ANDHRA UNIVERSITY

DEPARTMENT OF ELECTRICAL ENGINEERING

PROGRAM : M.TECH(CONTROL SYSTEMS ENGINEERING)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2019-2020 BATCH

PROGRAMME : *M.TECH. (Control System Engineering)*

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

The Graduate will be able to:

PEO-1: To develop specialized manpower for control industry.

PEO-2: To enhance analytical skills so as to enable to solve complexcontrol industrial problems.

PEO-3: To augment the student's capacity in pursuing research in emerging areas of control system.

PEO-4: To improve students' perspective towards environmental issues by sensitizing and building the awareness of green technologies.

PEO-5. To inculcate the culture of research oriented projects with state-of-art facility laboratories in control system.

PROGRAMME OUTCOMES (PO's)

The Graduate will be able to:

Program Outcomes		EEE Graduates will be able to
PO1	Engineering knowledge	Acquire in depth knowledge in the domain of control Engineering.
PO2	Problem analysis	Understand various control strategies and their applications for various types of systems.
PO3	Design/development ofsolutions	Understand and Design of large control systems involved through Modeling, Analysis and Simulation.
PO4	Conduct investigations of complex problems	Demonstrate implementation skills using advanced software and embedded tools.
PO5	Modern tool usage	Use recent state-of-the-art simulation tools in the field of control engineering such as Matlab, Homer Pro, Proteus, DSPACE, MULTISIM, LABVIEW and other Tools
PO6	The engineer and society	Be capable of contribute positively to collaborative and multidisciplinary research to achieve common goals.
PO7	Environment and sustainability	Demonstrate knowledge and understanding of control engineering and management principles and Undertake research in emerging areas of control systems with due consideration to economical, Environment and financial factors.
PO8	Ethics	Become aware of social issues and become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
PO9	Individual and teamwork	Capable of analyzing the work independently and reflective learning while developing project in the team with multidisciplinary settings

PO10	Communication	Communicate confidently, make effective presentations and write good reports to power engineering community and society.
PO11	Project management andfinance	Independently observe and examine critically the outcomes of his/her actions, apply corrective measures subsequently and move forward positively through a self corrective approach.
PO12	Life-long learning	Recognize the need for life-long learning and have the ability to do it independently in the domain of control engineering.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

The Graduates of EEE will be able to:

PSO1	The graduates are capable of applying the Knowledgeof in modern control industry.
PSO2	Analyse and design efficient systems to generate, transmit, distribute and utilize electricalenergy to meet social needs using advanced control tools.
PSO3	Electrical Engineers are capable to apply principles of management and economics for providing better services to the society with the technical advancements in control Engineering.

ANDHRA UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING

SCHEME AND SYLLABI
(With effect from 2019-2020 admitted batch on wards)

M.Tech Control Systems Engineering (CSE)
Common with Dual Degree Course V/VI (B.TECH+M.TECH)

SEMESTER- I

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
EECS1.1	Mathematical Methods in Control/Linear Systems	3	-	70	30	100	3
EECS1.2	Digital Control Systems	3	-	70	30	100	3
EECS1.3	Elective-I (Robotics and Automation /Advanced control systems/ Sliding Mode Control)	3	-	70	30	100	3
EECS1.4	Elective-II (Optimization Techniques /SCADA system &Applications/ Systems Biology)	3	-	70	30	100	3
EECS1.5	Research Methodology and IPR	3	-	70	30	100	2
EECS1.6	Audit Course–I	3	-	70	30	100	0
EECS1.7	Control Lab -I	-	3	50	50	100	2
EECS1.8	Control Lab-II	-	3	50	50	100	2
Total							**18**

SEMESTER-II

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
EECS2.1	Non Linear systems	3	-	70	30	100	3
EECS2.2	Control System Design	3	-	70	30	100	3
EECS2.3	Elective III (Optimal Control theory/Advanced Robotics/ Adaptive Learning and Control/ Stochastic Filtering and Identification)	3	-	70	30	100	3
EECS2.4	Elective IV (Model Reduction in Control/ Robust Control/Advanced DSP/ Control Systems Components)	3	-	70	30	100	3
EECS2.5	Audit Course-II	3	-	70	30	100	0
EECS2.6	Advanced Control Lab-I	-	3	50	50	100	2
EECS2.7	Advanced Control Lab-II	-	3	50	50	100	2
EECS2.8	Seminar	-	3	-	100	100	2
Total							**18**

SEMESTER-III

Code	Nameofthesubject	Periods/week		Max.Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
EECS3.1	Elective V (Modelling and Control of Distributed Parameter Systems/Computational Methods/ Industrial load Modelling and control)	3	-	70	30	100	3
EECS3.2	Open Elective a) Business Analytics b) Industrial Safety c) Cost Management of Engineering Projects d) Composite Materials e) Waste to Energy	3	-	70	30	100	3
EECS3.3	Major Project (Phase–I Dissertation)	-	-	100	--	100	10
Total							**16**

SEMESTER-IV

Code	Nameofthesubject	Periods/week		Max.Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
EECS4.1	Major Project (Phase–II Dissertation)	-		100		100	16
Total							**16**

Audit Course I &II

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

EECS 1.1: MATHEMATICAL METHODS IN CONTROL/LINEAR SYSTEMS

The course objectives

To enable the student to:

- To know the concept of linear spaces.
- To know the concept of Eigen values and Eigenvectors.
- To know about Probability distribution function of a random variable.
- To know about Probability density function of a random variable .
- To know about joint density and distribution function.
- To know the characteristic function.
- To know about Spectral density.

Course Outcomes

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

- To find the Eigen values and eigenvectors.
- To find Singular Value Decomposition.
- To know about central limit theorem and its application to a random variable.
- To know about covariance and able to find the covariance between two random vectors.
- Ability to find the response of linear systems to stochastic inputs.

SYLLABUS

Linear Spaces–Vectors and Matrices, Transformations, Norms, Matrix Factorization

Eigen value, Eigenvectors and Applications, SVD and Applications, Projections and Least Square Solutions

Probability, Random variables, Probability distribution and density functions, Joint density and conditional distribution, Functions of random variables and random vectors

Characteristic functions and correlation matrices, poisson function, central limit theorem, correlation function and covariance

Random Processes and properties, Response of Linear systems to stochastic inputs, Power Spectral Density theorem &simple applications

Text Book:

1. Papoulis &Pillai,"Probability,random variable and stochastic processes", Mcgraw Hill, 2002.

References Books:

1. G.Strang,"Introduction to Linear Algebra",4th Edition,Wellesley-Cambridge Press, 2009.
2. H. Stark & J.W.Woods, "Probability and random processes with application to signal processing", Pearson EducationAsia,2002.
3. J A Gubner:"Probability and Random processes for Electrical and Computer engineers", Cambridge Univ.Press. 2006

EECS 1.2: DIGITAL CONTROL SYSTEMS

The course objectives

To enable the student to:

- To find the z-transform of a given discrete-time sequence or discrete-time signal.
- To find inverse z-transform of a given z-transform.
- To find the time-response of a discrete-time system
- To find the frequency response of a discrete-time system
- To find the stability of discrete-time systems.
- Transform a given discrete-time state-model from one form to another form.
- The controllability and observability of a given discrete-time state-model.

Course Outcomes

At the end of this course, students has the ability to:

- To find z-transform of a given discrete-time signal.
- To find the inverse-Z- transform of a given Z-transform.
- To draw the root-locus plot of a given open-loop system.
- To draw the frequency response of a given system using Bode plot .
- To find the stability of a discrete-time system using Jury's stability.
- To find controllability and observability of a discrete-time state model.

SYLLABUS

Discrete –Time Systems: The Structure of a Digital Control System, Analog Systems with Piecewise Constant Inputs, Difference Equations, The Z-Transform, Z-Transform Solution of Difference Equation, The Time Response of a Discrete-Time System, Frequency Response of Discrete-Time Systems.

Modeling of Digital Control Systems: ADC Model, DAC Model, Transfer Function of the ZOH, Effect of Sampler on Transfer Function of a Cascade, Transfer Function for the DAC, Analog Subsystem, ADC Combination, Closed Loop Transfer Function, Analog disturbances in a Digital System, Steady-State Error and Error Constants.

Stability of Digital Control Systems: Definitions of Stability, Stable Z-Domain Pole Locations, Stability Conditions, Stability Determination, Jury Test.

State Space Representation: Discrete-Time State Space Equations, Solution of Discrete-Time State Space Equations, Z-Transfer from State Space Equations, Similarity Transformation, Stability of State Space Realizations, Controllability and Stabilizability, Observability and Detectability.

State Feedback Control: On State and Output Feedback, Pole Placement, Servo Problem, Principles of Observer, State Feedback and Pole Assignment Using Transfer Functions.

Text Books:

1.Digital control systems by B.C.Kuo, Oxford University Press.

References:

1. Digital Control Engineering:Analysis and Design,By M.Sami Fadali, Antonio Visioli, Academic Press ;1 edition (February16,2009).
2. Digital control systems by K.Ogata.

EECS 1.3(a): ROBOTICS AND AUTOMATION
(Elective-I)

The course objectives

To enable the student to:

- Understand robot configuration, structures, basic components, workspace and generations of robots.
- Get acquainted with performing spatial transformations and solve kinematics of the robot
- Get knowledge and analysis skills associated with trajectory planning
- Know about various sensors, actuators, robot programming
- Understand the control aspects of robots.

Course Outcomes

At the end of this course, a student has the ability to:

- Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators.
- Apply spatial transformation to obtain forward and inverse kinematics
- Solve robot dynamics problems, generate joint trajectory for path planning
- Describe working principle of various sensors and program different operations
- Appreciate applications of robots in industry

SYLLABUS

Fundamentals of Robot Technology: Basic structure, links and Joints, types of Joints, types of links, types of end effectors: Grippers: Mechanical, Vacuum cups, Magnetic, adhesive and miscellaneous. Tools as end effectors. Wrist configuration: concept of: yaw, pitch and roll.

Robot classification: According to 1) Co-ordinate system: Cartesian, cylindrical, spherical, SCARA, Articulated 2) Control Method: Servo controlled and non-servo controlled, their comparative study 3) Form of motion: P-T-P (point to point), C-P (continuous path), pick and place etc. and their comparative study 4) Motion conversion: Rotary to rotary, rotary to linear and viceversa.

Robot arm dynamics: Newton Euler Equations, Kinetic and potential energy, Lagrangian analysis for a single prismatic joint working against gravity and single revolute joint. Joint vector, homo generous co-ordinates. Matrix operators for translation and rotation

Robot Control: Open loop and closed loop control, Linear control Schemes, PD and PID control, Torque and Force control of robotic manipulators, Adaptive control, Hybrid control, Impedance control. Manipulator Jacobian, Jacobian for prismatic and revolute joint. Jacobian Inverse, Singularities, Control of Robot manipulator: joint position controls (JPC),resolved motion position controls(RMPC) and resolved motion rate control (RMRC)

Automation & Control: definition, types, merits and Criticism, architecture of industrial automation systems, manufacturing plants and operations: automation strategies, basic elements of automated system, advanced automation functions, Levels of automation. Process and discrete manufacturing industries, continuous and Discrete Control systems:

Text Books:

1. R.K.Mittal, I.J. Nagrath, "Robotics and Control", Tata McGraw Hill Publishing Company Ltd., New Delhi.

Reference books:

1. Arthur J.Critchlow, "Introduction to Robotics"
2. RobertJ. Schilling, "Fundamentals of Robotics: Analysis and Control", Prentice Hall of India,New Delhi
3. JohnJ.Craig,"Introduction to Robotics: Mechanics and Control", Pearson Education
4. MikellP.Groover, MitchellWeiss, Roger N. Nagel, Nicholas G.Odrey,"Industrial Robotics: Technology, Programming and Applications", Mc Graw Hill Book Company
5. Richard D.Klafter,Thomas A.Chemielewski, Michael Neign "Robotic Engineering–An Integral Approach", Prentice Hall of India Pvt. Ltd., New Delhi. Eastern Economy Edition.
6. K.S.Fu., R.C.Gonzalez, C.S.G.Lee, "Robotics: Control Sensing, Vision and Intelligence", International Edition,McGraw Hill Book Co.

EECS 1.3(b): ADVANCED CONTROL SYSTEMS
(Elective-I)

The course objectives

To enable the student to:

- To know the concept of linearization of a given non-linear system
- To know the concept of diagonalization
- To know about nullity of a matrix
- To know about concept of controllability and observability
- To know about stability of a linear or non-linear system using Lyapunov based analysis.
- To know the concept of pole-placement and observer design.
- To know about LQR design.

Course Outcomes

At the end of this course, students have the ability to:

- To know the concept of nullity, diagonalization.
- To verify the controllability and observability of simple systems.
- To verify the stability of linear and non-linear systems.
- Ability to design a lyapunov function
- Ability to design a controller using pole-placement.
- Ability to design an observer for simple problems
- Ability to design a LQR for linear systems.

SYLLABUS

Math Modelling of Dynamical Systems: Newtonian and Lagrangian approaches, Concept of dynamical state of a system, Concept of equilibrium point, linearization of non-linear model

Review of Linear Algebra concepts: Field, Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalisation

Modern Control Analysis: Concept and computation of systems modes, controllability theorem and its proof, Observability theorem and its proof, Controllable and observable sub spaces

Stability Analysis: Stability of linear systems, stability types and their definitions for any general system, Stability of an equilibrium point, Lyapunov stability theory for LTI systems, Quadratic forms and Lyapunov functions

Modern Control Design: Converting the math model to controllable canonical form and its use for pole placement, Concept of linear observer and its design, Design of reduced order observer, Compensator design using separation principle, Poles of compensator, Open loop and close-loop systems

Optimal Control Theory: Introduction to the philosophy of optimal control, formulation of optimal control problem, different performance criterion, Linear quadratic regulator (LQR) and optimum gain matrix, Riccati equations, conceptual models and statistical models for random processes, Kalmanfilter.

Text Book:

1. M.Gopal,“Modern Control System Theory” New Age International(P) Limited, New Delhi, 2000

References Books:

1. Bernard Friedland,“Control System Design:An Introduction to State-Space Methods”,Dover Publications,Inc. Mineola, NewYork, 2012
2. Thomas Kailath,“Linear Systems”,Prentice-HallInc.,NewJersey,1986

EECS 1.3(c): SLIDING MODE CONTROL
(Elective-I)

The course objectives

To enable the student to:

- To know the concept of sliding mode control
- To know the applications of sliding mode control
- To learn the uses of sliding mode control
- Properties of sliding mode control
- To simulate a double integrator problem
- To know about Reachability concept and to derive these conditions.
- To know about the design of sliding surface
- Concept of sliding mode observers.

Course Outcomes

At the end of this course, a student has the ability to:

- To know the concept of sliding mode.
- To verify the concept of reach ability for simple problems with different control structures.
- To design sliding mode controller for dc motor with uncertain parameters.
- To know about null space and range space dynamics
- To know the different algorithms of sliding surface design.
- To know about the concept of sliding mode observers.

SYLLABUS

An Introduction to Sliding Mode Control: Introduction, properties of sliding motion, typical controller design, pseudo-sliding with a smooth control action, a state-space approach.

Sliding mode control: Introduction, problem statement, existence of solution and equivalent control properties of the sliding motion, The reachability problem, the unit vector approach, continuous approximations.

Sliding mode Design approaches: Introduction, A regulator form based approach, a direct eigen structure assignment approach, Incorporation of a tracking requirement, Design study of Pitch-pointing flight controller.

Sliding mode controllers using output information: Introduction, problem formulation, a special case of square plants, a general frame work, dynamic compensation, observer based dynamic compensation, a model reference system using only outputs.

Sliding mode observers: Introduction, sliding mode observers, synthesis of a discontinuous observer, the Walcott-Zak observer revisited, sliding mode observers for fault detection.

Text Book:

1. Sliding Mode Control: Theory And Applications (Seriesin Systems and Control) by, CEdwards and SSpurgeon, Published by Taylor &Francis,

Reference Books:

1. Sliding Mode Control In Engineering (Automation and Control Engineering) by WilfridPerruquetti, Jean-Pierre Barbot published by Marcel Dekker,Inc,NewYork

EECS 1.4(a): OPTIMIZATION TECHNIQUES
(Elective-II)

The course objectives

To enable the student to:

- To know the concept optimization
- To know the Problem formulation steps
- To find out the necessary conditions to find an optimum point
- To find optimum point of a constrained linear programing problem
- To find optimum point of an unconstrained non-linear programming.

Course Outcomes:

At the end of this course, a student has the ability to:

- To formulate and define an optimization problem.
- To derive the necessary and sufficient conditions of an optimization problem.
- To formulate and solve a linear programming problem.
- Ability to solve an optimum point for an unconstrained non-linear optimization problem
- Ability to solve an optimum point for a constrained non-linear optimization problem

SYLLABUS

Introduction to Optimization: Introduction, Historical Development, Engineering Applications of Optimization, Statement of Optimization Problem.

Classical Optimization Techniques: Introduction, Single variable optimization, Multi variable optimization with no constraints; Multi variable optimization with Equality constraints–Solution by Direct Substitution method, Method of constrained variation, Method of Lagrangian multipliers; Multivariable optimization with inequality constraints: Kuhn-Tucker conditions.

Linear Programming: Introduction, Applications of Linear Programming, Standard Form of a Linear Programming, Basic Terminology and Definitions, Exceptional cases, Simplex method, Big-M method, Two-phase method, Revised Simplex method, Duality, Decomposition Principle.

Non Linear Programming I:Unconstrained optimization-Uni variatemethod,Pattern Directions, Powell's method, Gradient of a function, Steepest descent method, Conjugate GradientMethod,Newton'smethod,MarquardtMethod,Quai-NewtonMethods,Davidon-Fletcher-Powell Method,Broyden-Fletcher-Goldfarb-Shanno Method.

Non Linear Programming II: Constrained optimization-Characteristics of a Constrained Problem, Sequential linear programming, Basic approach in the methods of feasible directions,Zoutendijk's method of feasible directions,SequentialQuadraticProgramming.

Text Book:

1. Engineering Optimization: Theory and Applications' By S.S.Rao, New Age International Publishers, Revised Third Edition, 2005.

EECS 1.4(b): SCADA SYSTEMS & APPLICATIONS
(Elective-II)

The course objectives

To enable the student to:

- To know the concept and need of 'SCADA-Supervisory Control and Data Acquisition'
- To know about different components of SCADA
- To know about SCADA architecture
- To know about various communication technologies in SCADA system.

Course Outcomes:

At the end of this course, students has the ability to**:**

- To know about Data acquisition systems.
- To know different schemes of SCADA.
- To know about various architectures of SCADA systems.
- To know about various protocols of communication system of SCADA
- Ability to apply SCADA principles to basic systems.

SYLLABUS

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, & Industries

SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent ElectronicDevices(IED),ProgrammableLogicController(PLC),CommunicationNetwork,SCADAS erver, SCADA/HMI Systems

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of eachsystem -singleunifiedstandardarchitecture-IEC61850.

SCADA Communication: Various industrial communication technologies -wired and wireless methods and fiberoptics. Open standard communication protocols

SCADA Applications: Utility applications- Transmission and Distribution sector -operations, monitoring, analysis and improvement. Industries oil, gas and water. Case studies, Implementation, Simulation Exercises

TEXTBOOKS:

1. StuartA.Boyer,'SCADA Supervisory Control and Data Acquisition', Instrument Society of America Publications,USA,2004.
2. Gordon Clarke,Deon Reynders,'Practical Modern SCADA Protocols:DNP3,60870.5 and Related Systems', Newnes Publications,Oxford, UK,2004.

EECS 1.4(c): SYSTEMS BIOLOGY
(Elective-II)

The course objectives

To enable the student to:

- To know the basic properties of Neural Networks
- To know different mathematical models of artificial neural networks
- To know different ANN based control methodologies.
- To learn different stages in Fuzzy-logic based control.
- To understand Neuro-fuzzy controllers

Course Outcomes:

At the end of this course, students has the ability to:

- To know about different Neural networks models.
- To apply ANN based control methods for different engineering systems.
- To understand the concept of fuzzy logic based control and different logical operators
- To design a fuzzy based controller for a simple system
- To design a Neuro-fuzzy based controller for a simple system.

SYLLABUS

Neural Networks: Artificial Neural Networks: Basic properties of Neurons, Neuron Models, Feedforward networks–Perceptrons, Multilayer networks–Exact and approximate representation, Back propagation algorithm, variants of Back propagation, Un supervised and Reinforcement learning;Competitivelearningandself-organizingnetworks,HybridLearning.

ANN based control: Introduction: Representation and identification, modeling the plant, control structures – supervised control, Model reference control, Internal model control, Predictive control, Case study-application to electrical engineering.

FuzzyLogic: Overview of classical logic, Fuzzy sets vs Crispset, Membership function, Methods of Membership function, Value Assignment, defuzzification–Methods of defuzzification,fuzzy rule based and Approximation, Aggrigation of Fuzzyrules, Fuzzy inference system–Mamadani and Sugeno methods.

Fuzzy Controllers: Preliminaries – Basic architecture and operation of Fuzzy controller – Analysis of static properties of fuzzy controller – Analysis of dynamic properties of fuzzy controller–simulation studies–case studies–application to electrical engineering.

Neuro–Fuzzy Controllers: Neuro–fuzzy systems:A unified approximate reasoning approach–Construction of role bases by self learning: System structure and learning algorithm–A hybrid neural network based Fuzzy controller with self learning teacher. Fuzzified CMAC and RBF network based self-learning controllers, case studies–application to electrical engineering

Text Books:

1. Bose and Liang, Artificial Neural Networks, Tata Mcgraw Hill,1996.
2. KoscoB, Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Prentice Hall of India,NewDelhi,1992.

References Books:

1. Kli rG.J and Folger T.A,Fuzzy sets,Uncertainty and Information,PHI,NewDelhi1994.
2. Simon Haykin, Neural Networks, ISA, Research Triangle Park,1995.
3. Bose, Nirmal K.; Bose, N. K.; Liang, Ping, Neural Network Fundamentals with Graphs, Algorithms, and Applications (Mc Graw-Hill Series in electrical & Computer Engineering)
4. Robert Fuller,Introduction to Neuro-Fuzzy Systems,Springer,2000
5. J.-S.R.Jang, C.-T.Sun, and E.Mizutani, Neuro-Fuzzy and Soft Computing
6. Berenji, HamidR, Fuzzy and neural control (May1, 1992)
7. Fuzzy logic with Fuzzy Applications–T.J.Ross–McGraw Hill Inc,1997.
8. Fuzzy sets,Fuzzy logic, fuzzy systems by– loftAsker Zadeh

EECS 1.5: RESEARCH METHODOLOGY AND IPR

The course objectives

To enable the student to:

- Understand some basic concepts of research and its methodologies
- identify appropriate research topics
- Select and define appropriate research problem and parameters
- Nature of intellectual property, patent rights, grants

Course Outcome:

At the end of this course, the students should be able to:

- Demonstrate the ability to choose methods appropriate to research aims and objectives.
- Understand the limitations of particular research methods.
- Develop skills in qualitative and quantitative data analysis and presentation.
- Demonstrate enhanced writing skills.
- Developments in IPR.

SYLLABUS

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem - Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property - Procedure for grants of patents, Patenting under PCT.

Patent Rights:Scope of Patent Rights-Licensing and transfer of technology Patent information and databases –Geographical Indications.

New Developments in IPR: Administration of Patent System - New developments in IPR; IPR of Biological Systems, Computer Software etc. - Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Stuart Melville andWayne Goddard,"Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard andStuar tMelville,"Research Methodology:An Introduction"
3. Ranjit Kumar,2nd Edition,"Research Methodology:A step by Step Guide for beginners"
4. Halbert,"Resisting Intellectual Property",Taylor & FrancisLtd,2007.
5. Mayall,"Industrial Design",Mc Graw Hill,1992.
6. T.Ramappa,"Intellectual Property Rights Under WTO",S.Chand,2008

EECS 1.6(a):ENGLISH FOR RESEARCH PAPER WRITING

Course Objective

Students will be able to:

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

Course Outcome

At the end of this course, the students should be able to:

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

SYLLABUS

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

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

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

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.

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

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

Reference Books:

1. Goldbort R(2006) Writing for Science, Yale University Press(available on Google Books)
2. Day R(2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N(1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,20

EECS 1.6(b): DISASTER MANAGEMENT

Course Objective

Students will be able to:

- To familiarize the students about the disaster management and the need for its study.
- To familiarize the students about the concept of risk and vulnerability analysis
- To create awareness about disaster prevention and risk reduction
- To know about the relationship between disasters and developments.
- To understand the concepts of Rehabilitation, Reconstruction and Recovery in the event of Disaster

Course Outcome

At the end of this course, the students should be able to:

- Understand the need and significance of studying the disaster management
- To gain the knowledge of different types of disasters and causes for disasters.
- Gain knowledge on the impacts of Disasters on environment and society
- Ability to assess the vulnerability of a geographical area.
- Students will be able to know various methods of risk reduction measures and risk mitigation.
- Understands the role of Information Technology in Disaster Management
- Understands the Geographical Information System applications in Disaster Management

SYLLABUS

Introduction to Disaster: Definition, Factors And Significance ;Difference Between Hazard And Disaster; Natural And Man made Disasters: Difference, Nature,Types and Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life,DestructionOfEcosystem.NaturalDisasters:Earthquakes,Volcanisms,Cyclones,Tsunamis,Flo ods, 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.

Disaster Prone Areas in IndiaStudy Of Seismic Zones; Areas Prone To Floods And Droughts,Landslides And Avalanches; Areas ProneTo Cyclonic And Coastal Hazards With Special ReferenceToTsunami;Post-DisasterDiseasesAnd Epidemics Disaster Preparedness And Management Preparedness: Monitoring Of PhenomenaT riggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, DataFrom Meteorological and Other Agencies, Media Reports: Governmental And CommunityPreparedness.

Risk Assessment Disaster Risk:Concept and Elements,Disaster Risk Reduction,Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation InRisk Assessment and Warning,People'sParticipation In Risk Assessment.Strategies for Survival

Disaster Mitigation Meaning,Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation.Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References Books:

1. R. Nishith,SinghAK, “Disaster Management in India: Perspectives, issues and strategies New Royal book Company.
2. Sahni, PardeepEt.Al.(Eds.),”Disaster Mitigation Experiences and Reflections”,Prentice Hall Of India,New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies” , Deep & Deep Publication Pvt. Ltd., New Delhi.

EECS 1.6(c): SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objective

Students will be able to:

- Learning the Sanskrit language and its grammar in order to understand and analyze technical texts written in Sanskrit.
- Developing proficiency in reading and comprehending technical texts written in Sanskrit, such as those on mathematics, astronomy, physics, engineering, medicine, and other sciences.
- Enhancing the ability to translate technical texts written in Sanskrit into modern languages in order to make them accessible to a wider audience.
- Developing a deep understanding of the technical concepts and terminology used in Sanskrit texts and their relevance to modern scientific and technological advancements.
- Learning about the historical and cultural contexts in which the technical knowledge was developed in ancient India.
- Gaining an appreciation for the rich philosophical and spiritual traditions that have influenced the development of Sanskrit language and technical knowledge.
- Developing the ability to apply the insights gained from studying Sanskrit technical texts to modern scientific and technological challenges.

Course Outcome

At the end of this course, the students should be able to:

- To make the students understand in Sanskrit Grammar and Composition
- To help the students know the basic Sanskrit Grammar and Literature
- Appreciation for the cultural and historical context in which Sanskrit technical knowledge was developed.
- Enhanced understanding of the philosophical and spiritual traditions that have influenced the development of Sanskrit language and technical knowledge.
- Ability to apply insights gained from studying Sanskrit technical texts to modern scientific and technological challenges.
- Development of a deeper understanding of Indian civilization and culture, and its contributions to science and technology.

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Order - Introduction of roots - Technical information about Sanskrit

Literature Technical concepts of Engineering-Electrical,Mechanical,Architecture,Mathematics

Reference Books:

1. Abhyaspustakam"–Dr.Vishwas,Samskrita-Bharti Publication,NewDelhi
2. Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam,NewDelhiPublication
3. India'sGlorious Scientific Tradition"SureshSoni, Ocean book s (P) Ltd.,NewDelhi.

EECS 1.6(d): VALUE EDUCATION

Course Objective

Students will be able to:

- To teach and inculcate the importance of value based living.
- To give students a deeper understanding about the purpose of life.
- To teach and inculcate the essential qualities to become a good leader.

Course Outcome

At the end of this course, the students should be able to:

- Students will understand the importance of value based living
- Students will gain deeper understanding about the purpose of their life.
- Students will understand and start applying the essential steps to become good leaders.
- Students will emerge as responsible citizens with clear conviction to practice values and ethics in life.
- Students will become value based professionals.
- Students will contribute in building a healthy nation.

SYLLABUS

Values and self-development - Social values and individual attitudes - Work ethics, Indianvision of humanism- Moral and non - moral valuation - Standards and principles – Value judgements

Importance of cultivation of values- Sense of duty - Devotion, Self-reliance - Confidence, Concentration. Truthfulness,Cleanliness -Honesty, Humanity - Power of faith,NationalUnity– Patriotism-Lovefornature, Discipline

Personality and Behaviour Development - Soul and Scientific attitude - Positive Thinking - Integrity and discipline - Punctuality, Love and Kindness - Avoid fault Thinking - Free fromanger, Dignity of labour - Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of self-destructive habits - Association and Cooperation-Doing best for saving nature

Character and Competence –Holy books vs Blind faith - Self-management and Good health - Science of reincarnation - Equality, Nonviolence,Humility, Role of Women - All religions and same message-Mind your Mind, Self-control-Honesty,Studying effectively

Reference Bookss:

1. Chakroborty,S.K.“Values and Ethics for organizations Theory and practice”,Oxford University Press, NewDelhi

EECS 1.6(e): CONSTITUTION OF INDIA

Course Objective

Students will be able to:

- To learn the history of Indian constitution
- To understand the rights and duties of the citizens
- To understand the administration and its hierarchy
- To understand the role and functionality of election commission

Course Outcome

At the end of this course, the students should be able to:

- Understands the meaning and importance of Constitution
- Understands the Administration, its role
- Understands the Role and functioning of Election commission

SYLLABUS

History of Making of the Indian Constitution: History Drafting Committee, (Composition &Working)

Philosophy of the Indian Constitution: Preamble- Salient Features

Contours of Constitutional Rights & 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.

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

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

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

Reference Bookss:

1. The Constitution of India,1950 (BareAct),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.

EECS 1.6(f): PEDAGOGY STUDIES

Course Objective

Students will be able to:

- To understand conceptual framework and terminology of teaching
- To understand effectiveness of pedagogical practices
- To know the research gaps and learn the future directions

Course Outcome

At the end of this course, the students should be able to:

- Understands the conceptual framework and terminology of teaching
- Understands the effectiveness of pedagogical practices
- Learns the research gaps and the future directions

SYLLABUS

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informalclassroomsindevelopingcountries,Curriculum,Teachereducation.

Evidence on the effectiveness of pedagogical practices , Methodology for the in depth stage: quality assessment of included studies, Theory of change, Strength and nature of the bodyofevidenceforeffectivepedagogicalpractices,Pedagogictheoryandpedagogicalapproaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Research gaps and future directions: Research design, Contexts Pedagogy , Teacher education, Curriculum and assessment, Dissemination and research impact.

Reference Books:

1. AckersJ, Hardman F(2001)Class room interaction in Kenyan primary schools, Compare, 31(2):245-261.
2. Agrawal M (2004) Curricular reform in schools :The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report1.ondon:DFID.
4. AkyeampongK, LussierK,PryorJ,WestbrookJ(2013)Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Black well.

EECS 1.6(g): STRESS MANAGEMENT BY YOGA

Course Objective

Students will be able to:

- Understand higher consciousness and how to attain it.
- To understand philosophy of pure consciousness
- To understand relation of mind and body
- To identify stressors and manage them

Course Outcome

At the end of this course, the students should be able to:

- Learns the higher consciousness and how to attain it.
- Understands philosophy of pure consciousness
- Understands relation of mind and body
- Identifies stressors and stress management

SYLLABUS

Yoga: Royal Road to Higher Consciousness:Consciousnessor Chaitanya in Mandukya Upanishad, Bhagavad Gita, Yoga Sutras, Astavakra Gita; methods of accessing higher states of consciousness – overcoming body consciousness, overcoming mind consciousness; higher consciousness and person transformation; higher consciousness and parapsychic powers (siddhis).

Vedanta: A Philosophy of Pure Consciousness – Consciousness according to Advaita, Dvaitaand Visistadvaita schools, Consciousness according to Nyaya, Vaisesika and Sankya Schools.Self - awareness – Ramana Maharshi; Buddhism: A Psychology of Consciousness: - viññā a,5aggregates,12nidhanasm, cetasikas,nirvana.
The Mind-Body Relationship, the concept of Psychological Health in India, Scope of Health Psychology Emergence of Behavioural Medicine.

Stress – Stressors: Environmental, Social and Psychological, stress and illness, control and stress.

Reference Books:

1. S.Menon, B.V.Sreekantan,AnindyaSinha, PhilipClayton, Rnarasimha (2004).Science and Beyond: Cosmology, consciousness and technology in Indic traditions.National Institute of Advanced Studies, Bangalore
2. Nakamura(1989).Indian Buddhism,MotilālBanārsidass,Delhi.
3. Goleman,D &Gurin,J.(1993).Mind– Body Medicine,NewYork.

EECS 1.6(h): PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objective

Students will be able to:

- To learn holistic development through neetisatakam
- To learn how to deal with day to day work and duties
- To learn to apply basic knowledge from BhagwadGeetha to daily life

Course Outcome

At the end of this course, the students should be able to:

- Learns holistic development through neetisatakam
- Able to deal with day to day work and duties
- Able to apply basic knowledge from BhagwadGeetha to daily life

SYLLABUS

Neetisatakam- Holistic development of personality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride&heroism)
- Verses-26,28,63,65(virtue)
- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
- Chapter18-Verses45,46,48.

Statements of basic knowledge.

- ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
- Chapter 12 -Verses 13, 14, 15, 16,17,

18Personality of Rolemodel. Shrimad Bhagwad
Geeta:

- Chapter2-Verses17,Chapter3-Verses36,37,42,
- Chapter4-Verses18,38,39
- Chapter18–Verses37,38,63

Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath
3. Rashtriya Sanskrit Sansthanam,NewDelh

EECS 1.7: CONTROL LAB–I

Course objectives:

Students will be able to:

- To know basics of control systems.
- To know the operation of different blocks in a system.
- To understand advantages of closed loop systems.
- To know the concepts of feedback systems.

Course outcomes:

At the end of this course, the students should be able to:

- Knowledge of basic linear systems.
- Explain the role of PID controller.
- Summarize the importance of control variables.
- To understand servo motor applications.

LIST OF EXPERIMENTS

1. Temperature Control Using PID
2. Linear System Simulator
3. Potentiometer Error Detector
4. PID Controller Analog
5. Speed Torque Characteristics Of Two Phase Ac Servo Motor

EECS 1.8: CONTROL LAB-II

Course objectives:

Students will be able to:

- To know difference between simulation and implementation of hardware.
- To understand MATLAB software.
- To know the concepts blocks present in simulink.
- To know the different transfer function analysis.

Course outcomes:

At the end of this course, the students should be able to:

- Describe the stability of system by root locus.
- To understand PID controller by simulation.
- To understand different order systems.
- Describe the stability of system by bode plot.

LIST OF EXPERIMENTS

1. Temperature Control System Simulink
2. Stability Analysis Using Root Locus (2^{nd}, 3^{rd} , 4^{th}&5^{th} Order Systems) Using Matlab.
3. Stability Analysis Using Bode Plot (2^{nd}, 3^{rd} , 4^{th}&5^{th} Order Systems) Using Matlab.
4. Simulation Of P,Pi,Pd,Pid Controller.
5. Stability Analysis Using Nyquist (2^{nd}, 3^{rd} , 4^{th}&5^{th} Order Systems) Using Matlab.

EECS 2.1: NON LINEAR SYSTEMS

Course Objective

Students will be able to:

- To introduce the concept of non-linear system and to know about types of non-linear systems.
- To know the difference between linear and nonlinear systems
- To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
- To analyze the stability of non-linear systems using Lyapunov analysis.

Course Outcome

At the end of this course, the students should be able to:

- Student can able to linearize a given non-linear system.
- Student can identify the equilibrium points, and able to analyze system behavior at these equilibrium points.
- A student can analyze the stability of a non-linear system using describing function method.
- Able to analyze the stability of linear and non-linear systems using Lyapunov's stability theory.

SYLLABUS

Introduction to Non Linear System: Classification of non-linearity, types of non-linearity in physical system, jump phenomena and critical jump resonance curve, methods of analysis of non-linear systems and comparison, isoclines, singular point, limit cycle.

Phase Plane Analysis: Concept of phase plane, phase trajectory, phase portraits, methods of plotting phase plane trajectories Vander Pol's equation, stability from phase portrait, time response from trajectories, isoclines method, Pell's method of phase trajectory, and Delta method of phase trajectory construction.

Frequency Domain Analysis: Absolutest Sability, Describing function, DF of typical nonlinearities stability analysis using DF method, stability studies using DF method.

Liapunov Stability: Autonomous Systems: Stability of equilibrium point. Concepts of positive definite/semi definite, negative definite/semi definite, in definite functions, Lyapunov function, Liapunov Stability: asymptotic stability, global asymptotic stability, instability.

Linearization: Linear systems, linearization of nonlinear systems about equilibrium point, feedback linearization and input/output linearization.

Text Book:

1.M.Vidyasagar,'Nonlinear systems Analysis', 2nd Edition,1991,prentice-Hall Inc.

Reference Books:

1. Control Systems Theory and Application: Samarjit Ghosh, Pearson Education
2. Control System Engineering: Nagrath and Gopal,Wiley Eastern
3. Automatic Control System: GeorgeJ.Thaler Brown, JaicoP ublications
4. Nonlinear Systems: HasanA.Khalil,Printece Hall of India

EECS 2.2: CONTROL SYSTEM DESIGN

Course Objective

Students will be able to:

- The course aims to know about the principles of control design.
- This course aims to design classical controllers for continuous and discrete-time system using root-locus and Bode methods.
- Find the controller parameter to minimize a given performance measure.

Course Outcome

At the end of this course, the students should be able to:

- A student is able to design a lag or lead compensator for a system whose steady-state or transient performance need to be improved using root-locus and Bode methods.
- A student can able to find a controller parameter to meet certain objective.
- A student can able to determine state feedback controller using pole-placement technique for a desired closed-loop behavior.
- To know about centralized and decentralized control strategies of a multi-variable systems.
- A student is able to design a digital controller for a given system using z-plane synthesis and also dead-beat response method.

SYLLABUS

Design of Linear Control Systems: Review of compensation techniques to obtain desired performance, Reshaping of Bode &Root locus plots to obtain desired response ,Initial condition and forced response, a simple lag–lead design.

Integral square error compensation: parameter optimization using Integral-square error criterion with and without constraints, principles of State variable Feedback compensation of continuous-time and discrete-time systems, simple problems to understand the concept.

MIMO Control design: Principles of Linear Quadratic Optimal Regulators, Discrete Time Optimal Regulators, Observer Design, Linear Optimal Filters, State Estimate Feedback, Transfer Function Interpretation, simple problems to understand the concept.

PID Controller: PID controller, Simulation of multi-loop control system using P, PI, PD, PID controller, Standard compensator structures (P,PD, PI and PID control).

Design of digital control system: Protocol of Digital controller design, Classical Compensation of Discrete-time control systems: Forward path continuous, Forward-path DigitalZ-plane Synthesis approaches,Dead beat performance.

Text Books:

1. G.C.Goodwin, S.F.Graebe, M.E.Salgado,“Control System Design”, Prentice Hall of India
2. Gupta and Hasdorf,'Fundamentals of Automatic control Willey Eastern,1970
3. B.C.Kuo,Automatic control systems'(5thEdition),Prentice Hall of India,1988.

Reference Books Books:

1. M.Gopal,“Digital Control and State Variable Method”,Tata McGraw Hill
2. Hadi Saadat, “Computational Aidsin Control System Using MATLAB”, McGraw Hill International
3. Ogata K.,“Modern Control Engineering”,4th Edition,Prentice Hall
4. Norman S.Nise,“Control Systems Engineering”,3rd Edition,Wiley

EECS 2.3(a): OPTIMAL CONTROL THEORY
(Elective-III)

Course Objective

Students will be able to:

- To provide a basic knowledge of the theoretical foundations of optimal control
- To develop skills needed to design controllers using available optimal control theory and software
- To implement optimization methods for optimal control.

Course Outcome

At the end of this course, the students should be able to:

- A student is able to know the problem formulation steps of optimal control theory.
- A student is able to find an optimal controller that minimizing a performance measure.
- A student is able to know about Bellmans principle of optimality, principle of invariant imbedding, characteristics of dynamic programming.
- To determine an optimal controller using HJB principle.
- To determine an optimal controller using pontryagin minimum principle.
- To know about two-point boundary value problems.

SYLLABUS

Introduction: Problem formulation- State variable representation of systems – Performance measures for optimal control problems– selecting a performance measure.

Dynamic programming: The optimal control law - principle of optimality and its application – optimal control system-interpolation-recurrence relation of dynamic programming-computational procedure for solving optimal control problems–characteristics of dynamic programming solution-analytical results-discrete linear regulator problems- Hamilton- Jacobi-Bellman equation-continuous linear regulator problems.

The Calculus of variations: Fundamental concepts-linearity of functional-closeness of functions-the increment of a functional-The variation of a functional- maxima and minima of functional- the fundamental theorem of the calculus of variations - Functional of a single function-the simplest variational problems.

The Variational approach to optimal control problems: Necessary conditions for optimal control-Linear regulator problem Pontryagin's minimum principle and state in equality constraints.

Iterative numerical techniques for finding optimal controls: Two-point boundary-value problems-The method of steepest descent-Features of the steepest descent algorithm.

Text Book:

1.Optimal control theory- An Introduction by Donald E.Kirk-Prentice Hall Networks series.

EECS 2.3(b): ADVANCED ROBOTICS
(Elective-III)

Course Objective

Students will be able to:

- Understand robot configuration, structures, basic components, workspace and generations of robots. Get acquainted with performing spatial transformations and solve kinematics of the robot
- Get knowledge and analysis skills associated with trajectory planning
- Learn about various sensors, actuators, robot programming

Course Outcome

At the end of this course, the students should be able to:

- Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators.
- Apply spatial transformation to obtain forward and inverse kinematics
- Solve robot dynamics problems, generate joint trajectory for path planning .
- Describe working principle of various actuators.
- Describe working principle of various drive systems.
- Describe working principle of various sensors.

SYLLABUS

Robotics: Historical back ground, Definitions. Laws of Robotics, Robotics systematic robot anatomy Common Robot configurations, coordinate system, work envelop. Elements of robotic system and effector, actuators, controller, teach pendant, sensors Specification of robots, Applications, Safety measures.

Robot Kinematics: Forward and reverse Kinematics of 3 DOF Robot arms, Homogeneous transformations, Kinematics equation using homogeneous transformations.

Actuators: Hydraulic actuators. Pneumatic actuator, Electrical actuators, Directional control, Servo Control Flow control valves.

End effectors: Classification, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive Grippers, force analysis in Grippers.

Sensors: Need for sensing systems, Sensory devices, Types of sensors, Robot vision system Robot Languages and Programming, Description of AI techniques used for Robot control.

Text Books:

1. Kevin M.Lynch,Frank C.Park, Modern Robotics,Cambridge University Press
2. J.J.Craig, Introduction to Robotics, Pearson

EECS 2.3(c):ADAPTIVE LEARNING AND CONTROL
(Elective-III)

Course Objective

Students will be able to:

- This is an advanced course on control system design which combines feedback, adaptation and learning for engineered systems.
- The course involves a mathematically rigorous treatment of questions on stability, convergence and robustness of adaptive systems.
- The format of the course is research-oriented with emphasis on reading research papers and implementing simulation projects.

Course Outcome

At the end of this course, the students should be able to:

- Students should be able to explain the fundamental concepts and theories of adaptive control.
- Student should know about Direct MRAC and indirect-MRAC.
- Students should have a strong understanding of classical control system design, including feedback control, stability analysis, and the design of compensators.
- Students should be able to analyze the performance of adaptive control algorithms and understand their limitations.
- Students should be able to design adaptive control systems for simple practical applications.

SYLLABUS

Model Reference Books Adaptive Control: Motivational Example, Introduction to Direct Model Reference Books Adaptive Control, Direct Model Reference Books Adaptive Control of Scalar Linear Systems with Parametric Uncertainties, Historical Roots and Foundations of Model Reference Books Adaptive Control.

State Feedback Direct Model Reference Books Adaptive Control: Introduction, Command Tracking, Direct MRAC Design for Scalar Systems, Dynamic Inversion MRAC Design for Scalar Systems, MRAC Design for Multi-Input Multi-Output Systems.

Model Reference Books Adaptive Control with Integral Feedback Connections: Introduction, Control Design, MRAC Augmentation of an Optimal Base line Controller.

Robust Adaptive Control: MRAC Design in the Presence of Bounded Disturbances, MRAC Design Modifications for Robustness.

Methods in Adaptive Control: Adaptive Back stepping, Adaptive Output Feedback Control, Adaptive Neuro Control., Examples of Adaptive Control. One case study and computer simulation.

Text Books:

1. Robust and Adaptive Control: With Aerospace Applications, Advanced text books in control and signal processing, by Eugene Lavretsky, Kevin A. Wise, publisher Springer 2012.

EECS 2.3(d):STOCHASTIC FILTERING AND IDENTIFICATION– SYSTEM IDENTIFICATION AND PARAMETERESTIMATION (Elective-III)

Course Objective

Students will be able to:

- Introduce fundamental concepts of optimal estimation, filtering, prediction, and system identification.
- Understanding of stochastic processes, including stationary and non-stationary processes, and the basic principles of stochastic filtering.

Course Outcome

At the end of this course, the students should be able to:

- Understanding the concept of stochastic processes, optimal filtering and optimal prediction.
- To find the time response ofstochastic process.
- Students should be able to identify and estimate system parameters from input-output data, including linear and nonlinear systems, and using techniques such as maximum likelihood estimation, least-squares estimation, and Bayesian estimation.

SYLLABUS

Stochastic Filtering: Elements of the theory of stochastic processes and development ofsystemmodels-optimalpredictionandfilteringfordiscretelinearsystems-Optimalsmoothing for discrete linear systems-Optimal estimation for continuous linear systems-Stochasticoptimalcontrolfordiscretelinearsystems-
Stochasticoptimalcontrolforcontinuouslinearsystems.

Introduction& Classical Models: system models and model classification, identification problem, some fields of applications. Time response and frequency response methods of transfer function evolution, Impulse response identification using cross correlation test and orthogonal series expansion, methods of convolution, model learning technique.

Least square Method: Least square estimates and its properties, non recursive least square identification of dynamic system, extensions such as generalised least square repeated least square and instrumental variable method.

Recurse Methods: Recursive least square, minimum variance algorithms, stochastic approximation method, maximum likelihood method.

Identification of state variable models: State Estimatior using Kalman and extended kalmanfilter, simultaneous state and parameter estimation of linear systems.

Non-Linear systems identification: Identification of a volterra series models,identification of non-linear state models using extended kalman filter,quasi linearization method,invariant imbedding, gradient method, Numerical identification through model following approach.

Text Book:

1. Stochastic Optimal Linear Estimation and Control,J.S.Meditch,McGraW Hill Book Company, 1969.

Reference Books:

1. J.M.Mendel,'Discrete Techniques of parameter esimation' Marcel Dekker, 1973.
2. F.Eykhoff,'system identification,parameter and state estimation, John Willey,1974.
3. A.P.SageandJ.L.Melsa 'identification', Academic press,1971.

EECS 2.4(a):MODEL REDUCTION IN CONTROL
(Elective-IV)

Course Objective

Students will be able to:

- To understanding of the basic concepts of model reduction, including projection-based techniques, balanced truncation, and modal analysis.

Course Outcome

At the end of this course, the students should be able to:

- To understand the principle of large scale systems modeling.
- To understand the principles of model matching and able to apply to a system.
- To understand the principle of Pade approximation, Routh approximation, continued fraction approximations of the system which are represented using transfer functions.
- To understand the principles of controllaw reduction approach using davison and Chidambara Models.
- Able to analyze the stability of reduced order model.

SYLLABUS

L.S.S.Modelling: Time Domain: Introduction, Aggregation methods, exact and model aggregation by continued fraction, chained aggregation descriptive variables approach, descriptive variable systems, solvability and conditionality, timeinvariance,shufflealgorithm.

L.S.S.Modelling Frequency Domain: Introduction, Moment matching, Pade approximation, Routh approximation, continued fraction method, error minimization methods, mixed methods and unstable systems, Pade model method, Pade-Routh method, multi input and multi output systems, reduction, matrix continued fraction method, Model continued fraction method, Pademodel method, frequency comparison method.

Time Scales and Singular Perturbations: Introduction,problem statement and preliminaries,numerical algorithm,basic properties,relation to model aggregation,feedback control design, singularly perturbed linear systems, fast and slow sub systems,eigenvalue distribution, approximation to time scale approach, system properties, design ofoptimal controllers,fast and slow controllers,lower order controls.

Model Order Reduction and Control: Reduced Order Model Using Davison, Chidambara and Marshall Techniques, Suboptimal Control Using Davison and Chidambara Models, Control Law Reduction Approach Using Davison Model and Chidambara Models, Choice of Reduced Model Order.

Aggregation Methods: Aggregation of Control Systems Determination and Properties of Aggregated System Matrix, Error in Aggregation, Modal Aggregation- Reduced Order Model Stability of Feedback System, Aggregation by Continued Fraction

Text Books:

1. 'Large Scale Systems Modeling and Control', Mohammad Jamshidi, 1989, North Hollard (Series in systems science and engineering, vol.9).
2. 'Large Scale Systems Modeling', Magdi S. Mohamoud and Madan G. Singh, Pergamon Press (International series on Systems and Control),1981

EECS 2.4(b):ROBUST CONTROL
(Elective-IV)

Course Objective

Students will be able to:

- To know about stability and performance specifications in the frequency domain.
- To know about the preliminaries and the concept of robust control.

Course Outcome

At the end of this course, the students should be able to:

- Identify sources of uncertainty and disturbances in control systems and understand their impact on system performance.
- Analyze the robustness of a control system using quantitative measures such as gain and phase margins.
- Apply robust control design techniques, such as H-infinity control, mu synthesis, and robust PID control, to design control systems that are robust to uncertainties and disturbances.
- Understand the limitations of robust control techniques and be able to select the appropriate approach for a given control problem.

Introduction: Introduction to Robust Control, Control-Oriented Models for Linear-Time-Invariant Systems, Norms of Vectors and Matrices in Euclidean Spaces.

State Feedback Optimal Control: Introduction, Norms for Signals and Systems, Power signals, Norms for Systems, Computing Norms for Systems, Well-Posedness and Stability, Stability and Performance Specifications in the Frequency Domain, Loop Shaping Using Frequency–Dependent Weights, State Feedback Optimal Control.

Output Feedback Control: Output Feedback Using Projective Controls, Linear Quadratic Gaussian with Loop Transfer Recovery, Summary, Loop Transfer Recovery Using the Lavretsky Method.

Robust Control: Modelling of uncertain systems-Unstructured Uncertainties Additive, multiplicative and other forms. Parametric uncertainty, Interval Systems, Structured uncertainties, Linear fractional transformation Robust design specifications: Small gain theorem and robust stabilization, Performance considerations, Structured singular values. Design - Mixed sensitivity optimization, 2-Degree of freedom design, Sub-optimal solutions,H_2/H_∞Systems.

Loop-shaping design procedures: Robust stabilization against Normalized co-prime factor Perturbation, Loop shaping design procedures, μ -Analysis and Synthesis-Consideration of robust performance, μ-synthesis :D–K iteration method, Schur Compliment &Linear Matrix Inequalities: Some standard LMI problems–eigen-value problems, generalized eigen-value problems; Algorithms to solve LMI problems–Ellipsoid algorithm, interior point methods.

Text Books:

1. Robust and Adaptive Control: With Aerospace Applications, Advanced text books in control and signal processing, by Eugene Lavretsky, Kevin A. Wise, publisher Springer 2012

Reference Books:

1 D.W.Gu,P.Hr.Petkov and M.M.Konstantinov, 'Robust Control design with MATLAB', Springer, 2005.
2 AlokSinha,'Linear Systems-Optimal and Robust Controls',CRC Press,2007.
3 S.Skogestad and Ian Postlethwaite,'Multivariable feed back control',John Wiley& Sons, Ltd, 2005.

EECS 2.4(c):ADVANCED DSP
(Elective-IV)

Course Objective

Students will be able to:

- At the completion of this course, the student should have in depth knowledge of processing digital signals.

Course Outcome

At the end of this course, the students should be able to:

- Know the analysis of discrete time signals.
- To study the modern digital signal processing algorithms and applications.
- Have an in-depth knowledge of use of digital systems in real time applications
- To know about classical filter design and FIR design.
- To know about to Multirate Signal Processing.

SYLLABUS

Review of Discrete – Time Signal & System representation in Z –Transform domain – Inverse Z – Transform – Properties – System characterization in Z – domain -- Equivalence between Fourier Transform and the Z-Transform of a Discrete signal.

Sampling in Fourier domain - Discrete Fourier Transform and its properties – Linear filtering using DFT–Resolution of DFT-FFT Algorithm–Radix-2FFTAlgorithm-DIT & DIF Structures-Higher Radix schemes.

Classification of filter design - Design of IIR filters – Bilinear transformation technique –Impulse invariance method–Step invariance method.

FIR filter design – Fourier series method - Window function technique-finite Word Length Effects

Introduction to Multirate Signal Processing – Decimation – Interpolation-introduction to STFT WT

Text Book:

1. John G.Prokis and Dimitris G.Hanolakis,'Digital Signal Processing,Principles,Algorithms & Applications' 4thEdition,Pearson Education,2006.

Reference Books:

1. Ludemann L. C., 'Fundamentals of Digital Signal Processing', Harper and Row publications,2009.
2. Antoniou A.,'Digital Filters–Analysis and Design', TataMc-GrawHill, 2001.
3. Oppenheim and Schaffer,'Discrete time Signal processing',Pearson Education,2007

EECS 2.4(d):CONTROL SYSTEM COMPONENTS
(Elective-IV)

Course Objective

Students will be able to:

- Understand the fundamental principles behind the operation of control system components, including their specifications, characteristics, and limitations.
- To know about design and integration of different control system components to build effective control systems that meet specific performance criteria.

Course Outcome

At the end of this course, the students should be able to:

- To acquire in depth knowledge about classification and principles of (i) gyroscopes and (ii) potentiometers.
- To acquire in depth knowledge about principles of (i) Tachometers and (ii) synchros.
- To understand the principle of stepper motors and servomotors
- Classification stepper and servomotors.
- To know about construction and working principles of Magnetic Amplifiers and Servo Amplifiers.
- Familiarize with current trends and emerging technologies in control system components, such as smart sensors, MEMS devices, and wireless communication protocols.

SYLLABUS

Gyroscopes and Potentiometers: Working of gyroscopes, types of gyroscopes and their generalized mathematical model, applications of horizontal and vertical gyroscopes. Types of potentiometers, applications of potentiometers and selection of potentiometers.

Tachometers and Synchros: Construction details, e.m.f equation of tachometers, types of tachometers, characteristics of tachometers, tachometer applications. Constructional details and working of Synchros, Principles of Resolvers and Decoders.

Stepper Motors and Servomotors: Working principle of Stepper motor, types – permanent magnet stepper motor, reluctance type stepper motor, hybrid stepper motor, Applications of stepper motor. Servomotors types, DC servomotors, AC servomotors – transfer functions, speed control methods(armature controlled &field controlled).

Magnetic Amplifiers and Servo Amplifiers: construction, types of magnetic amplifiers –series, parallel and self-saturated magnetic amplifiers, Characteristics of magnetic amplifiers, features of servo amplifiers, DC and AC servo amplifiers.

MEMS and Accelerometers: Introduction to MEMS, definitions, classification and applications. Introduction to the Accelerometer and types of accelerometers.

Text Book:

1.Gibson T.E.andTetuerF.B,"Control System Components",McGraw Hill,NewYork1993.

Reference Books:

1. Greenwood,"Mechanical details of product design",Mc GrawHill,NewYork,1990.
2. NadimMaluf and Kirt Williams "An Introduction to Micro electro mechanical Systems Engineering" Second edition

EECS 2.5(a): ENGLISH FOR RESEARCH PAPER WRITING

Course objectives

To enable the student to:

- Improving academic writing skills.
- Building knowledge of research writing conventions.
- Developing vocabulary for academic writing.
- Enhancing critical thinking and analysis
- Providing feedback and peer review.

Course Outcomes

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

- Enhancing one's ability to write academically.
- Acquiring an understanding of the conventions of research writing.
- Expanding one's vocabulary in preparation for academic writing.
- Improving one's capacity for analytical and critical thinking
- Giving feedback and participating in peer reviews.

SYLLABUS

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

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

Review of the Literature, Methods, Results, Discussion, Conclusions,The Final Check.

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.

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

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

Reference Books:

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

EECS 2.5(b):DISASTER MANAGEMENT

Course objectives

To enable the student to:

- Understanding disasters and their impacts.
- Developing emergency response skills.
- Building knowledge of disaster risk reduction.
- Enhancing community preparedness.
- Promoting disaster recovery and rehabilitation.

Course Outcomes

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

- Having an understanding of natural disasters and the effects they have.
- Improving emergency response abilities.
- Expanding one's understanding of how to mitigate the effects of disasters.
- Improving the level of readiness among the community.
- Facilitating post-disaster recovery and reconstruction efforts.
-

SYLLABUS

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

Repercussions Of Disasters And Hazards: 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.

Disaster Prone Areas in India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference Books To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management 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.

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival

Disaster Mitigation Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Reference Books:

1. R.Nishith, Singh AK, "Disaster Management inIndia :Perspectives ,issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al.(Eds.),"Disaster Mitigation Experiences and Reflections", Prentice Hall Of India,NewDelhi.

3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt.Ltd., NewDelhi.

EECS 2.5(c):SANSKRIT FOR TECHNICAL KNOWLEDGE

Course objectives

To enable the student to:

- Building proficiency in reading technical texts.
- Developing a technical vocabulary in Sanskrit.
- Understanding Sanskrit grammar and syntax.
- Enhancing translation skills.
- Applying Sanskrit knowledge to contemporary technical fields.

Course Outcomes

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

- Improving one's reading skills with regard to specialized books.
- Expanding one's Sanskrit vocabulary with specialized terms.
- Knowing Sanskrit grammar and syntax.
- Improving translation skills.
- Using one's knowledge of Sanskrit in contemporary scientific and technological sectors.

SYLLABUS

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Order - Introduction of roots - Technical information about Sanskrit Literature

Technical concepts of Engineering-Electrical,Mechanical,Architecture,Mathematics

Reference Books:

1. Abhyaspustakam"–Dr.Vishwas,Samskrita-BhartiPublication,NewDelhi
2. TeachYourself Sanskrit"Prathama Deeksha -Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, NewDelhiPublication.
3. India's Glorious Scientific Tradition"Suresh Soni, Ocean books(P)Ltd.,NewDelhi.

EECS 2.5(d):VALUE EDUCATION

Course objectives

To enable the student to:

- Developing ethical and moral values.
- Fostering a positive attitude and mindset.
- Encouraging social responsibility and civic engagement.
- Enhancing intercultural and interpersonal understanding.
- Encouraging environmental awareness and sustainability

Course Outcomes

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

- The formation of ethical and moral principles.
- Cultivating a constructive frame of mind and optimistic attitude.
- Motivating individuals to take on more civic and social responsibilities.
- Improving both the understanding between individuals and between cultures.
- Promoting environmental consciousness as well as sustainable practises

SYLLABUS

Values and self-development - Social values and individual attitudes - Work ethics, Indian vision of humanism- Moral and non-moral valuation-Standards and principles- Value judgements

Importance of cultivation of values-Sense of duty-Devotion, Self-reliance-Confidence, Concentration. Truthfulness, Cleanliness - Honesty, Humanity - Power of faith, National Unity – Patriotism-Love for nature, Discipline

Personality and Behaviour Development-Soul and Scientific attitude-Positive Thinking-Integrity and discipline - Punctuality, Love and Kindness - Avoid fault Thinking - Free from anger, Dignity of labour - Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of self-destructive habits - Association and Cooperation – Doing best for saving nature

Character and Competence –Holy books vs Blind faith - Self-management and Good health - Science of reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message-Mind your Mind, Self-control-Honesty, Studying effectively

Reference Books:

1. Chakroborty,S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

EECS 2.5(e):CONSTITUTION OF INDIA

Course objectives

To enable the student to:

- Acquiring an understanding of the structure and operation of the Indian Constitution.
- Knowing one's rights and obligations as a citizen of India.
- Familiarity with Indian politics.
- An understanding of Indian law is fundamental.
- Hone one's analytical skills by learning to dissect intricate problems in law and government.

Course Outcomes

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

- Learning how the Indian Constitution is put together and how it works.
- Being aware of one's basic freedoms and responsibilities as an Indian citizen.
- Familiarity with Indian politics.
- Familiarity with Indian law as an essential aspect.
- Learning to think critically and analyze complex political and legal concerns.

SYLLABUS

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble- Salient Features

Contours of Constitutional Rights & 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.

Organs of Governance: Parliament - Composition - Qualifications and Disqualifications – Powers and Functions – Executive - President- Governor - Council of Ministers - Judiciary, AppointmentandTransferofJudges,Qualifications-PowersandFunctions

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

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

Reference Books:

1. The Constitution of India,1950(BareAct),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.,LexisNexis,2014.
4. D.D.Basu,Introduction to the Constitution of India,LexisNexis,2015.

EECS 2.5(f): PEDAGOGY STUDIES

Course objectives

To enable the student to:

- Increase the critical awareness of pedagogy's principles, theories, and practices and their implications for teaching and learning in many educational contexts.
- Examine how pedagogy affects social, cultural, and political settings that determine schooling.
- Evaluate various pedagogical methods and initiatives for student learning and engagement.
- Evaluate one's teaching and learning practises and find opportunities for improvement.
- Use pedagogical knowledge to create, administer, and evaluate engaging, relevant learning experiences.

Course Outcomes

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

- Develop a critical understanding of the principles, theories, and practices of pedagogy and their implications for teaching and learning in various educational contexts.
- Explore the relationship between pedagogy and the broader social, cultural, and political contexts that shape educational systems and practices.
- Analyze different pedagogical approaches, techniques, and strategies, and evaluate their effectiveness in promoting student learning and engagement.
- Reflect on one's own pedagogical practices and beliefs, and identify areas for growth and improvement in teaching and learning.
- Synthesize and apply pedagogical knowledge to design, implement, and assess learning experiences that are engaging, relevant.

SYLLABUS

Introduction and Methodology: Aims and rationale, Policy background, Conceptual frame work and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and follow-up support, Peersupport, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Research gaps and future directions: Research design, Contexts Pedagogy, Teacher education ,Curriculum and assessment, Dissemination and research impact.

Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies,36(3):361-379.
3. AkyeampongK(2003)Teacher training in Ghana-does it count? Multi-site teacher education research project(MUSTER) country report1. ondon:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning ofbasic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development,33(3):272–282.
5. Alexander RJ(2001)Culture and pedagogy: International comparisons in primary education.Oxford and Boston:Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' ampaign.
7. www.pratham.org/images/resource%20working%20paper%202.p

EECS 2.5(g):STRESS MANAGEMENT BY YOGA

Course objectives

To enable the student to:

- Learn how yoga can alleviate stress and its affects on the body and mind.
- Learn yoga postures, breathing techniques, and relaxation exercises to calm the mind, ease tension, and improve health.
- Regular yoga and stress management promote physical, mental, and emotional wellbeing.
- Practice self-care and mindfulness outside of yoga to manage stress.
- Develop tools to relax and balance under stress and uncertainty by increasing awareness of the mind-body link.

Course Outcomes

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

- Understand the causes and effects of stress on the body and mind, and explore how yoga can be used as a tool to manage and reduce stress levels.
- Learn various yoga postures, breathing techniques, and relaxation exercises that can be used to calm the mind, relieve tension in the body, and promote overall wellbeing.
- Develop a regular yoga practice and integrate stress management techniques into daily routines, leading to improved physical, mental, and emotional health.
- Recognize the importance of self-care and mindfulness practices in managing stress, and apply these techniques to other areas of life beyond the yoga mat.
- Cultivate a deeper awareness of the mind-body connection and develop tools to create a sense of calm and balance during times of stress and uncertainty.

SYLLABUS

Yoga: Royal Road to Higher Consciousness: Consciousness or Chaitanya in Mandukya Upanishad, Bhagavad Gita, Yoga Sutras, Astavakra Gita; methods of aces sing higher states of consciousness Over coming body consciousness, overcoming mind consciousness; higher consciousness and person trans formation; higher consciousness and parapsychic powers(siddhis).

Vedanta: A Philosophy of Pure Consciousness – Consciousness according to Advaita, Dvaita and Visistadvaita schools, Consciousness according to Nyaya, Vaisesika and Sankya Schools. Self -awareness–RamanaMaharshi; Buddhism: A Psychology of Consciousness:-viññāa,5aggregates,12nidhanasm, cetasikas,nirvana.
The Mind-Body Relationship, the concept of Psychological Health in India,Scope of Health Psychology Emergence of Behavioural Medicine.

Stress–Stressors: Environmental,SocialandPsychological,stressandillness,control and stress.

Reference Books:

1. S. Menon, B.V.Sreekantan, Anindya Sinha, PhilipClayton, R Narasimha (2004). Science and Beyond: Cosmology, consciousness and technology in Indictraditions. National Institute of Advanced Studies,Bangalore
2. Nakamura(1989).Indian Buddhism,MotilālBanārsidass,Delhi.
3. Goleman,D &Gurin,J.(1993).Mind –Body Medicine,NewYork.

EECS 2.5(h): PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course objectives

To enable the student to:

- Enhancing self-awareness.
- Improving communication skills.
- Building confidence and self-esteem.
- Cultivating emotional intelligence.
- Fostering personal growth and resilience.

Course Outcomes

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

- Improving one's level of self-awareness
- Developing one's capacity for effective communication
- Increasing one's self-confidence and sense of worth.
- Developing one's emotional quotient through practise.
- Encouragement of personal development and resiliency.

SYLLABUS

Neetisatakam- Holistic development of personality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride&heroism)
- Verses-26,28,63,65(virtue)
- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

Approach today to day work and duties.

- ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
- Chapter18-Verses45,46,48.

Statements of basic knowledge.

- ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. ShrimadBhagwadGeeta:

- Chapter2-Verses17,Chapter3-Verses36,37,42,
- Chapter4-Verses18,38,39
- Chapter18–Verses37,38,63

Reference Books:

1. "Srimad Bhagavad Gita"by Swami Swarupananda Advaita Ashram
2. Bhartrihari'sThree Satakam(Niti-sringar-vairagya)byP.Gopinath
3. Rashtriya Sanskrit Sansthanam,NewDelhi.

EECS 2.6: ADVANCED CONTROL LAB -I

Course objectives

To enable the student to:

- To know about LAG, LEAD, LAG-LEAD compensator.
- To understand different components in simscape.
- To know the control of simple pendulum by simulation.
- To know the operation of Potentiometer.

Course Outcomes

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

- Understand simulation of series and parallel RLC circuits.
- Explain the various compensators.
- Summarize the importance of first and second order systems.
- Understanding various electrical components present in simscape.

LIST OF EXPERIMENTS

1. Simulation of Lag Compensator.
2. Simulation of Lead Compensator.
3. Simulation of Time Response Of 1^{st} & 2^{nd} Order System.
4. Simulation of Potentiometer.
5. AVR Model of Thermal Power Plant.
6. Closed Loop Feedback Control Simulation For Simple Pendulam.
7. Analysis of Different Components in Simscape.
8. Simulation of Series and Parallel RLC Circuits.
9. Simulation of Lag-Lead Compensator.

EECS 2.7: ADVANCED CONTROL LAB -II

Course objectives

To enable the student to:

- To know Characteristics of magnetic amplifiers.
- To understand Framework and methods for the analysis closed loop system with two control variables.
- To know the concepts of state space model.
- To know the effects of feedback systems.

Course Outcomes

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

- Understanding of transfer function analysis of various motors.
- Understanding of state space model analysis.
- Summarize the difference between linear and non linear systems.
- To understand synchro pair.

LIST OF EXPERIMENTS

1. Dc motor speed control by simulation.
2. Simulation of synchro pair
3. Transfer function of dc generator.
4. Effect of feedback on dc servo motor
5. State space model for classical transfer function using matlab.
6. Characteristics of magnetic amplifiers.
7. Analysis of non linear system.
8. Analysis of closed loop control system with two fee-back signals.
9. Simulation of position control of stepper motor.

EECS 2.8: SEMINAR

Course objectives

To enable the student to:

- To analyze a physical system (power system/ power electronic system/ mechanical/ biological ..etc.,) from control systems point of view. Here, the student is expected to Identify a physical system, formulate its mathematical model, develop a block-diagram or signal flow graph, obtain the physical system specifications in time/ frequency domain, Identify the deficiencies and to compensate these deficiencies design a controller, Then analyze the stability and robustness (GM,PM) of the physical system.
- A student is motivated to read, and analyze research papers in a Control Systems discipline.
- Improve Presentation Skills
- To improve analytical thinking towards benchmark topics related to control system theory/ control system applications.

Course Outcomes

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

- Identify a physical system and model a physical system.
- Obtain step response and frequency response specifications of physical model.
- Identify the specifications to be improved like decrease of overshoot, setting time, improve the damping, increase the band width, increase GM or PM, etc..
- Design a lag or lead, PID/ state-feedback/ optimal compensator.
- Analyze the stability and robustness.

EECS 3.1(a): MODELLING AND CONTROL OF DISTRIBUTED PARAMETER SYSTEMS
(Elective-V)

Course objectives

To enable the student to:

- To understand Partial Differential Equations and numeric solutions of Partial Differential Equations
- To understand Lyapunov stability of Distributed Parameter Systems
- To understand the principles of finite element discretization and boundary element discretization of Distributed Parameter Systems

Course Outcomes

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

- To know the principles of distributed parameter systems able to explain with an example.
- Understand the parabolic and hyperbolic Partial Differential Equations.
- Understand Lyapunov stability of Distributed Parameter Systems,
- To design an Observer for a Distributed Parameter Systems.

SYLLABUS

Overview: Motivation and examples (wave propagation, fluid flow, network traffic, electro magnetism)

Modeling of Distributed Parameter Systems: Parabolic and Hyperbolic PDEs, Analytic and Numerical Solution of PDEs

Lyapunov stability of DPS, Boundary control and Observer Design of DPS

Finite Difference discretization of DPS, Finite Element discretization of DPS, Boundary Elements discretization of DPS

Reduction of discretized models

Applications: Control of systems with time-delays, control of fluid flow, network control

Reference Books:

1. MiroslavKrstic and AndreySmyshlyaev, “Boundary Control of PDEs:A Course on Back stepping Designs”,SIAM, 2008
2. Panagiotis D.Christofides,Birkhauser”Nonlinear and Robust Control of PDE Systems”, 2001
3. Hassan K.Khalil”Non linear Systems”,Third Edition,Prentice Hall 2002

EECS 3.1(b): COMPUTATIONAL METHODS
(Elective-V)

Course objectives

To enable the student to:

- To know about various computational methods of system of linear equations.

Course Outcomes

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

- Understands QR decomposition method and singular value decomposition principles.
- Understands non-linear regression , multi linear regression, general linear regression.
- Understands vector space, basic vectors, orthogonal/unitary transform.
- Understands about theory Graphs and Matrices.

SYLLABUS

Formulation and solution of linear system of equations, Gauss elimination, LU, QR decomposition, Iteration methods (Gauss-Seidal), convergence of iteration methods, Singular value decomposition and the sensitivity of rank to small perturbation
Newton‘s divided difference, interpolation polynomials, Lagrange interpolation polynomials

Non-linear regression, multiple linear regression, general linear least squares

Vectorspaces,Basisvectors,Orthogonal/Unitarytransform,Fouriertransform,Laplacetransform

Local and global minima, Line searches, Steepest descent method, Conjugate gradient method, Quasi Newton method, Penalty function

Graphs and Matrices, simple graph, cyclicgraph, complete graph, properties of the Laplacian matrix and relation with graph connectivity, Non-negative matrices. Applications of graph theory to engineering problems Suggested reading

Reference Books:

1. Steven C.Chapra and Raymond P.Canale “Numerical Methods for Engineers”, Mc GrawHill
2. Hines and Montrogmery, John “Probability and Statistics in Engineering and Management Studies”,
3. R.B.Bapat “Graphs and Matrices”,,TRIM Series,Hindustan BookAgency,2011

EECS 3.1(c):INDUSTRIAL LOAD MODELLING AND CONTROL
(Elective-V)

Course objectives

To enable the student to:

- To understand Industrial Load Management

Course Outcomes

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

- Understands the Demand Side Management of Electrical Energy.
- Understand the classification of Electricity pricing.
- Understands the Reactive power management in industries.
- Understands Industrial load profiling.
- Understands Selection of Schemes Optimal Operating Strategies, Peak load saving, Constraints Problem formulation.

SYLLABUS

Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial Loads Continuous and Batch processes-Load Modelling.

Electricity pricing –Dynamic and spot pricing –Models, Direct load control-Interruptible loadcontrol, Bottom upapproach-scheduling- Formulation of load Models,Optimization and control algorithms-Case studies.

Reactive power management in industries, controls-power quality impacts, application offiltersEnergy saving inindustries.

Cooling and heating loads, load profiling, Modelling- Cool storage, Types-Control strategies,Optimal operation, Problem formulation-Case studies.

Captive power units, Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration.

Selection of Schemes Optimal Operating Strategies, Peak load saving, Constraints Problem formulation-Case study, Integrated Load management for Industries.

Reference Books:

1. C.O.Bjork "Industrial Load Management-Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W.GellingsandS.N.Talukdar,.Load management concepts. IEEE Press, NewYork, 1986,pp. 3-28
3. Y.Manichaikul and F.C.Schweppe,"Physically based Industrial load", IEEE Trans.on PAS, April1981
4. H.G.Stoll, "Leastcost Electricity Utility Planning",Wiley Inter science Publication, USA, 1989.
5. I.J.NagarathandD.P.Kothari,.Modern Power System Engineering. ,Tata Mc Graw Hill publishers ,NewDelhi,1995

6. IEEE Bronze Book“Recommended Practice for Energy Conservation and cost effective planning in Industrialf acilities”,IEEEInc,USA

EECS 3.2(a):BUSINESS ANALYTICS
(OpenElective)

Course Objectives

To enable the student to:

- Enable all participants to recognise, understand and apply the language, theory and models of the field of business analytics
- Foster an ability to critically analyse, synthesis and solve complex unstructured business problems
- Encourage an aptitude for business improvement, innovation and entrepreneurial action
- Encourage the sharing of experiences to enhance the benefits of collaborative learning
- Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organizations and the communities they serve

Course Outcomes

Upon completion of the subject students will be able to:

- Understand and critically apply the concepts and methods of business analytics.
- Identify, model and solve decision problems in different settings.
- Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity.
- Create viable solutions to decision making problems.

SYLLABUS

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics . Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Organization Structure: Organization Structure of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality,Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using analytic Solver Platform, New-Product Development Model, News vendor Model, Over booking Model,Cash Budget Model.

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without

Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J.Schniederjans, Dara G.Schniederjans, Christopher M.Starkey,Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

EECS 3.2(b):INDUSTRIAL SAFETY
(Open Elective)

Course Objectives

To enable the student to:

- recognize and evaluate occupational safety and health hazards in the workplace.
- determine appropriate hazard controls following the hierarchy of controls.
- furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities.
- the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task oriented training.

Course Outcomes

Upon completion of the subject students will be able to:

- Evaluate workplace to determine the existence of occupational safety and health hazards.
- Identify relevant regulatory and national consensus standards along with best practices that are applicable.
- Select appropriate control methodologies based on the hierarchy of controls. Analyze injury and illness data for trends.

SYLLABUS

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and fire fighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance , Types and applications of tools used for maintenance, Maintenance cost& its relation with replacement economy, Service life of equipment.

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v.Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv.

Diesel generating (DG)sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H.P.Garg,S.Chand and Company.
3. Pump-hydraulic Compressors, Audels,Mc grew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn,Hans,Chapman&HallLondon.

EECS 3.2(c): COST MANAGEMENT OF ENGINEERING PROJECTS
(Open Elective)

Course Objectives

To enable the student to:

- Establish systems to help streamline the transactions between corporate support departments and the operating units.
- Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.
- Use pseudo profit centers to create profit maximizing behavior in what were formerly cost centers.

Course Outcomes

Upon completion of the subject students will be able to:

- Understand the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.
- Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.
- Understand the meaning and different types of project management and project execution, detailed engineering activities.
- Understand the project contracts, cost behaviour and profit planning types and contents, Bar charts and Network diagram.
- Analyse by using quantitative techniques for cost management like PERT/CPM.

SYLLABUS

Cost: Cost Elements, Pricing, Materials, Labour; Engineering, Equipment, Parts, and Tool; Economic Costs, Activity-Based Cost Management.

Cost Estimating & Planning: Estimating, Process Product Manufacturing, Discrete Product Manufacturing. Planning and Scheduling.

Progress & Cost Control: Progress Measurement and Earned Values, Earned Value for Variable Budgets, Tracking Cost and Schedule Performance, Performance and Productivity Management.

Project Management: Project Management Fundamentals, Project Organization Structure, Project Planning, Project Labour Cost Control, Leadership and Management of Project People, Quality Management, Value Analysis, Contracting for Capital Projects, Strategic Asset Management.

Economic Analysis, Statistics & Probability: Basic Engineering Economics, Applied Engineering Economics, Statistics & Probability, Basic Concepts in Descriptive Statistics, Risk Management.

Reference Books:

1.Charles J.Austin Industrial Engineering & Technology Building,(AG/IT216)

EECS 3.2(d): COMPOSITE MATERIALS
(Open Elective)

Course Objectives

To enable the student to:

- Explain the mechanical behavior of layered composites compared to isotropic materials.
- Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro levels.
- Determine stresses and strains relation in composites materials.

Course Outcomes

Upon completion of the subject students will be able to:

- Explain the behavior of constituents in the composite materials
- Enlighten the students in different types of reinforcement
- Develop the student's skills in understanding the different manufacturing methods available for composite material.
- Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

SYLLABUS

Introduction: Definition of composite 2 material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.

Performance of structural composites: Basic analytical concepts(Qualitative black box approach and Quantitative analytical approach), Performance analysis by various models (Law of Mixtures, Shear lag model, Laminated plate model, Eshelby's models and Other models, - thermo elasticity, plasticity and creep), Strengthening mechanisms, Stress distribution in fibre and the matrix (shear stress and axial tensile stress in the fibre along its length), critical length of fibre for full strengthening, Analysis of uni axial tensile stress-strain curve of unidirectional continuous and short fibre composites, Estimation of the required minimum amount of fibre and critical amount of fibre to gain a composite strength, Analysis of strength of a composite during loading at an angle to the fibres, Nano-structured composites.

Performance of Composite in Non structural Applications: Composites in Electrical, Super conducting and Magnetic Applications, Nano-composite devices.

Industrial Application of Composite Materials: Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries, Packaging industries,Household and sports components etc.

Fracture & amp; Safety of Composite: Fracture behavior of composites, Mechanics and Weakest link statistics, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite (Fracture toughness, COD and J-integral approaches, Fatigue crack growth rate), Fracture Mechanics of brittle matrix fibre composite, Fracture mechanics of metal matrix fibre composite, Experimental evaluation (composite), Elementary reliability analysis.

Reference Books:

1. Composite materials,K.K.Chawala,2nd ed.,(1987) Springer-Verlag,NewYork.
2. Nano composite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003),Wiley-VCHVerlagGmbHCo. KGaA,Weinheim.
3. Mechanics and Analysis of Composite Materials,V.V.VasilievandE.V.Morozov,(2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5lGB,UK.
4. Ceramic matrix composites,K.K.Chawala,1st ed.,(1993),Chapman & amp; Hall, London.
5. Advances in composite materials,G.Piatti,(1978)Applied Science Publishers Ltd., London.

EECS 3.2(e): WASTE TO ENERGY
(Open Elective)

Course Objectives

To enable the student to:

- To enable students to understand of the concept of Waste to Energy.
- To link legal, technical and management principles for production of energy form waste.
- To learn about the best available technologies for waste to energy.
- To analyze of case studies for understanding success and failures.
- To facilitate the students in developing skills in the decision making process.

Course Outcomes

Upon completion of the subject students will be able to:

- Apply the knowledge about the operations of Waste to Energy Plants.
- Analyse the various aspects of Waste to Energy Management Systems.
- Carry out Techno-economic feasibility for Waste to Energy Plants.
- Apply the knowledge in planning and operations of Waste to Energy plants.

SYLLABUS

Introduction to Energy from Waste:Classification of waste as fuel–Agrobased, Forestresidue, Industrial waste -MSW–Conversion devices–Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis–Types, slowfast–Manufacture of charcoal–Methods-Yields and application–Manufacture of pyrolytic oils andgases,yields and applications.

Biomass Gasification:Gasifiers–Fixed bed system–Downdraft and updraft gasifiers–Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifieroperation.

Biomass Combustion: Biomass stoves–Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation -Operation of all the above biomass combustors.

Biogas: Properties of biogas(Calorific value and composition)-Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification-Biomass conversion processes-Thermo chemical conversion-Direct combustion – biomass gasification-pyrolysis and liquefaction-bio chemical conversion-anaerobic digestion-Types of biogas Plants–Applications-Alcohol production from biomass-Bio diesel production Urban waste to energy conversion-Biomass energy programme in India.

Text Books:

1. Non-Conventional Energy, Desai,AshokV.,Wiley Eastern Ltd.,1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I&II, TataMcGrawHill PublishingCo.Ltd.,1983.
3. Food,Feed and Fuel from Biomass,Challal,D.S., IBHPublishingCo.Pvt.Ltd.,1991.
4. Biomass Conversion and Technology,C.Y.WereKo-BrobbyandE. B.Hagan, John Wiley &Sons, 1996.

EECS 3.3: MAJOR PROJECT (PHASE-I DISSERTATION)

EECS 4.1: MAJOR PROJECT (PHASE–II DISSERTATION)