand the major issues on Micro-Grid economics

UNIT I INTRODUCTION TO DISTRIBUTED ENERATION **9**

DG definition - Reasons for distributed generation-Benefits of integration - Distributed generation and the distribution system - Technical, Environmental and Economic impacts of distributed generation on the distribution system - Impact of distributed generation on the transmission system-Impact of distributed generation on central generation

UNIT II DISTRIBUTED ENERGY RESOURCES **9**

Combined heat and power (CHP) systems-Wind energy conversion systems (WECS)- Solar photovoltaic (PV) systems-Small-scale hydroelectric power generation-Other renewable energy sources-Storage devices-Inverter interfaces

UNIT III DG PLANNING AND PROTECTION **9**

Generation capacity adequacy in conventional thermal generation systems-Impact of distributed generation-Impact of distributed generation on network design Protection of distributed generation-Protection of the generation equipment from internal Faults-Protection of the faulted distribution network from fault currents supplied by the distributed generator-Impact of distributed generation on existing distribution system protection.

UNIT IV CONCEPT OF MICROGRID **9**

Microgrid Definition-A typical Microgrid configuration- Functions of Micro source controller and central controller- Energy Management Module (EMM) and Protection Co-ordination Module (PCM)- Modes of Operation- Grid connected and islanded modes- Modelling of Microgrid- Microturbine Model- PV Solar Cell Model- Wind Turbine Model-Role of Microgrid in power market competition

UNIT V IMPACTS OF ROGRID **9**

Technical and economical advantages of Microgrid-Challenges and disadvantages of Microgrid development-Management and operational issues of a Microgrid- Impact on heat utilization-Impact on process optimization-Impact on market-Impact on environment-Impact on distribution system- Impact on communication standards and protocols. Microgrid economics-Main issues of Microgrid economics-Microgrids and traditional power system economics-Emerging economic issues in Microgrids-Economic issues between Microgrids and bulk power systems-Potential benefits of Microgrid economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the concepts of Distributed Generation and Microgrids.

CO2: Summarize the various Distributed Energy resources.

CO3: Develop planning schemes of Distributed Generation.

CO4: Develop protection schemes of Distributed Generation.

CO5: Examine the concept of Microgrid and its mode of operation.

CO6: Analyze the impacts of Microgrid.

TEXT BOOKS:

1. Nick Jenkins, Janaka Ekanayake, GoranStrbac, "Distributed Generation", Institution of Engineering and Technology, London, UK,2010.

2. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", The Institution of Engineering and Technology, London, United Kingdom, 2009.

REFERENCES :

1. Math H. Bollen , Fainan Hassan, "Integration of Distributed Generation in the Power System", John Wiley &Sons, New Jersey, 2011.
2. Magdi S. Mahmoud, Fouad M. AL-Sunni, "Control and Optimization of Distributed Generation Systems", Springer International Publishing, Switzerland, 2015.
3. Nadarajah Mithulananthan, Duong Quoc Hung, Kwang Y. Lee, "Intelligent Network Integration of Distributed Renewable Generation", Springer International Publishing, Switzerland, 2017.
4. Ali K., M.N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley and sons, New Jersey, 2010.

23EEP048	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT (7+2 Skill) 9

Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features - electricity tariff - Thermal Basics - need and types of energy audit - Energy management/audit approach- understanding energy costs - maximizing system efficiencies - optimizing the input energy requirements - energy audit instruments - Case study.

UNIT II MATERIAL AND ENERGY BALANCE (7+2 Skill) 9

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES (7+2 Skill) 9

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss - Cogeneration: classification and saving potentials - Case Study.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM (7+2 Skill) 9

Compressed Air System: Types of air compressors - efficient compressor operation – Compressed air system components - leakage test - savings opportunities - Refrigeration System: Vapour compression refrigeration cycle – refrigerants - coefficient of performance - factors affecting Refrigeration and Air conditioning system - savings opportunities - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system – saving potential - Cooling Tower: Types and performance evaluation, efficient system operation – flow control strategies and energy saving - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues - Case Study.

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES (7+2 Skill) 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - Electric motors: Types – lo sses in induction motors - motor efficiency - factors affecting motor performance - rewinding and motor replacement issues - energy saving opportunities with energy efficient motors - soft starters with energy saver - variable speed drives – Fans and blowers: Types - efficient system operation – flow control strategies -Pumps and Pumping System: Types - system operation - low control methods - Lighting System: Light source, choice of lighting, luminance requirements – ballast – occupancy sensors - energy efficient lighting controls - energy conservation avenues - Case Study.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content

Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 10

1. Study of energy conservation and audit
2. Performance study of Electric Motors.
3. Analysis on fan characteristic curves at different operating points
4. Case study of illumination system
5. Performance analysis of Compressors

COURSE OUTCOMES:

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

CO1: To acquire knowledge in the field of energy management and auditing process.

CO2: To explain about basic concepts of economic analysis and load management.

CO3: Apply technique to design the effective thermal utility system.

CO4: To improve the efficiency in compressed air system.

CO5: Acquired the design concepts in the field of lighting systems, light sources.

CO6: Aquire the design concepts of various conservation systems.

TEXTBOOKS:

1. Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers", McGraw-Hill Education, First Edition, 2020.

REFERENCES:

1. Moncef Krati, 'Energy Audit of Building Systems: An Engineering Approach', Third Edition, CRC Press, Dec.2020.
2. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited, 2015.
3. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits', American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
4. Thomas D.Eastop, 'Energy Efficiency: For Engineers and Technologists', Longman Scientific & Technical, 1990, 1st Edition.
5. 'Energy Managers and Energy Auditors Guide book', Bureau of Energy Efficiency, 2006.
6. Larry C. Witte, Philip S.Schmidt, David R.Brown, 'Industrial Energy Management and Utilization', Springer Berlin Heidelberg, 1988.

List of Open Source Software/ Learning website:

1. http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf
2. https://www.sciencedirect.com/science/article/pii/S2212827114004491
3. https://mppolytechnic.ac.in/mp-staff/notes_upload_photo/
4. CS595EnergyEfficiencyinElectricalUtilities-5391.pdf
5. http://knowledgeplatform.in/wp-content/uploads/2017/03/1.3-Energy-management-Audit.pdf
6.

23EEP049	SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT-I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study

UNIT-II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT-III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT-IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT-V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Examine the need, challenges and benefits of Smart Grid

CO2: Explain the present developments and International policies in Smart Grid

CO3: Analyze the performance of various Smart Grid technologies

CO4: Determine the Advanced Metering infrastructure (AMI),smart meters and other smart devices in smart grid

CO5: Illustrate the Power Quality management in Smart Grid

CO6: Survey on the various communication networks for smart grid applications

TEXT BOOKS:

1. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
2. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.

REFERENCES :

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
2. Kenneth C. Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
3. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.
4. Bharat Modi, Anu Prakash & Yogesh Kumar , 'Fundamentals of Smart Grid Technology', S.K. Kataria & Sons, 2022

23EEP050	HVDC AND FACTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To emphasis the need for FACTS controllers.
- To learn the characteristics, applications and modeling of series and shunt FACTS controllers.
- To analyze the interaction of different FACTS controller and perform control coordination.
- To impart knowledge on operation, modelling and control of HVDC link.
- To perform steady state analysis of AC/DC system.

UNIT-I INTRODUCTION **9**

Review of basics of power transmission networks-control of power flow in AC transmission line-Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers-Need for HVDC system-MTDC system Review of basics of LCC and VSC HVDC system. Configurations-Monopolar Asymmetric and Symmetric MMC-HVDC Scheme- Bipolar and Homopolar HVDC Scheme- Multi-Terminal HVDC Configuration-Layout of HVDC system (LCC, VSC).

UNIT-II THYRISTOR BASED FACTS CONTROLLERS **9**

Choice of converter configuration – Simplified analysis of Graetz circuit Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers. Modelling of LCC HVDC system and controllers, transformer derating and core saturation instability, Concepts of Power Oscillation Damping Controller, Frequency Controller and Sub synchronous Damping controller in LCC HVDC.

UNIT-III ANALYSIS OF LCC HVDC CONVERTERS AND HVDC SYSTEM CONTROL 9

Choice of converter configuration – Simplified analysis of Graetz circuit Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers. Modelling of LCC HVDC system and controllers, transformer derating and core saturation instability, Concepts of Power Oscillation Damping Controller, Frequency Controller and Sub synchronous Damping controller in LCC HVDC.

UNIT-IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static synchronous compensator (STATCOM) - Static synchronous series compensator (SSSC) Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers (UPFC) - Modeling of UPFC and IPFC for power flow and transient stability studies-Concepts of Power Oscillation Damping using FACTS controllers.

UNIT-V VOLTAGE SOURCE CONVERTER BASED HVDC SYSTEM AND CONTROLS 9

Applications VSC based HVDC: Operation, Modeling for steady state and dynamic studies, Introduction to Modular Multilevel converters- Main circuit design-Converter Operating Principle and Averaged Dynamic Model- Per-Phase Output-Current Control - Arm-Balancing (Internal) Control- Vector Output-Current Control-Higher-Level Control-Modulation and Submodule Energy Balancing- Offshore HVDC integration System Studies -Control and Protection of MMC-HVDC under AC and DC Network Fault Contingencies- Modeling and Simulation of MMC based MTDC Simulation exercises, Steady state, Fault recovery characteristics - Solution of DC load flow-Solution of AC-DC power flow: Sequential and Simultaneous methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Analyze the working principle to refresh on basics of power transmission networks and need for FACTS controllers.

CO2: Designing of series and shunt compensation devices for power transfer enhancement.

CO3: Analyze the significance of different voltage source converter-based FACTS controllers.

CO4: Compare the knowledge on AC/DC system coordinated control with FACTS and HVDC link.

CO5: Examine and explore the MMC converter applications FACTS and MTDC system.

CO6: Apply FACTS and HVDC system in transmission line for power flow control.

TEXT BOOKS:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International (P) Ltd., New Delhi, 2002.
2. N. G. Hingorani and L.Gyugui, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", B.S. Publications, Indian Reprint 2000.

REFERENCES:

1. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers, New Delhi, Reprint 2008.
3. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International (P) Ltd., New Delhi, 2002.
4. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Pregrinus, London,1983.
5. V. K. Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", Kluwer Academic Publishers 2004.

KCG COLLEGE OF TECHNOLOGY (AUTONOMOUS)
REGULATIONS 2023
M.E. COMPUTER SCIENCE AND ENGINEERING
CHOICE BASED CREDIT SYSTEM
III & IV SEMESTERS CURRICULUM & SYLLABUS

SEMESTER – III

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	23CSP301	Applied Cryptography and Security	PCC	3	0	0	3	3
2		Professional Elective III	PEC	3	0	0	3	3
3		Professional Elective IV	PEC	3	0	0	3	3
4		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5	23CSP321	Project Work I	EEC	0	0	12	12	6
TOTAL				**12**	**0**	**12**	**24**	**18**

SEMESTER – IV

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	23CSP421	Project Work II	EEC	0	0	24	24	12
TOTAL				**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES

SEMESTER- III, ELECTIVE-III

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23CSP011	Software Defined Networks	PEC	3	0	0	3	3
2	23CSP012	Web Services and API Design	PEC	3	0	0	3	3
3	23CSP013	Nature Inspired Computing Algorithms	PEC	3	0	0	3	3
4	23CSP014	Digital Image Processing	PEC	3	0	0	3	3
5	23CSP015	Natural Language Processing	PEC	3	0	0	3	3

SEMESTER -III, ELECTIVE-IV

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23CSP016	Mixed Reality	PEC	3	0	0	3	3
2	23CSP017	Embedded Software Development	PEC	3	0	0	3	3
3	23CSP018	Deep Learning and Computer Vision	PEC	3	0	0	3	3
4	23CSP019	Cyber Physical Systems	PEC	3	0	0	3	3
5	23CSP020	Bioinformatics	PEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1	23AXP091	English for Research Paper Writing	2	0	0	0
2	23AXP092	Disaster Management	2	0	0	0
3	23AXP093	Constitution of India	2	0	0	0
4	23AXP094	நற்றமிழ் இலக்கியம்	2	0	0	0

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL. NO.	COURSE CODE	COURSETITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1	23OEP901	Principles of Sustainable Development	3	0	0	3
2	23OEP902	Environmental Impact Assessment	3	0	0	3
3	23OEP904	Renewable Energy Technology	3	0	0	3
4	23OEP907	Additive Manufacturing	3	0	0	3
5	23OEP908	Electric Vehicle Technology	3	0	0	3
6	23OEP909	Micro and Small Business Management	3	0	0	3

SEMESTER-WISE CREDIT DISTRIBUTION

SEMESTER	FC	PCC	PEC	RMC	EEC	OEC	Total
Semester I	4	15		2			**21**
Semester II		17	6		1		**24**
Semester III		3	6		6	**3**	**18**
Semester IV					12		**12**
Total – KCG – Curriculum - ME(CSE)	**4**	**35**	**12**	**2**	**19**	**3**	**75**
AU	**4**	**34**	**13**	**2**	**19**	**3**	**75**

M.E COMPUTER SCIENCE ENGINEERING

23CSP101 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness ofproblems.

UNIT-I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS **9**

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms-Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT-II HIERARCHICAL DATA STRUCTURES **9**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B -trees – Basic operations on B -Trees – Deleting a key from a B -Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximumdegree.

UNIT-III GRAPHS **9**

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT-IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

UNIT-V NP COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Design data structures and algorithms to solve computing problems.
- **CO2:** Choose and implement efficient data structures and apply them to solve problems.
- **CO3:** Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
- **CO4:** Design one's own algorithm for an unknown problem.
- **CO5:** Apply suitable design strategy for problem solving.

REFERENCES:

1. S. Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.

2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.

3. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.

4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.

5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.

6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

23CSP102 ADVANCED NETWORK TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts ofnetworks
- To explore various technologies in the wirelessdomain
- To study about 4G and 5G cellularnetworks
- To learn about Network FunctionVirtualization
- To understand the paradigm of Software definednetworks

UNIT-I NETWORKING CONCEPTS 9

Peer To Peer Vs Client-Server Networks.Network Devices.Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN.Network Adapter.Hub. Switch. Router. Firewall, IP addressing.

UNIT- II WIRELESS NETWORKS 9

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT-III MOBILE DATA NETWORKS 9

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio-spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT-IV SOFTWARE DEFINED NETWORKS 9

SDN Architecture, Characteristics of Software-Defined Networking, SDN- and NFV-Related Standards, SDN Data Plane, Data Plane Functions, Data Plane Protocols, OpenFlow Logical Network Device, Flow Table Structure., Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing.ITU-T Model. Open Daylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface.Network Services Abstraction Layer.Network Applications.User Interface.

UNIT-V NETWORK FUNCTIONS VIRTUALIZATION 9

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases-NFV and SDN –Network virtualization – VLAN and VPN

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Explain basic networking concepts
- **CO2:** Compare different wireless networking protocols
- **CO3:** Describe the developments in each generation of mobile data networks
- **CO4:** Explain and develop SDN based applications
- **CO5:** Explain the concepts of network function virtualization

REFERENCE BOOKS:

1.James Bernstein, "Networking made Easy", 2018. (UNIT I)

2.HoudaLabiod, Costantino de Santis, HossamAfifi "Wi-Fi, Bluetooth, Zigbee and WiMax", Springer 2007

(UNIT 2)

3.Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT 3)

4.Saad Z. Asif "5G Mobile Communications Concepts and Technologies" CRC press – 2019 (UNIT 3)

5.William Stallings "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 2016.(Unit 4 and 5)

6.Thomas D. Nadeau and Ken Gray, SDN – Software Defined Networks, O"Reilly Publishers, 2013.

7.Guy Pujolle, "Software Networks", Second Edition, Wiley-ISTE, 2020

23CSP103 COMPUTATIONAL INTELLIGENCE AND DATA VISUALIZATION TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of computational intelligence paradigms and practice assignments
- To understand and apply optimization based on swarm intelligence on various applications
- To develop skills to both design and critique visualizations.
- To understand technological advancements of data visualization and various data visualization techniques
- To understand the methodologies used to visualize large data sets

UNIT-I COMPUTATIONAL INTELLIGENCE PARADIGMS 9

Artificial Neural Networks – Artificial Neuron- Supervised Learning Neural Networks – Unsupervised Learning Neural Networks – Reinforcement Learning - Evolutionary Computation Introduction – Genetic Algorithms - Genetic Programming - Swarm Intelligence - Artificial Immune Systems - Fuzzy Systems - Assignments

UNIT-II COMPUTATIONAL SWARM INTELLIGENCE 9

Particle Swarm Optimization- Basic Particle Swarm Optimization-Social Network Structures - Basic Variations - Basic PSO Parameters - Single-Solution Particle Swarm Optimization-Advanced Topics - Applications - Ant Algorithms - Ant Colony Optimization-Meta-Heuristic- Cemetery Organization and Brood Care- Division of Labor - Advanced Topics – Applications- Traveling Salesman Problem

UNIT-III INTRODUCTION AND FOUNDATION OF DATA VISUALIZATION 9

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson's Affordance theory – A Model of Perceptual Processing.

UNIT- IV VISUALIZATION TECHNIQUES 9

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT-V INTERACTION CONCEPTS AND TECHNIQUES 9

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Understand the concept of computational intelligence paradigms through practicing assignments
- **CO2:** Apply optimization based on swarm intelligence on various applications
- **CO3:** Visualize the objects in different dimensions and design and process the data for Visualization.
- **CO4:** Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
- **CO5:** Apply the virtualization techniques for research projects.

REFERENCE BOOKS:

1. Computational Intelligence An Introduction Andries P. Engelbrecht University of Pretoria South Africa
2. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
3. Colin Ware, "Information Visualization Perception for Design", 4th edition, Morgan Kaufmann Publishers, 2021.
4. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2nd Edition, 2007.
5. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.

23CSP111 ADVANCED DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- Describe the fundamental elements of relational database managementsystems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XMLdocuments.
- Distinguish the different types of No SQLdatabases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT-I RELATIONAL DATA MODEL **15**

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

Suggested Activities:

Data Definition Language

- Create, Alter andDrop
- Enforce Primary Key, Foreign Key, Check, Unique and Not NullConstraints
- CreatingViews

Data Manipulation Language

- Insert, Delete,Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full OuterJoin
- Aggregate Functions
- Set Operations
- Nested Queries Transaction Control
- Language commit, Roll back and save points

UNIT-II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY 15

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Suggested Activities:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing **a Relational Database using PHP, Python and R**

UNIT-III XML DATABASES 15

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery.

Suggested Activities:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases
- XML Querying

UNIT-IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS 15

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – Mongo DB Data Model – Mongo DB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

Suggested Activities:

- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNIT-V DATABASE SECURITY 15

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

Suggested Activities:

Implementing Access Control in Relational Databases

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.
- **CO2:** Understand and write well-formed XML documents
- **CO3:** Be able to apply methods and techniques for distributed query processing.
- **CO4:** Design and Implement secure database systems.
- **CO5:** Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCE BOOKS:

1.R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 2016.

2.Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.

3.C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006

4.Raghu Ramakrishnan , Johannes Gehrke "Database Management Systems", Fourth Edition, McGraw Hill Education, 2015.

5.Harrison, Guy, "Next Generation Databases, NoSQL and Big Data" , First Edition, Apress publishers, 2015

6.Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015

23CSP121 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS:

1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3. Implementation of Merge Sort and Quick Sort
4. Implementation of a Binary Search Tree
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication
12. Activity Selection and Huffman Coding Implementation

HARDWARE/SOFTWARE REQUIREMENTS

1. **64-bit Open source Linux or its derivative**
2. **Open Source C++ Programming tool like G++/GCC**

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Design and implement basic and advanced data structures extensively
- **CO2:** Design algorithms using graph structures
- **CO3:** Design and develop efficient algorithms with minimum complexity using design techniques
- **CO4:** Develop programs using various algorithms.
- **CO5:** Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

REFERENCE BOOKS:

1. Lipschutz Seymour, "Data Structures Schaum's Outlines Series", Tata McGraw Hill, 3rd Edition, 2014.

2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

3. http://www.coursera.org/specializations/data-structures-algorithms

4. http://www.tutorialspoint.com/data_structures_algorithms

5. http://www.geeksforgeeks.org/data-structures/

23CSP201 ADVANCED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- To understand the basic notions of a web service, web service standards, and service-oriented architecture;
- To understand the different stages of testing from testing during development of a software system

UNIT- I SOFTWARE PROCESS AND MODELING 9

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioural Modelling.

UNIT-II SOFTWARE DESIGN 9

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern- Based Design.

UNIT-III SYSTEM DEPENDABILITY AND SECURITY 9

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design.

UNIT-IV SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING 9

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

UNIT-V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT 9

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

SUGGESTED ACTIVITIES

1. Comparatively analysing different Agile methodologies.
2. Describing the scenarios where 'Scrum' and 'Kanban' are used.
3. Mapping the data flow into suitable software architecture.
4. Developing behavioural representations for a class or component.
5. Implementing simple applications as RESTful service.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The Students will be able to

- **CO1:** Identify appropriate process models based on the Project requirements
- **CO2:** Understand the importance of having a good Software Architecture.
- **CO3:** Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- **CO4:** Understand the basic notions of a web service, web service standards, and service-oriented architecture;
- **CO5:** Be familiar with various levels of Software testing

REFERENCE BOOKS:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018

23CSP211 MULTICORE ARCHITECTURE AND GPU PROGRAMMING

	L	T	P	C
COURSE OBJECTIVES:	**3**	**0**	**2**	**4**

- To learn about the various parallel programming paradigms,
- To develop multicore programs and design parallel solutions.
- To understand the basics of GPU architectures
- To understand CPU GPU Program Partitioning
- To write programs for massively parallel processors

UNIT-I SHARED MEMORY PROGRAMMING WITH OpenMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT-II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

UNIT-III PARALLEL PROGRAM DEVELOPMENT 9

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

UNIT-IV GPU ARCHITECTURE 9

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

UNIT-V CUDA PROGRAMMING 9

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

TOTAL : 45 PERIODS

PRACTICALS:

1. Write a simple Program to demonstrate an OpenMP Fork-Join Parallelism.
2. Create a program that computes a simple matrix-vector multiplication b=Ax, either in C/C++. Use OpenMP directives to make it run in parallel.

3. Create a program that computes the sum of all the elements in an array A (C/C++) or a program that finds the largest number in an array A. Use OpenMP directives to make it run in parallel.
4. Write a simple Program demonstrating Message-Passing logic using OpenMP.
5.Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using OpenMP.
6. Implement a program Parallel Random Number Generators using Monte Carlo Methods in OpenMP.
7. Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.
8. Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.
9. Write a Program to demonstrate MPI-send-and-receive in C.
10. Write a Program to demonstrate by performing-parallel-rank-with-MPI in C.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

- **CO1:** Write programs using OpenMP and MPI.
- **CO2:** Design parallel programming solutions to common problems.
- **CO3:** Compare and contrast programming for serial processors and programming for parallel processors.
- **CO4:** Describe GPU Architecture
- **CO5:** Write programs using CUDA, identify issues and debug them

REFERENCE BOOKS:

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.
4. Shane Cook, CUDA Programming: "A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
5. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.
6. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.
7. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose

23CSP212 INTERNET OF THINGS AND ITS APPLICATIONS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry PI and experiment simple IoT application on it

UNIT-I INTRODUCTION **9+6**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT-II IoT ARCHITECTURE, GENERATIONS AND PROTOC **9+6**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors –Description & Characteristics

UNIT-III IoT PROTOCOLS AND TECHNOLOGY **9+6**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP - Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

UNIT-IV CLOUD ARCHITECTURE BASICS **9+6**

The Cloud types; IaaS, PaaS, SaaS - Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT-V IOT PROJECTS ON RASPBERRY PI **9+6**

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

TOTAL: 75 PERIODS

SUGGESTED ACTIVITIES:

1. Develop an application for LED Blink and Pattern using Arduino or RaspberryPi
2. Develop an application for LED Pattern with Push Button Control using Arduino or RaspberryPi
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or RaspberryPi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection webapplication
6. Develop an application for Smart parking application using python and Django for web application

COURSE OUTCOME:

- **CO1:** Understand the various concept of the IoT and their technologies
- **CO2:** Develop the IoT application using different hardware platforms
- **CO3:** Implement the various IoT Protocols
- **CO4:** Understand the basic principles of cloud computing
- **CO5:** Develop and deploy the IoT application into cloud environment

REFERENCES:

a. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
b. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
c. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
d. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
e. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd Edition Scitech Publishers, 202014

Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)

23CSP213 ADVANCED OPERATING SYSTEMS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- To get a comprehensive knowledge of the architecture of distributed systems.
- To understand the deadlock and shared memory issues and their solutions in distributed environments.
- To know the security issues and protection mechanisms for distributed environments.
- To get a knowledge of multiprocessor operating systems and database operating systems.

UNIT-I INTRODUCTION **9**

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

UNIT-II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT **9**

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems–issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.

UNIT-III DISTRIBUTED SHARED MEMORY AND SCHEDULING **9**

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent

set of checkpoints – synchronous and asynchronous checkpointing and recovery – checkpointing for distributed database systems- recovery in replicated distributed databases.

UNIT-IV DATA SECURITY 9

Protection and security -preliminaries, the access matrix model and its implementations.- safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributed systems.

UNIT-V MULTIPROCESSOR AND DATABASE OPERATING SYSTEM 9

Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.

TOTAL: 45 PERIODS

Lab Exercises

1. Writing your own system calls
2. Scheduling/Resource Allocation
3. Concurrency and Synchronization
4. Multicore OS
5. File Systems (Distributed, Big Data and Internet)
6. Virtualization

Text Books :

1. Thomas Anderson and Michael Dahlin Operating Systems: Principles and Practice, 2nd Edition Recursive books (August 21, 2014), ISBN: 0985673524
2. Daniel P. Bovet & Marco Cesati Understanding the Linux Kernel (3rd edition) O'Reilly & Associates, November 2005. ISBN: 0596005652

Reference Books :

1. RemziArpaci-Dusseau and Andrea Arpaci-Dusseau Operating Systems: Three Easy Pieces Arpaci-Dusseau Books August, 2018 (Version 1.00)
2. Jonathan Corbet; Alessandro Rubini; Greg Kroah-Hartman Linux Device Drivers (3rd edition) O'Reilly & Associates, February 2005. ISBN-13: 978-0-596-00590-0

3. Robert Love Linux Kernel Development (3nd Edition) Addison-Wesley Professional, 2010. ISBN: 0672329468
4. Ellen Siever, Stephen Figgins, Robert Love, and Arnold Robbins Linux in a Nutshell, 6th Edition O'Reilly & Associates, September 2009. ISBN: 978-0-596-15448-6

PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOME:

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

- **CO1:** Understand and explore the working of Theoretical Foundations of OS.
- **CO2:** Analyze the working principles of Distributed Deadlock Detection and resource management
- **CO3:** Understand the concepts of distributed shared memory and scheduling mechanisms
- **CO4:** Understand and analyze the working of Data security
- **CO5:** Apply the learning into multiprocessor system architectures.

REFERENCES:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.

23CSP222 ADVANCED SOFTWARE ENGINEERING LABORATORY

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LAB OBJECTIVE:

The Software Engineering Lab has been developed by keeping in mind the following objectives:

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

LIST OF EXPERIMENTS:

1. Write a Problem Statement to define a title of the project with bounded scope of project
2. Select relevant process model to define activities and related task set for assigned project
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5. Develop the activity diagram to represent flow from one activity to another for software development
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project
8. Write Test Cases to Validate requirements of assigned project from SRS Document
9. Evaluate Size of the project using function point metric for the assigned project
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11. Use CPM/PERT for scheduling the assigned project
12. Use timeline Charts or Gantt Charts to track progress of the assigned project

TOTAL: 30 PERIODS

LAB OUTCOME:

- **CO1:** Can produce the requirements and use cases the client wants for the software being Produced.
- **CO2:** Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture.
- **CO3:** Create and specify such a software design based on the requirement specification that the software can be implemented based on the design.
- **CO4:** Can assess the extent and costs of a project with the help of several different assessment methods.

KCG COLLEGE OF TECHNOLOGY (AUTONOMOUS)
REGULATIONS 2023
M.E. MANUFACTURING ENGINEERING
CHOICE BASED CREDIT SYSTEM
III & IV SEMESTERS CURRICULUM & SYLLABUS

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Professional Elective III	PEC	3	0	0	3	3
2		Professional Elective IV	PEC	3	0	0	3	3
3		Professional Elective V	PEC	3	0	0	3	3
4		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5	23MFP321	Project Work I	EEC	0	0	12	12	6
TOTAL				12	0	12	24	18

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	23MFP421	Project Work II	EEC	0	0	24	24	12
TOTAL				0	0	24	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 76

PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

SEMESTER III, ELECTIVES - III, IV & V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	23MFP037	Quality and Reliability Engineering	PEC	3	0	0	3	3
2	23MFP038	Materials Management	PEC	3	0	0	3	3
3	23MFP039	Mechatronics	PEC	3	0	0	3	3
4	23MFP040	Internet of Things for Manufacturing	PEC	3	0	0	3	3
5	23MFP041	Product Lifecycle Management	PEC	3	0	0	3	3
6	23MFP042	Product Design and Development	PEC	3	0	0	3	3
7	23MFP043	Industrial Safety	PEC	3	0	0	3	3
8	23MFP044	Smart Manufacturing	PEC	3	0	0	3	3
9	23MFP045	Entrepreneurship Development	PEC	3	0	0	3	3
10	23MFP046	Materials Testing and Characterization Techniques	PEC	3	0	0	3	3
11	23MFP047	Advances in Materials	PEC	3	0	0	3	3

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

S. No.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	23OEP901	Principles of Sustainable Development	3	0	0	3
2.	23OEP902	Environmental Impact Assessment	3	0	0	3
3.	23OEP903	Machine Learning and Deep Learning	3	0	0	3
4.	23OEP904	Renewable Energy Technology	3	0	0	3
5.	23OEP905	Blockchain Technology	3	0	0	3
6.	23OEP906	Internet of Things and Cloud	3	0	0	3
7.	23OEP909	Micro and Small Business Management	3	0	0	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. No.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	23AXP091	English for Research Paper Writing	2	0	0	0
2.	23AXP092	Disaster Management	2	0	0	0
3.	23AXP093	Constitution of India	2	0	0	0
4.	23AXP094	நற்றமிழ் இலக்கியம்	2	0	0	0

SUMMARY OF CREDIT DISTRIBUTION SEMESTER-WISE

SEMESTER	FC	RMC	PCC	DEC	NEC	EEC	Total
Semester I	4	2	14	-	-	1	**21**
Semester II	-	-	19	6	-	-	**25**
Semester III	-	-	-	9	3	6	**18**
Semester IV	-	-	-	-	-	12	**12**
KCG Curriculum M.E - MFG.	**4**	**2**	**33**	**15**	**3**	**19**	**76**
AU – R2021	**4**	**2**	**32**	**15**	**3**	**19**	**75**

M.E MANUFACTURING ENGINEERING

23MFP037	QUALITY AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students construct the various quality control charts for variables and attributes.
- To study the various sampling plans.
- To make the students design for reliability.
- To learn different methods of improving reliability.
- To learn the basics of maintainability.

UNIT-I QUALITY & STATISTICAL PROCESS CONTROL 9

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT-II ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT-III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT-IV CONCEPT OF RELIABILITY 9

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, Weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markov analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

UNIT-V DESIGN FOR RELIABILITY AND MAINTAINABILITY 9

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress- strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are exposed to the various quality control techniques, to understand the importance and concept of reliability and maintainability in industries.

CO1: Apply control chart techniques in production process

CO2: Understand inspection by sampling techniques

CO3: Able to do reliable design

CO4: Improve the availability of equipment through proper maintenance

CO5: Know how to improve the reliability

REFERENCES :

1. Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education, 2002.

2. Bester field D.H., "Quality Control" Prentice Hall, 1993.

3. Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Tata- McGraw Hill, 2000.

4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.

5. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.

6. Patrick D To' corner, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002

23MFP038	MATERIALS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To introduce the students

- The various concepts of materials management.
- Familiarize them with vendor development and rating.
- The various aspects of Logistics and storage.
- Planning and Forecasting of the need.
- Various aspects of Inventory management.

UNIT-I INTRODUCTION 9

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT-II MANAGEME NT OF PURCHASE 9

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT-III MANAGEMENT OF STORES AND LOGISTICS 9

Stores function – Location – Layout – Stock taking – Materials handling – Transportatio n – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT-IV MATERIALS PLANNING 9

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT-V INVENTORY MANAGEMENT 9

ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

CO1: Familiarized with the various concepts and functions of material management

CO2: Able to handle the purchase and stores Independently

CO3: Understand Logistics and inventory pricing

CO4: Materials planning and periodic replenishment of material

CO5: Just in time techniques and inventory management

REFERENCES :

1. Dr. R. Kesavan, C. Elanchezian and T. SundarSelwyn, Engineering Management – Eswar Press – 2005.

2. Dr. R. Kesavan, C. Elanchezian and B. Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.

3. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.

4. Gopalakrishnan P, Handbook of Materials Management, Prentice Hall of India, 2005.

5. Guptha P.K. and Heera, Operations Research, Suttan Chand & Sons, 2007.

6. Lamer Lee and Donald W. Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 2006.

23MFP039	MECHATRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand key elements of Mechatronics system, representation into block diagram
- It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach the engineering.
- Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.
- Understand the PLC used in home appliances.

UNIT-I INTRODUCTION **9**

Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design – Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics – Mechatronics elements.

UNIT-II SENSORS AND TRANSDUCERS **9**

Introduction – Performance Terminology – Potentiometers – Strain gauges – LVDT – Eddy current sensor – Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors – Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.

UNIT-III MICROPROCESSORS AND MICROCONTROLLERS **9**

Introduction – Architectures of 8 – bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, LEDs, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT-IV ACTUATORS **9**

Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge Circuits – Piezoelectric actuators.

UNIT-V MECHATRONIC SYSTEMS **9**

Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

CO1: Identify the key elements of mechatronics system and its representation in terms of block diagram.

CO2: Understand the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O

CO3: Interfacing of Sensors, Actuators using appropriate DAQ micro-controller

CO4: Differentiate between traditional design and Mechatronics design

CO5: Apply the mechatronics concepts in home appliances

REFERENCES :

1. Devadas shetty, Richard A. Kolk, "Mechatronics System Design", PWS Publishing Company, 2001.

2. M.A. Mazidi & J.G. Mazidi, 8051 Micrcontroller and embedded systems, 2002

3. R.K.Rajput.A Text Book of Mechatronics, Chand &Co, 2007

4. W.Bolton, "MICHATRONICS" Pearson Education Limited, 2004

23MFP040 INTERNET OF THINGS FOR MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of IoT, Opportunities and challenges in IoT
- To design a IoT solution
- To develop an IoT protype
- To explain the various protocols used in IoT and Localization
- To examine the applications of IoT in Manufacturing

UNIT-I INTRODUCTION **9**

Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

UNIT-II DESIGN OF IoT **9**

Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT-III PROTOTYPING OF IoT **9**

Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

UNIT-IV PREREQUISITES FOR IoT **9**

IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

UNIT-V APPLICATION IN MANUFACTURING **9**

Applications HCI and IoT world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

CO1: Identify the Opportunities and challenges in IoT

CO2: Propose a suitable IoT design

CO3: Develop an optimized IoT protype

CO4: Understand the various protocols used in IoT and Localization

CO5: Understand the applications of IoT in Manufacturing

REFERENCES :

1. Adrian McEwan and Hakim Cassimally, "Designing the internet of things", Wiley, 2013

2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.

3. Internet of Things: A Hands-On Approach by Vijay Madisetti, Arshdeep Bahga, VPT; 1st edition 2014.

4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence" Elsevier

5. Meta Products -Building the Internet of Things by Wimer Hazenberg, Menno Huisman, BIS Publishers 2014.

23MFP041	PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand history, concepts and terminology of PLM
- To understand functions and features of PLM/PDM
- To understand different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To Use PLM/PDM with legacy data bases, CAx & ERP systems

UNIT-I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT-II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT-III DETAILS OF MODULES IN APDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools

UNIT-IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for– business, organization, users, product or service, process performance.

UNIT-V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are
CO1: Summarize the history, concepts and terminology of PLM
CO2: Use the functions and features of PLM/PDM
CO3: Use different modules offered in commercial PLM/PDM tools. **CO4:** Implement PLM/PDM approaches for industrial applications. **CO5:** Integrate PLM/PDM with legacy data bases, CAx& ERP systems.

REFERENCES :

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition).

2. International Journal of Product Lifecycle Management, Inderscience Publishers

3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.

4. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007.

5. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).

6. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

23MFP042 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Learn to know the necessity for a New Product by analysing the market trend.
- Select methodology and process for development.
- Generate detailed specifications for the given architecture.
- Integrating CAE, CAD, CAM tools in product design and asses the quality and performance of products.
- Make a prototype of a problem adhering to design principles to enhance manufacturability.

UNIT-I PRODUCT DEVELOPMENT AND CONCEPT SELECTION 9

Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.

UNIT-II PRODUCT ARCHITECTURE 9

Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT-III INDUSTRIAL AND MANUFACTURING DESIGN 9

Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT-IV PROTOTYPING AND ECONOMIC ANALYSIS 9

Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT-V MANAGING PRODUCT DEVELOPMENT PROJECTS 9

Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected to

CO1: Identify the need for a New Product

CO2: Design and develop various products

CO3: Work out the cost of developing a product

CO4: Will be able to prototype the product

CO5: Know how to patent the new design or the product.

REFERENCES :

1. Charles Gevirtz, Developing New products with TQM, McGraw – Hill International editions, 1994

2. Karal .T. Ulrich, Steven D.Eppinger, Product Design and Development, McGRAW- HILL International Editions.2003.

3. S.Rosenthal, Effective product design and development, Irwin 1992.

23MFP043	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop and strengthen the safety ideas and motivate the students to impart basic safety skills
- To know about Industrial safety programs, Industrial laws, regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To assess the safety of human beings from toxic substances
- To analyse industrial hazards and its risk assessment.

UNIT-I OPERATIONAL SAFETY **9**

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and

risk assessments, on – site and off site. Control of major industrial hazards.

UNIT-II SAFETY APPRAISAL AND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.Product architecture Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT-III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT-IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT-V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

CO1: Expected to gain knowledge and skills needed to run an industry with utmost safety precautions.

CO2: Understand the industrial laws, regulations and source models.

CO3: Apply the methods of prevention of fire and explosions.

CO4: Analyse the effect of release of toxic substances

CO5: Understand the methods of hazard identification and preventive measures.

REFERENCES :

1. John V Grimaldi, Safety Management. AITB publishers, 2003.

2. John.V Grimaldi and Rollin. H Simonds, "Safety Management", All India traveller book seller, New Delhi – 1989.

3. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.

4. Singh, U.K and Dewan, J.M., "Safety, Security And Risk Management", APH publishing company, New Delhi, 1996.

23MFP044	SMART MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students to fundamentals of Manufacturing
- To familiarize with selection of sensors for various application
- To learn the basics of agent-based manufacturing
- Understand Cyber physical systems
- Provide brief understanding about industry 4.0 concepts in Manufacturing systems

UNIT-I SENSORS SMART MANUFACTURING 9

Introduction – Role of sensors in manufacturing automation – operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors. Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques. Automatic identification techniques for shop floor control – optical character and machine vision sensors – smart / intelligent sensors – integrated sensors, Robot sensors, Micro sensors, Nano sensors.

UNIT-II DATA ANALYTICS 9

Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL) Advances in data visualization & related tools-Statistical Techniques for Analytics, Descriptive Statistics Inferential statistics, Regression and ANOVA

UNIT-III CYBER PHYSICAL SYSTEMS 9

Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS

UNIT-IV E- MANUFACTURING 9

Introduction of Agent based manufacturing- agent based Manufacturing, Cloud Based Manufacturing Information technology-based Supply chain, Concept of agile manufacturing and E-manufacturing.

UNIT-V INDUSTRY 4.0 **9**

Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students are expected to appreciate:

CO1: Appreciate concepts and basic framework necessary for smart manufacturing

CO2: Current trends at system level in manufacturing organizations

CO3: Use of Sensors and Selection of sensors for various applications

CO4: IoT based manufacturing systems

CO5: The importance of industry 4.0 concepts at manufacturing systems

TEXT BOOKS :

1. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515

2. Bahga and V. Madisetti, Cloud Computing, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2013, ISBN: 978-1494435141

3. M. Skilton and F. Hovsepian, The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business, Springer Nature, 2017, ISBN: 978-3-319-62479-2

4. M. P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing" Pearson Education, 4th Edition, 2016, ISBN: 978-0133499612

5. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas and G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw Hill, 2nd Edition, 2017 ISBN: 978- 1259006210

REFERENCES :

1. Gilchirst, Industry 4.0: The Industrial Internet of Things, Apress (Springer), 1st Edition, 2016, ISBN: 978-1-4842-2046-7

2. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580

3. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520.

4. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall, 1st Edition, 1994, ISBN: 978-8120308701

5. S. K. Saha, Introduction to Robotics, Tata Mcgraw Hill Education Private Limited, 2nd Edition, ISBN: 978-9332902800

23MFP045	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart knowledge on the competencies necessary to establish new ventures
- To inculcate strategic thinking, budgeting and ethical behaviour which are vital to enhance entrepreneurial skills
- To establish start-ups and small businesses
- To evaluate the business and monitor

UNIT-I ENTREPRENEURAL COMPETENCE 9

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT-II ENTREPRENEURAL ENVIRONMENT 9

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.

UNIT-III BUSINESS PLAN PREPARATION 9

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT-IV LAUNCHING OF SMALL BUSINESS 9

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT-V MANAGEMENT OF SMALL BUSINESS 9

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will:

CO1: Gain knowledge and skills needed to run a business.

CO2: Innovate and solve challenges in business

CO3: Determine risks in the trade and respond effectively

CO4: Utilize tools and develop strategies to manage

business **CO5:** Establish start-ups and evaluate the business

REFERENCES :

1. Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014.

2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, (Revised Edition) 2013.

3. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra, 2nd Edition ,2005

4. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.

5. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai 1997.

6. Arya Kumar. Entrepreneurship. Pearson, 2012.

7. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage, 2012.

23MFP046	MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Make them acquainted with microscopic techniques to analyse crystal structures
- Acquire an understanding on the electron microscopic techniques for characterization
- Gain a fundamental on chemical and thermal analysis
- Provide the knowledge on various static methods to characterize materials
- Study the failure of materials under stress

UNIT-I MICRO AND CRYSTAL STRUCTURE ANALYSIS 9

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT-II ELECTRON MICROSCOPY 9

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM -Applications.

UNIT-III CHEMICAL AND THERMAL ANALYSIS 9

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X- Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravitymetric Analysis (TGA)

UNIT-IV MECHANICAL TESTING – STATIC TESTS 9

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT-V MECHANICAL TESTING – DYNAMIC TESTS 9

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests- modal analysis - Applications of Dynamic Tests.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

CO1: To be knowledgeable in microstructure evaluation, crystal structure analysis,

CO2: To take images in electron microscopy and process those images,

CO3: To do Chemical Thermal Analysis,

CO4: Analyse the results of static mechanical testing

CO5: Analyse the results of dynamic mechanical testing.

REFERENCES :

1. ASM Hand book-Materials characterization, Vol – 10, 2004.

2. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.

3. Davis J. R., Tensile Testing, 2nd Edition, ASM International, 2004.

4. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn., 1982.

5. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGraw Hill, 1988.

6. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., Scanning Electron Microscopy & X ray- Micro Analysis, (2nd Edition), ISBN – 0306441756, Plenum Publishing Corp., 2000.

7. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.

8. Morita.S, Wiesendanger.R, and Meyer.E, "Non-contact Atomic Force Microscopy" Springer, 2002,

9. Newby J., Metals Hand Book- Metallography & Micro Structures, (9th Edition), ASM International, 1989.

10. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications, 2007.

23MFP047	ADVANCES IN MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The students will be able to

- Understand major types of special steels such as HSLA, TRIP, Dual and Tool steels and cast-irons
- Study the polymer behaviour and develop polymer composites
- Study energy conversion materials
- Learn about various materials used for bio implants
- Understand the advantage of materials at Nano scale

UNIT-I METALLIC MATERIALS 9

Classification of metallic materials - Ferrous and nonferrous. Ferrous metals and alloys- Introduction to specifications – types of steels, alloy steels, tool steels; stainless steels, HSLA, TRIP steels, TWIP steels. Shape memory alloys – Intermetallic – Superalloys- Titanium and Magnesium alloys – Bulk metallic glass –high entropy alloys- metamaterials –topological materials

UNIT-II POLYMERS AND COMPOSITES 9

Structure of polymers, characterization and applications of polymers: mechanical behavior of polymers, strengthening of polymers, crystallization and glass transition phenomenon and types of polymers.

Composites: Particle reinforced composites, fiber reinforced composites – influence of fiber length, orientation and concentration. Fiber phase, matrix phase, metal matrix composites, polymer matrix composites, ceramic matrix composites, carbon – carbon composites, hybrid composites and structural composites.

UNIT-III ENERGY MATERIALS 9

Need for high performance energy materials - carbon nanostructure based energy conversion and storage materials - nanomaterials for solar cell applications - next generation energy storage materials – Li and Ni based batteries, fuel cells.

UNIT-IV BIO MATERIALS **9**

Introduction to biomaterials; need for biomaterials; Salient properties of important material classes; Property requirement of biomaterials; Metallic implant materials, ceramic implant materials, polymeric implant materials, composites as biomaterials; Orthopedic, dental and other applications.

Biomaterials preparation and characterization; Processing and properties of different bio ceramic materials; Mechanical and physical properties evaluation of biomaterials; New and novel materials for biomedical applications. Design concept of developing new materials for bio-implant applications; Nanomaterials and nanocomposites for medical applications

UNIT-V NANO MATERIALS **9**

Concept of nano materials – scale / dimensional aspects, Top-down and bottom-up approaches for preparing nano materials Advantages and limitations at the nano level – thermodynamic aspects at the nano level, health and environmental issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students would be able to:

CO1: Understand the various ferrous alloys and their applications

CO2: Understand different types of composite materials and polymers

CO3: Understand Solar materials

CO4: Understand the properties of different biomaterials

CO5: Understand the structure and behavior of Nano materials.

REFERENCES :

1. Avner S. H., 'Introduction to Physical Metallurgy', 2nd Edition, McGraw Hill, 1974

2. Leslie W. C., 'The Physical Metallurgy of Steels', McGraw Hill, 1982

3. Pickering P. B., 'Physical Metallurgy and the Design of Steels', Applied Science Publishers, 1983

4.Hench L. Larry, and Jones J., (Editors), Biomaterials, Artificial organs and Tissue Engineering, Woodhead Publishing Limited, 2005.

5. Gunter Schmid, "Nanoparticles: From Theory to Applications", Wiley-VCH Verlag GmbH & Co., 2004.

6.Brick R. M., Gorden R. B, Phillips A., 'Structure and Properties of Alloys', McGraw Hill, 1965

7.Hench L. Larry, & Wilson J., (Editors), An Introduction to Bio ceramics, World Scientific, 1994.

8. Charles P. Poole, Jr., Frank J. Owens, "Introduction to nano technology", Wiley, 2003.

23OEP901 PRINCIPLES OF SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT-I SUSTAINABILITY AND DEVELOPMENT CHALLEGES 9

Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development- millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.

UNIT-II PRINCIPLES AND FRAME WORK 9

History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step- peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas

UNIT-III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT-IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 9

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity –Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation –– Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT-V ASSESSING PROGRESS AND WAY FORWARD 9

Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.

CO2 Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals

CO3 Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption

CO4 Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.

CO5 Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES :

1. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012

2. A guide to SDG interactions: from science to implementation, International Council for Science, Paris, 2017

3. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.

4. The New Global Frontier - Urbanization, Poverty and Environment in the 21st Century - George Martine, Gordon McGranahan, Mark Montgomery and Rogelio Fernández-Castilla, IIED and UNFPA, Earthscan, UK, 2008

5. Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006

6. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

23OEP902 ENVIRONMENTAL IMPACT ASSESSMENT

L	T	P	C
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OBJECTIVES:

- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT-I INTRODUCTION **9**

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process-screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues – public hearing in EIA- EIA consultant accreditation.

UNIT-II IMPACT INDENTIFICATION AND PREDICTION **9**

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological –– cumulative impact assessment

UNIT-III SOCIO-ECONOMIC IMPACT ASSESSMENT **9**

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT-IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT-V CASE STUDIES **9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles

CO2 Understand various impact identification methodologies, prediction techniques and model of impacts on various environments

CO3 Understand relationship between social impacts and change in community due to development activities and rehabilitation methods

CO4 Document the EIA findings and prepare environmental management and monitoring plan

CO5 Identify, predict and assess impacts of similar projects based on case studies

REFERENCES :

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India

2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey

6. World Bank –Source book on EIA ,1999

7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

23OEP903 MACHINE LEARNING AND DEEP LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course is aimed at

1. Understanding about the learning problem and algorithms

2. Providing insight about neural networks

3. Introducing the machine learning fundamentals and significance

4. Enabling the students to acquire knowledge about pattern recognition.

5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT-I LEARNING PROBLEMS AND ALGORITHMS **9**

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT-II NEURAL NETWORKS **9**

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT-III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS **9**

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT-IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS **9**

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT-V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1 : Illustrate the categorization of machine learning algorithms.

CO2: Compare and contrast the types of neural network architectures, activation functions.

CO3: Acquaint with the pattern association using neural networks.

CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks.

CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES :

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning

2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.

3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.

4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.

5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

23OEP904 RENEWABLE ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT-I INTRODUCTION **9**

Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT-II SOLAR PHOTOVOLTAICS **9**

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT-III PHOTOVOLTAIC SYSTEM DESIGN **9**

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT-IV WIND ENERGY CONVERSION SYSTEMS **9**

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT-V OTHER RENEWABLE ENERGY SOURCES 9

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources.

REFERENCES :

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.
5. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006
6. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
8. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.

23OEP905 BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT-I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9

Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT-II BITCOIN AND CRYPTOCURRENCY 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT-III INTRODUCTION TO ETHEREUM 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 9

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT-BLOCKCHAIN APPLICATIONS 9

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and explore the working of Blockchain technology.

CO2: Analyze the working of Smart Contracts.

CO3: Understand and analyze the working of Hyperledger.

CO4: Apply the learning of solidity to build de-centralized apps on Ethereum.

CO5: Develop applications on Blockchain.

REFERENCES :

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016

3. Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014. .

4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.

5. D. Drescher, Blockchain Basics. Apress, 2017.

23OEP906 INTERNET OF THINGS AND CLOUD COMPUTING TECHNOLOGIES

L	T	P	C
3	**0**	**0**	**3**

OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT-I FUNDAMENTALS OF IoT **9**

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT-II PROTOCOLS FOR IoT **9**

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT-III CASE STUDIES/INDUSTRIAL APPLICATIONS **9**

Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT-IV CLOUD COMPUTING INTRODUCTION **9**

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT-V IoT AND CLOUD **9**

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the various concept of the IoT and their technologies.

CO2: Develop IoT application using different hardware platforms.

CO3: Implement the various IoT Protocols.

CO4: Understand the basic principles of cloud computing.

CO5: Develop and deploy the IoT application into cloud environment.

REFERENCES:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman, CRC Press, 2017

2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.

3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.

4. Simon Walkowiak, "Big Data Analytics with R" PackT Publishers, 2016

5. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.

23OEP909 MICRO AND SMALL BUSINESS MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT-I INTRODUCTION TO SMALL BUSINESS 9

Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship – evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT-II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT-III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY 9

Management and Leadership – employee assessments – Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT-IV FINANCING SMALL BUSINESS 9

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT-V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES:

1. Hankinson,A.(2000). "The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000." Industrial and Commercial Training 32(3):94-98.
2. Parker,R.(2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253.
3. Journal articles on SME's.