UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: ELECTRIC DRIVE
Course Code: EE701
L-T Scheme: 4-1 **Course Credits: 4**

Introduction:

This course examines the application of the Power electronics devices into different machines. This course covers the topic:

- Different electric drives
- Dc motor drive
- Induction Motor drive
- Synchronous motor drive
- Industrial application of different drives.

Objectives:

In this subject we will study the different components of electrical system where we can use the power electronics devices for different electrical machines and learn how we can apply those drives and industries.

Learning Outcomes:

Knowledge:

1. Understand the different components and theory of electric drives.
2. Understand the power ratings of Motor.
3. Different starting methods of electric drives.
4. Understand the Different Braking methods of Electrical Drives.
5. Different Dc Motor Drives Principles.
6. Understand The Different Induction Motor Drives and their principle
7. Understand The Different Synchronous Motor Drives and their principle
8. Know about the application of the different drives in the industries.

Course Contents:

Unit 1

Electric Drive:

Concept, classification, parts and advantages of electrical drives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi quadrant operation of drives. Load equalization.

Unit 2

Motor power rating:

Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors

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Course Description

Unit 3

Stating of Electric Drives:

Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting.

Unit 4

Braking of Electric Drives:

Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking

Unit 5

DC motor drives:

Modeling of DC motors**,** State space modeling, block diagram &Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current chopper controlled DC motor drives.

Unit 6

Induction motor drives:

Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme, pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/hertz control, vector or filed oriented control

Unit 7

Synchronous motor drives:

Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.

Unit 8

Industrial application:

Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor Drive. Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives

Text Books

1. Fundamental of Electrical Drives, G.K.Dubey, New Age International Publication

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References

1. Electric Drives, Vedam Subrah manyam, TMH
2. A first course on Electrical Drives,S.K.Pillai, New Age International Publication
3. Modern Power Electronics & Acdrives, B.K.Bose, PearsonEducation

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Utilization of Electric Power
Course Code: EE702
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:

This course examines the basic know how of electric traction, illumination engineering, heating and welding utilizing electric power. This course greatly emphasis on the application and impact of electrical power on these fields. The Topics to be covered (tentatively) include:

- Electrification of traction system and various parameters affecting it
- Different control methods and protective measures taken in traction system
- Basic know how of illumination engineering
- Illumination designing of different environment
- Various types of electrical heating available and their working principle
- Various types of electrical welding available and their working principle
- Practical applications and advantages of electrical heating and welding

Objectives:

In this course we will study the basic components of utilization of electric power in the field of Traction, Illumination, Heating and Welding. The functions, mechanisms, policies and techniques used in these fields (Traction, Illumination, Heating and Welding) to meet the various practical requirements, are also given great importance keeping in mind the advantages and limitations while electric power is used.

Learning Outcomes:

Knowledge:

1. Understand how traction system works giving greater importance on electric power utilization
2. Factors affecting energy consumption of any traction system
3. Different protective devices and measures implemented while realizing an electric traction system.
4. Know how the uses of power electronic controllers are increasing to achieve speed control, braking in electric traction system.
5. Become comfortable with basics of illumination and understand its various aspects like Laws of illumination, Polar cuvees, Photometry, Integrating sphere, Types of Lamps e.t.c.
6. Different lighting scheme & their design methods, Flood and Street lighting.
7. Understand why greater importance is given on electric heating and welding than conventional methods nowadays.
8. Various types of electrical welding available and analysis on their working procedure.
9. Various types of electrical heating available and analysis on their working procedure.

Application:

1. To develop, implement, and understand the use of various electrical drives in traction system
2. To develop, implement, and design various Illumination schemes for domestic, municipal as well as industrial purposes
3. To develop a clear understanding of different electrical heating procedure and their applications
4. To develop a clear understanding of different electrical welding procedure and their applications

Course Contents:

Unit 1: Electric Traction:

Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for

resistance, power & energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion).

Unit 2: Electric traction motor & their control:
Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of supply voltage, Temporary interruption of supply, Tractive effort. Use of AC series motor and Induction motor for traction. Traction motor control: DC series motor control, multiple unit control, Braking of electric motors, current collection in traction system, Power electronic controllers in traction system

Unit 3: Illumination:
The nature of radiation, Polar curve, Law of illumination, Photometry (Photovoltaic cell, Photometry, integrating sphere, brightness measurement), Types of Lamps: Conventional and energy efficient, Basic principle of light control, Different lighting schemes & their design methods, Flood and Street lighting.

Unit 4: Heating:
Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating.

Unit 5: Welding:
Resistance welding, Arc welding, Ultrasonic welding, Electron bean welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes.

Text Books
1. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.

References
1. Partab H: Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons.

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Course Description

Title of Course: Power System-III
Course Code: EE 703A
L-T Scheme: 3-1 **Course Credits: 3**

Introduction:

This course broadly investigates the underlying aspect of power system operation and control. It also envisages the broader parameters like voltage stability, frequency control and also reactive power balance. Besides taking into account of travelling waves and lightning.

Objectives:
The basic objective of this course is to make the students aware of the operational dimensions of a power plant.

Learning Outcomes:
The students are able to assimilate the various aspects of power generation, transmission and distribution from the topics covered in this course.

Knowledge:

- Understanding of power plant economic load scheduling
- Hydro thermal load scheduling
- Voltage stability and reactive power control
- Frequency control and stability
- The various aspects of load shedding

Course Contents:

Unit 1: Power Systems in Restructured Environment; Distributed and Dispersed Generation; Environment Aspects of Electric Power Generation.

Unit 2: Generation Cost Curves; Economic Operation of Thermal System; Plant Scheduling, Transmission Loss and Penalty Factor, Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment.

Unit 3: Concept of AVR and ALFC Loops, Significance of Double Loop in ALFC; Exciter and VAR Control; Single Area Load Frequency Control; Two Area Load Frequency Control; Frequency Response.

Unit 4: Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors; Introduction to SVC and STATCOM.

Unit 5: Types of System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Protection against Lightning and Surges.

Text Books

1.Power System Analysis, Granger and Stevenson, McGraw Hill.

References

1. Power system stability and Control, P. Kundur ,McGraw Hill
2. Modern power system analysis, Kothari &Nagrath, Mc.Graw Hill

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Course Description

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Course Description

Title of Course: Control System-III
Course Code: EE703B
L-T Scheme: 3-0 Course Credits: 3

Introduction:

This course examines control system analysis and design concepts in classical and modern state space methods. The Topics to be covered (tentatively) include:

- Fundamentals of control system
- Fundamentals of Feedback Linearization
- Fundamentals of Sliding Mode Control
- Fundamentals of Optimal control system

Objectives:

The Course Educational Objectives are:

1. In recent years, control systems have assumed an increasingly important role in the development and advancement of modern civilization and technology. Practically every aspect of our day-to-day activities is affected by some type of control systems.
2. Control systems are found in abundance in all sectors of industry, such as equality control of manufactured products, automatic assembly line, machine-tool control, space technology and weapon systems, computer control, transportation systems, power systems, robotics, Micro-Electro-Mechanical systems (MEMS), nano-technology and many others.
3. In this subject it is aimed to introduce to the students the principles and application of control systems in everyday life. The basic concepts of block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems infrequency domain and time domain.
4. Simulation exercises are included in Matlab tool and Simulink tool throughout for practice.

Learning Outcomes:

Knowledge:

Once the student has successfully completed this course, he/she will be able to answer the following questions or perform following activities:

1. Able to understand the basic concepts of Feedback Linearization.
2. Able to describe different Sliding Mode Control
3. Able to analyze the classical control design technique.

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Course Description

Applications:

1. To develop, implement, and analyze Feedback Linearization.
2. To develop and implement Sliding Mode Control.
3. To understandOptimal control system

Course Contents:

Unit 1:

Feedback Linearization:

Motivation, Input–Output Linearization, Full-State Linearization, State Feedback Control and Stabilization.

Unit 2:

Sliding Mode Control:

Overview of SMC, Motivating Examples, Stabilization of second order system; Advantages and disadvantages.

Unit 3:

Optimal control system:

Formulation of optimal control problem: Minimum time, minimum energy, minimum fuel problem, state regulator, output regulator & tracking problems.

Calculus of variations: Constrained fixed point and variable point problems, Euler Lagrange equations.

Problems with equality and inequality constraints. Engineering application, Lagrange, Mayer &Bolza problems, Pontryagin's maximum (minimum) principle.

Multiple decision process in discrete and continuous time - The dynamic programming.

Numerical solution of two point boundary value problems - the steepest descent method and the Fletcher - Powell Method.

Text Books:

1. Applied Nonlinear control, J.J.E. Slotine& W. Li, Prentice Hall
2. Modern Control theory, M. Gopal, 2nd Edition, New age international publishers.
3. Introduction to control system, D.K. Anand& R.B. Zmood, Asian book Pvt. Ltd.

Reference Books:

1. Adaptive control system, K.J. Astrom and B. Wittenamark, Addision Wesley Publishing Co
2. Nonlinear control systems, Springer Verlag..

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Electric Machine-III
Course Code: EE703C
L-T Scheme: 3-1 **Course Credits: 3**

Introduction:

This course outlays the understanding of electric machines analytically from the concepts of tensors. It is in fact the generalized theory of machines.

Objectives:

The course is aimed at conceptualizing electric machines with respect to the generalized theory.

Learning Outcomes:

The students are able to understand the generalized theory of electric machines. Analyse the transient behavior and the impact of harmonics on AC machines.

Knowledge:

- Understanding of primitive machines
- Park transformation
- AC & DC Machine dynamics
- Space vectors
- Transient analysis
- Effect of harmonics on AC machines

Course Contents:

Unit 1: The Primitive machine, Voltage equations of the Primitive machine, Invariance of power, Transformation from a displaced brush axis, Transformation from three phases to two phases, Transformation from rotating axes to stationary axes, Physical concepts of Park's transformations, Transformed impedance matrix, Electrical torque, Restriction of the generalized theory of electrical machines.

Unit 2: Separately excited D.C. generators: steady state analysis, and transient analysis. Separatelyexcited D.C. motor: steady state analysis, transient analysis, Transfer function & Block diagram.

Unit 3: Electrical transients in Synchronous machine, Expression for reactance and time constants. Dynamics of synchronous machine, Electro-mechanical equation- motor operation-generator operation - small oscillations, general equation for small oscillations- representation of oscillations in state variable form. Dynamics of Induction machine, Induction machine dynamics during starting and braking, acceleration time, Induction machine dynamics during normal operation, Equation of dynamical response of Induction motor.

Unit 4: Space Vectors and its application to the analysis of electrical machines specially induction
motors: Principle, DQ flux-linkages model, Space Phasor model derivation, Analytical solution of machine dynamics, Signal flow graph of the space modelled Induction motor, Control principle of Induction motor.

Unit 5: Harmonic effects on Induction motor, harmonic equivalent circuit and harmonic torque.

1.Generalized theory of Electrical machines, P.S.Bimbhra, Khanna publishers.

References

1. Power system stability, Vol-III, E.W.Kimbar, John Wiley & Sons.
2. Electrical Machinery, A.E. Fitzgereld, C. Kingslay and S.D. Uman, Mc Graw Hill.

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: High Voltage Engineering
Course Code: EE704A
L-T Scheme: 3-0 **Course Credits: 3**

Introduction:

This course gives high voltage generation concepts, ideas of high voltage measurement methods, basics of transient surges and protection methods. The Topics to be covered (tentatively) include:

- Breakdown phenomena
- Generation of High Voltage
- Generation of Impulse Voltage
- Measurement of High Voltage
- Transient in power systems
- Insulation Co ordination
- High Voltage Testing

Objectives:

The objective of the course is to introduce the breakdown phenomenon of different insulating materials, to understand the principles of theory of high voltage generation and measurements, to learn different high voltage measuring techniques, to understand lightning phenomena and HV Insulation.

Learning Outcomes:

Knowledge:

1. Learn how break down occurs in HV insulations.
2. Gain basic concept of dielectric strength of insulating materials.
3. Concepts of different HV generation circuits
4. Selecting the Method of HV generation.
5. learn different high voltage measuring techniques
6. Selection tof methods for HV measurement
7. Concepts of lightning phenomenon
8. Ideas of insulation co ordination
9. High Voltage testing methods

Application:

1. High voltage is a key component in electrostatic applications.
2. Testing of different protection devices in power system.
3. High voltage is used, in cathode ray tube, to generate X-rays and particle beams.
4. Application of surge arresters includes switching surge mitigation, and temporary overvoltage control

Course Contents:

Unit 1: Breakdown phenomena: Breakdown of Gases:Mechanism of Break down of gases, Charge multiplication, Secondary emission, Townsend Theory, Streamer Theory, Paschen's Law, Determination of Minimum breakdown voltage, Partial Discharge: definition and development in solid dielectric, Break Down of Solids: Intrinsic breakdown, Electromechanical break down, Thermal breakdown, Streamer Breakdown Breakdown of Liquid: Intrinsic Break down, Cavitation Theory, Suspended particle Theory, Breakdown in Vacuum: Non metallic electron emission mechanism, Clump mechanism, Effect of pressure on breakdown voltage

Unit 2: Generation of High Voltage : Generation of high AC voltages: Testing transformer, Cascaded transformer, Series resonant circuit, single stage and multi stage, Advantages of Series Resonant Circuit in testing of cables, Generation of DC high voltage: Cockcroft Walton double, Multistage HVDC generation circuit, Electrostatic generator, Definition of Impulse Voltage as per Indian

Standard Specification, Wave front and wave tail time, Generation of Impulse Voltage, Multistage Impulse generator, triggering of Impulse Generator.

Unit 3: Measurement of High Voltage: Sphere gap voltmeter, AC , DC and impulse high voltage measurement as per Indian Standard Specifications, Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high AC voltage in conjunction with capacitance dividers, Capacitance Voltage Transformer.

Unit 4: Lightning Phenomena, Electrification of cloud, Development of Lightning Stroke, Protection of Electrical Apparatus against over voltage, Lightning Arrestors, Valve Type, Metal Oxide arresters, Insulation Co ordination, Basic Insulation level. Basic Impulse level, Switching Impulse level, Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment, High Voltage testing, Testing as per Indian Standard Specifications, Power frequency withstand, induced over voltage and impulse test on transformers

Text Books

1. C. L. Wadhwa ,High Voltage Engineering , New Age International Publishers

References

1. John Kuffel, Peter Kuffel , High Voltage Engineering Fundamentals ,Kindle Edition

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Course Description

Title of Course: POWER PLANT ENGINEERING
Course Code: EE704B
L-T Scheme: 3-1 **Course Credits: 3**

Introduction:

This course examine the working of different types of power generation systems namely thermal, hydro, nuclear, diesel and gas plants. The Topics to be covered (tentatively) include:

- How to select a power plant and its economics
- Different aspects of steam, diesel, gas turbine and nuclear power plant
- Get a brief about the working principle of the different power plants.

Objectives:

1. To realize the necessity for interconnected operation of different power stations.
2. A brief overview of different parts of the different power plants
3. Interconnection of the electrical systems in this power plants.

Learning Outcomes:

Knowledge:

1. To gain the knowledge about the Significance of various components of the power generation plants.
2. To understand the different steps for choosing a power plant
3. Understand the different parts of steam power plant
4. Get the brief idea about the diesel and gas turbine power plant
5. To gain knowledge about the different areas of nuclear power plant.
6. Electrical system required in the power plant operations.

Course Contents:

Unit 1

Introduction:

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant.

Unit 2

Power plant economics and selection:

Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other consideration plant selection.

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Course Description

Unit 3

Steam power plant:

General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency Site selection of a steam power plant

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Unit 4

Diesel power plant:

General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, super charging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Unit 5

Gas turbine power plant:

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, co generation, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant.

Unit 6

Nuclear power plant:

Principles of nuclear energy, Layout of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.
Hydroelectric station Hydrology, Principles of working, applications, site selection, classification and arrangements, Hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, inter connected systems. Non Conventional Power Plants Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Unit 7

Electrical system:

Generators and their cooling, transformers and their cooling. Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms. Pollution due to power generation

Text Books

1. Power Plant Engineering, P.K.Nag, Tata McGraw Hill.

References:

Course Description

1. PowerPlantEngineering,F.T.Morse,AffiliatedEast-WestPressPvt.Ltd,New Delhi/Madras
2. Power Plant Technology El-Vakil, McGrawHill

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: POWER GENERATION ECONOMICS
Course Code: EE704C
L-T Scheme: 3-1 **Course Credits: 3**

Introduction:

This course mainly focus on the how to generate power more economically. This Topic mainly covers-

- Economic generations of power
- Different Tariffs
- Economic dispatch of load
- How we use Load forecasting in power system
- Different unit commitments in power generation.

Objectives:

In this course we will study the Different aspects of power generation more economically. Different tariffs in power generation.

Learning Outcomes:

Knowledge:

1. Understand the different ways to generate power more economically in power plants
2. Study the different tariffs.
3. Know about the different unit commitment in power generations
4. Know about the economic dispatch of the power generation
5. Understand the state estimation and load forecasting of power generation.

Course Contents:

Unit 1

Economics of Generation:

Cost of power generation-Thermal, Hydro and Nuclear. Types of Consumers in a distribution system-Domestic, Commercial, Industrial etc. Concept of load factor, plant capacity factor, plant use factor, diversity factor, demand factor. Choice of size and number of generation units.

Unit 2

Tariff:

Block rate, flat rate, two part, maximum demand, power factor and three part tariffs. Subsidization and cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies, Availability based tariff (ABT)

Unit 3

Unit Commitment:

Constraints in Unit Commitment, Spinning reserve, Thermal unit constraints, Hydro constraints, Must run, Fuel constraints. Unit commitment solution methods,

Unit 4

Economic Dispatch:

Transmission loss formulae and its application in economic load scheduling. Computational methods in economic load scheduling. Active and reactive power optimization

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Course Description

Unit 5

State Estimation and load forecasting in power system:

Introduction, state estimation methods, concept of load forecasting, load forecasting technique and application in power system

Text Books

1. Modern power system analysis, D.P.Kothari & I.J.Nagtrath, Tata McGraw Hill.

References

1. Economic operation of Power System, L.K.Kirchma yar John Wiely, Newyork.
2. Power system Analysis, operation & control, Chakrabarty&Haldar,2nd edition,PHI.

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Renewable and Non-Conventional Energy
Course Code: EE704D
L-T Scheme: 3-0 **Course Credits: 3**

Introduction:

This course introduces the alternative energy sources yet to be fully employed by humans. It covers the basic principles behind the processes required to generate energy from them. It helps to understand the future prospects of these energy sources in the world especially in India. The Topics to be covered (tentatively) include:

- Introduction to Energy sources
- Solar Energy
- Wind Energy
- Energy from biomass
- Geothermal energy
- Energy from ocean,
- Magneto hydrodynamic power generation
- Hydrogen energy
- Fuel cell

Objectives:

In this course we will study about the non-conventional sources of energies. We will understand the mechanism of the different devices run by these alternative energy sources. . We will learn about the future prospects of these energy sources in India. .

Learning Outcomes:

Knowledge:

1. To introduce the alternative and renewable energy sources.
2. To familiarize with the mechanisms used to harness renewable sources of energy.
3. To enable the students to understand the advantages and prospects of these energy resources.
4. To familiarize the students with the devices and machineries to get power from these sources.

Application:

1. To understand the fundamentals of different energy sources
2. To familiarize with the condition of upcoming energy crisis.
3. To understand the future scope and challenges faced by this field.
4. To understand the technology to harness these sources.

Course Contents:

Unit 1: Introduction to Energy sources:

Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.

Unit 2: Solar Energy:

Solar radiation -beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Flat plate collectors, concentrating collectors, Solar air heaters types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photovoltaic-solar

cells, different types, Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.

Unit 3: Wind Energy:
Principle of wind energy conversion; Basic components of wind energy conversion systems; Wind mill components, various types and their constructional features, Design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic or cesacting on wind mill blades and estimation of power output; wind data and site selection considerations

Unit 4: Energy from Biomass:
Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, Constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas

Unit 5: Geothermal Energy:
Introduction, Basic definitions, Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock , magma, Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

Unit 6: Energy from Ocean:
Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India, Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy, Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

Unit 7: Magneto Hydrodynamic power generation:
Principle of MHD power generation, MHD system, Design problems and developments, Gas conductivity, materials for MHD generators and future prospects.

Unit 8: Hydrogen Energy:
Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, Utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.

Unit 9: Fuel cell:
Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells

Text Books
1. G.D. Rai, Non conventional Energy sources, Khanna Publishers

References
1. Ashok V. Desai, Non conventional Energy, New Age International Publishers Ltd.
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UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Computer Networks
Course Code: EC604C
L-T Scheme: 3-1 **Course Credits:3**

Introduction:

This course is to provide students with an overview of the concepts and fundamentals ofdata communication and computer networks. Topics to be covered include: datacommunication concepts and techniques in a layered network architecture, communicationsswitching and routing, types of communication, network congestion, network topologies,network configuration and management, network model components, layered networkmodels (OSI reference model, TCP/IP networking architecture) and their protocols, varioustypes of networks (LAN, MAN, WAN and Wireless networks) and their protocols. The courseis supplemented by a practical component covered in CS692 concurrently.

Objectives:

At the end of the course, the students will be able to:
1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Learning Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:
1. Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Identify the different types of network devices and their functions within a network
6. Understand and building the skills of subnetting and routing mechanisms.
7. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.
8. Analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

Application:

1. To configure and implement network topology.
2. To configure and implement local area network.
3. To design network and assign IP address
4. Connect Remote computers
5. Analyze the network.

Course Contents:

Unit-1:

Introduction; Data communications: components, data representation (ASCII,ISO etc.),direction of data flow(simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN);Internet: brief

history, internet today; Protocols andstandards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Physical layer:
Overview of data(analog & digital), signal(analog &digital), transmission (analog & digital)& transmission media (guided & non-guided); TDM, FDM, WDM; Circuit switching: time division & space division switch, TDM bus; Telephone network;

Unit-2:
Data link layer:
Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

Medium access sub layer:
Point to point protocol, LCP, NCP, FDDI, token bus,token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fast Ethernet;

Unit-3:
Network layer:
Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : Internet address, classful address, subnetting; Routing : techniques,static vs. dynamic routing , routing table for classful address; Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.

Transport layer:
Process to process delivery; UDP; TCP; Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve QoS.

Unit-4:
Application layer:
DNS; SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography, user authentication, security protocols in internet, Firewalls.

Modern topics:
ISDN services & ATM ; DSL technology, Cable modem, SONET. Wireless LAN: IEEE 802.11; Introduction to blue-tooth, VLAN's, Cellular telephony & Satellite network.

Text Books:
1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas

Reference Books:
1. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH

3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Artificial Intelligence
Course Code: EE705B
L-T Scheme: 3-0 **Course Credits: 3**

Objectives: In this course we will study the basic components of an intelligent system, their functions, mechanisms, policies and techniques used in their implementation and examples.

Learning Outcomes: The students will have a detailed knowledge of the concepts of artificial intelligence, various applications of AI in different fields, Aware of a variety of approaches to AI techniques

Course Contents:

Unit-1 (Introduction to AI): Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI. Introduction of Intelligent Systems: Agents and Environments, Good Behavior: the concept of Rationality, The Nature of Environments, The structure of Agents, How the components of agent programs work.

Unit-2 (Problems Solving, Search and Control Strategies)

Solving Problems by Searching, Study and analysis of various searching algorithms. Implementation of Depth-first search, Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bi-directional search Informed (Heuristic) Search Strategies: Greedy best-first search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience. Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hillclimbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic Actions: AND-OR search trees, Searching with Partial Observations. Adversarial Search and Constraint Satisfaction Problems, Study of min-max algorithm Adversarial Search: Games, Optimal Decisions in Games, The mini-max algorithm, Optimal decisions in multiplayer games, Alpha--Beta Pruning, Move ordering , Imperfect Real-Time Decisions, Evaluation functions, Cutting off search, Forward pruning, Search versus lookup, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Alpha-beta pruning and CSP, Implementation aspects of minimax algorithm and CSP.

Unit- 3 (Knowledge Representations Issues, Predicate Logic, Rules)

Knowledge representation, KR using predicate logic, KR using rules. Reasoning System - Symbolic, Statistical: Reasoning, Symbolic reasoning, Statistical reasoning.

Unit-4 (Quantifying Uncertainty, Learning Systems)

Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples.

Unit-5 (Expert Systems)

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Course Description

Introduction, Knowledge acquisition, Knowledge base, working memory, Inference engine, Expert system shells, Explanation, Application of expert systems. Fundamentals of Neural Networks: Introduction and research history, Model of artificial neuron, Characteristics of neural networks, learning methods in neural networks, Singlelayer neural network system, Applications of neural networks. Fundamentals of Genetic Algorithms: Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm.

Text Books

1. Rich, Elaine Knight, Kevin, Artificial Intelligence, Tata McGraw Hill.
2. Luger, George F, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education.

References

1. Nilsson, Nils J, Artificial Intelligence, Morgan Kaufmann.
2. Russell, Stuart J. Norvig, Peter, AI: A Modern Approach, Pearson Education.

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

Course Description

Title of Course: Digital Communication
Course Code: EE705C
L-T Scheme: 3-0 **Course Credits: 3**

Introduction:

The course provides a basic understanding of the analysis and design of digital communication systems, building on various ideas from probability theory, stochastic processes, linear algebra and Fourier analysis. The Topics to be covered include:

- Random process, stochastic process and ergodic process
- Signal vector representation and Grahm schimdt orthogonalization procedure
- Receiver design and sufficient statistics
- Controlling the spectrum and the Nyquist criterion
- Line coding, band pass communication
- Modulation techniques, Inter symbol Interference

Objectives:

Digital communication uses electrical signalling methods to transmitinformation over a physical channel separating a transmitter and receiverwith the channel properties often time varying. This course presents thetheory and practice of digital communication including signal design,modulation methods, demodulation methods, wireless channel basicsand the application of this to the design of modern OFDM systems.

Learning Outcomes:

Knowledge:

1. Understand the basicconcepts ofdigitalcommunicationsystems
2. Apply different modulation schemesto baseband signals
3. Analyze the BERcharacteristics of Baseband Modulated signals.
4. Analyze the BERcharacteristics of BandpassModulated signals.

Course Contents:

Unit 1: ProbabilityTheoryand RandomProcesses: Conditionalprobability,communicationexample,jointprobability,statisticalindependence,randomvariable-continuousanddiscrete,cumulative distribution function, probability density function – Gaussian, Rayleigh and Rician, mean, variance, random process, stationary and ergodicprocesses, correlationcoefficient,covariance,auto correlationfunction anditsproperties,randombinary wave,power spectraldensity.

Unit 2: Signal Vector Representation: Analogybetweensignalandvector, distinguishability ofsignal, orthogonalityandorthonormality,basisfunction,orthogonalsignalspace,message point,signalconstellation,geometric interpretationofsignals,likelihoodfunctions,Schwartz inequality,Gram-Schmidtorthogonalizationprocedure,response of thenoisysignalatthe receiver,maximumlikelihood decisionrule, decisionboundary,optimum correlationreceiver; probability of error, errorfunction,complementaryerror function,Type-IandType-IIerrors.

Unit 3: Digital DataTransmission:Conceptofsampling,PulseAmplitudeModulation(PAM),interlacingandmultiplexingofsamples,PulseCodeModulation(PCM),quantization, uniformandnon-uniformquantization,quantizationnoise,binaryencoding, A-Lawandμ-lawcompanding,differentialPCM,deltamodulationandAdaptivedeltamodulation.Digital transmissioncomponents,source,multiplexer,linecoder,regenerativerepeater,conceptofline coding –

polar/unipolar/bipolarNRZandRZ, Manchester,differentialencodingandtheirPSDs,pulseshaping,InterSymbolInterference(ISI),Eyepattern,Nyquistcriterionforzero ISI, equalizer,zero forcing equalizer, timing extraction

Unit 4: Digital ModulationTechniques:Typesof DigitalModulation,coherentand non-coherentBinaryModulationTechniques,basicdigitalcarrier modulation techniques:ASK,FSKandPSK,CoherentBinaryPhaseShiftKeying(BPSK),geometricalrepresentationofBPSKsignal;errorprobabilityofBPSK,generationanddetectionofBPSKSignal, power spectrumofBPSK.ConceptofM-aryCommunication,M-aryphaseshiftkeying,theaverageprobabilityofsymbolerrorforcoherentM-aryPSK,powerspectraofMPSK,Quadrature Phase ShiftKeying (QPSK), error probabilityof QPSKsignal, generationand detectionof QPSKsignals,power spectraof QPSKsignals, OffsetQuadrature Phaseshift Keying (OQPSK),CoherentFrequencyShiftKeying(FSK),BinaryFSK,errorprobabilityofBFSKsignals,generationanddetectionofCoherentBinaryFSKsignals,power spectraofBFSKsignal,MinimumShiftKeying(MSK),signalconstellationofMSKwaveforms,errorprobabilityofMSKsignal,GaussianMinimumShiftKeying:GMSK, basicconceptof OFDM,constellation diagram,Someperformanceissuesfordifferentdigitalmodulationtechniques-ErrorVectorMagnitude(EVM),EyePatternandRelativeConstellationError(RCE),Conceptual ideaforVector SignalAnalyzer (VSA).

Text Books

1. DigitalCommunications,S.Haykin,Wiley India.
2. Principlesof CommunicationSystems,H.Taub and D.L.Schilling,TMH PublishingCo.
3. ModernDigitalandAnalog CommunicationSystems,B.P.LathiandZ.Ding, OxfordUniversityPress

References

1. DigitalCommunications, J.G.Proakis,TMHPublishing Co.
2. DigitalCommunication,A.Bhattacharya,TMH PublishingCo.

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Course Description

Title of Course: ELECTRIC SYSTEM DESIGN
Course Code: EE705D
L-T Scheme: 3-0 **Course Credits: 3**

Introduction:

This course gives a thorough understanding in the various aspects of electrical systems and their design features.

Objectives:

The objective of the course is toto introduce the student fundamentals of electrical symbols, electrical devices and their design.

Knowledge:

Understanding of electrical systems and their design aspects.

Application:

Student gets the understanding of various aspects of electrical systems.

Unit 1: Introduction to electrical symbols and quantities used in design engineering, energy calculations, electrical loading of electro-mechanical devices/equipments, estimation of plant electrical load using diversity factor.
Unit 2: Development of single line diagrams and control schematics, selection and sizing of electrical equipments.
Unit 3: Cable selection and sizing, cable routing.
Unit 4: Earthing and lightning protection design.
Unit 5: Illumination design
Unit 6: Substation Design

TextBooks:

1. Handbook of Electrical Power Distribution, 2nd Edition, Gorti Ramamurthy, Universities Press.

ReferenceBooks:

1. ABB Switchgear handbook.
2. Siemens handbook of electrical engineering.

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Course Description

Title of Course: Electric Drive Lab
Course Code: EE791
L-T-P scheme: 0-0-3 **Course Credit: 2**

Objectives:

1. To learn and understand the characteristics of thysistor controlled DC Drive.
2. To provide an understanding of the design aspectof different types Chopper fed DC Drive.
3. To provide an efficient understanding ofperformance of single phase half controlled symmetrical and asymmetrical bridge converter.
4. To provide an efficient understanding Regenerative / Dynamic braking operation of AC motor.
5. To learn and understand the performance Study Regenerative / Dynamic braking operation for DC Motor .

Learning Outcomes: The students will have a detailed knowledge of the concepts of characteristics of athysistor controlled DC Drive. Aware of a variety of approaches to triggering circuits of / Dynamic braking operation of DC/AC motor. Student will learn the basics behind performance of AC Single phase motor-speed control using TRIAC,Chopper fed DC Drive.Upon the completion of Electrical Drive practical course, the student will be able to:

- **Understand** and implement characteristics of anvarious thysistor controlled DC Drive.
- **Use** modern tools and circut to understand the performance of VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM software.
- **Understand** the concepts of AC Single phase motor-speed control using TRIAC.
- **Analyze** and **simulate**V/f control operation of 3F induction motor drive
- **Implement** aChopper fed DC Drive.
- **Simulate**Regenerative / Dynamic braking operation for DC Motor using software.
- **Understand the**PC/PLC based AC/DC motor control operation.
- **Simulate**Regenerative / Dynamic braking operation for AC Motor using software.
- **Analyze** and **simulate**permanent magnet synchronous motor drive fed by PWM Inverter using Software.
- **Simulate** VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM Software.

Course Contents:
Exercises that must be done in this course are listed below:

Exercise No. 1: Study of thysistor controlled DC Drive.
Exercise No. 2: Study of Chopper fed DC Drive.
Exercise No. 3: Study of AC Single phase motor-speed control using TRIAC.
Exercise No. 4: PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.
Exercise No. 5:VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM Software.
Exercise No. 6: Study of V/f control operation of 3F induction motor drive.
Exercise No. 7: Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
Exercise No. 8: Study Regenerative / Dynamic braking operation for DC Motor - Study using software.
Exercise No. 9: Study Regenerative / Dynamic braking operation of AC motor - study using software.PC/PLC based AC/DC motor control operation.

Text Book:

1. Fundamental of Power Electronics with MATLAB, Randall Shaffer, Cengage Learning.
2. SPICE for Power electronics and electric power, M.H. Rashid & H.M. Rashid, Taylor & Francis.
3.Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.

4. Electric Drives, VedamSubrahmanyam, TMH
5. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.5. Modeling & Simulation using MATLAB-SIMILINK , S. Jain, Wiley India
6. MATLAB & SIMULINK for Engineers, A.K. Tyagi, Oxford University Press.

Recommended Systems/Software Requirements:

1. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
2. Matlab 32 bit or 64 bit 2009a/2009b. PowerSIM(PSM) 8, DSPICE
3. Testing kit for TRAIC,SCR,DUAL converter, Chopper, Inverter and converter circuit, Microcontroller train kit(PV59RD2V51),uc8051,128kb memory.
4. Chip burning kit.
5. Spare equipments.

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Course Description

Title of Course: Electric System Design-I Lab
Course Code: EE792
L-T-P scheme: 0-0-3 **Course Credit: 2**

Objectives:
1. To introduce the student fundamentals of Electrical System design and layout.
2. To learn the basics of line diagram.
3. To assimilate the design criteria and use it for a large scale design.

Learning Outcomes: The students will have a detailed knowledge of the concepts Electrical System and their co-ordination.

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1:Study of residential house wiring using switches, fuse, lamps and energy meter.
Exercise No. 2: Study of different types of wiring
Exercise No. 3: Study of fluorescent lamp wiring.
Exercise No. 4: Measurement of electrical quantities.
Exercise No. 5: Study of ETAP.

Text Book:
1. Electric Power Distribution Handbook, G Ramamurthy, University Press, 2nd Edition.

Recommended Systems/Apparatus Requirements:
Laboratory Kits, Multimeters, Connecting wires, Watt Meters, PC.

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Course Description

Title of Course: Seminar on Industrial Training
Course Code: EE781
L-T –P Scheme: 0-0-3 **Course Credits: 2**

Course Description & Objectives:

1. **Understand** the history of medical research and bioethics related to the HeLa cells. Understand the diverse social and economic, racial and gender contexts within which Henrietta Lacks lived and died. Understand the themes of this seminar. Appreciate the legacy and implications of these medical, ethical and social understandings on today's society.

2. **Identify**, understand and discuss current, real-world issues.

3. **Distinguish** and **integrate** differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of the student's own academic discipline (e.g., in agriculture, architecture, art, business, economics, education, engineering, natural resources, etc.). And apply a **multidisciplinary strategy** to address current, real-world **issues**.

4. Improve oral and written **communication** skills.

5. Explore an appreciation of the **self** in relation to its larger diverse social and academic contexts.

6. Apply principles of **ethics** and **respect** in interaction with others.

Course Outcomes:

After the completion of this course, the student should be able to:

1. **Learn and integrate.** ***Through independent learning and collaborative study, attain, use, and develop knowledge*** *in the arts, humanities, sciences, and social sciences, with disciplinary specialization and the ability to integrate information across disciplines.*

2. *Use multiple thinking strategies to* ***examine real-world issues, explore creative avenues of expression, solve problems, and make consequential decisions***

3. **Learn and integrate.** Communicate**.** *Acquire, articulate, create and convey intended meaning using* ***verbal*** *and* ***non-verbal method of communication*** *that demonstrates respect and understanding in a complex society.*

4. *Use multiple thinking strategies to examine* ***real-world issues, explore creative avenues of expression, solve problems, and make consequential decisions.***

Course Description

5. **Clarify purpose and perspective.** *Explore **one's life purpose and meaning** through transformational experiences that foster an understanding of **self**, **relationships**, and **diverse global perspectives**.*

6. **ractice citizenship.** *Apply principles of **ethical** leadership, **collaborative engagement**, **socially responsible behavior**, **respect for diversity** in an interdependent world, and a service-oriented commitment to advance and sustain local and **global communities**.*

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Course Description

Title of Course: Project Part- I
Course Code: EE782
L-T –P Scheme: 6P **Course Credits: 4**

Project: an activity where the participants have some degree of *choice* in the outcome. The result is complete and functional, that is, it has a beginning, middle and end. Usually, it spans multiple lab periods and requires work outside scheduled lab periods. Since there are choices in implementation, *design* is inherently a component of a project. A project is inherently different from an *analysis* or *exercise*, in which the solution has a predictable form. Projects span a wide variety of possibilities: design and build, identify a system, do a forensic analysis, evaluate a product or assess some environmental situation.

Program Objective 1
Graduates shall make their way to the society with proper scientific and technical knowledge in mechanical engineering.

Program Objective 2
Graduates shall work in design and analysis of mechanical systems with strong fundamentals and methods of synthesis.

Program Objective 3
Graduates shall adapt to the rapidly changing environment in the areas of mechanical engineering and scale new heights in their profession through lifelong learning.

Program Objective 4
Graduates shall excel in career by their ability to work and communicate effectively as a team member and/or leader to complete the task with minimal resources, meeting deadlines.

Program Outcomes:

1. Ability to apply knowledge of mathematics, science and mechanical engineering fundamentals for solving problems.
2. Ability to Identify, formulate and analyze mechanical engineering problems arriving at meaningful conclusions involving mathematical inferences.
3. Ability to design and develop mechanical components and processes to meet desired needs considering public health, safety, cultural, social, and environmental aspects.
4. Ability to understand and investigate complex mechanical engineering problems experimentally.
5. Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations.
6. Ability to understand the effect of mechanical engineering solutions on legal, cultural, social, public health and safety aspects./li>

Course Description

7. Ability to develop sustainable solutions and understand their impact on society and environment.
8. Ability to apply ethical principles to engineering practices and professional responsibilities.
9. Ability to function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
10. Ability to comprehend, design documentation, write effective reports, make effective presentations to the engineering community and society at large.
11. Ability to apply knowledge of engineering and management principles to lead teams and manage projects in multidisciplinary environments.
12. Ability to engage in independent and life-long learning in the broad context of technological changes and advancements.