JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA–533003, Andhra Pradesh, India
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B.TECH – ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicableforbatchesadmittedfrom2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA-533003, Andhra Pradesh, India

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III B.Tech – I Semester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	PCC	Power Systems-II	3	0	0	3
2	PCC	Power Electronics	3	0	0	3
3	PCC	Control Systems	3	0	0	3
4	OEC	Open Elective- I/ Job Oriented Elective-I	3	0	0	3
5	PEC	Professional Elective - I	3	0	0	3
6	PCC	Control Systems Lab	0	0	3	1.5
7	PCC	Power Electronics Lab	0	0	3	1.5
8	SC	Soft Skill Course:Employability Skills	2	0	0	2
9	MC	Environmental Science	2	0	0	0
10	PROJ	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)	0	0	0	1.5
		TotalCredits	**21.5**			
		Minors Course*	4	0	0	4
		Honors Course*	4	0	0	4

III B.Tech – II Semester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	PCC	Microprocessors and Microcontrollers	3	0	0	3
2	PCC	Electrical Measurements and Instrumentation	3	0	0	3
3	PCC	Power System Analysis	3	0	0	3
4	PEC	Professional Elective - II	3	0	0	3
5	OEC	Open Elective –II/ Job Oriented Elective-II	3	0	0	3
6	PCC	Electrical Measurements and Instrumentation Lab	0	0	3	1.5
7	PCC	Microprocessors and Microcontrollers Lab	0	0	3	1.5
8	PCC	Power Systems and Simulation Lab	0	0	3	1.5
9	SC	**Skill Advanced Course:** Machine Learning with Python	2	0	0	2
10	MC	Research Methodology	2	0	0	0
		Total Credits	**21.5**			
		Minors Course*	4	0	0	4
		Honors Course*	4	0	0	4

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IV B.Tech – I Semester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	PEC	Professional Elective – III	3	0	0	3
2	PEC	Professional Elective – IV	3	0	0	3
3	PEC	Professional Elective – V	3	0	0	3
4	OEC	Open Elective- III/Job Oriented Elective-III	3	0	0	3
5	OEC	Open Elective-IV /Job Oriented Elective-IV	3	0	0	3
6	HSMC	Universal Human Values-2: Understanding Harmony	3	0	0	3
7	SC	**Skill Advanced Course** Machine Learning with PythonLab	0	0	4	2
8	PROJ	Industrial / Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII Semester)	0	0	3	3
		Total Credits	**23**			
		Minors Course*	4	0	0	4
		Honors Course*	4	0	0	4

IVB.TechIISemester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	Major Project	Project work, seminar and internship in industry (6 Months)	--	--	--	12
		Total Credits	**12**			

HSMC:Humanities and Social Science Including Management Courses
BSC :Basic Science Courses
ESC:Engineering Science Courses
PCC:Professional Core Courses

PEC : Professional Elective Courses
OEC : Open Elective Courses
PROJ : Internship, Seminar, Project Wok
MC : Mandatory Courses
SC : Skill Oriented Courses

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Professional Elective Subjects offered to EEE Branch Students:

Professional Elective – I:

1. Linear IC Applications
2. Utilization of Electrical Energy
3. Computer Architecture and Organization
4. Optimization Techniques
5. Object Oriented Programming through Java

Professional Elective – II:

1. Signal and Systems
2. Electric Drives
3. Advanced Control Systems
4. Switchgear and Protection
5. Big Data Analytics

Professional Elective –III:

1. Digital Signal Processing
2. Renewable and Distributed Energy Technologies
3. Flexible Alternating Current Transmission Systems
4. Power Systems Deregulation
5. Data Base Management Systems

Professional Elective – IV:

1. Hybrid Electric Vehicles
2. High Voltage Engineering
3. Programmable Logic Controllers and Applications
4. Cloud Computing with AWS
5. Deep Learning Techniques

Professional Elective – V:

1. Power System Operation and Control
2. Switched Mode Power Conversion
3. AI Applications toElectrical Engineering
4. Data Science
5. MEAN Stack Technologies

Open Electives offered by EEE Department for Other Branches (Except EEE Branch)

Open Elective-I:

1. Renewable Energy Sources
2. Concepts of Optimization Techniques
3. Concepts of Control Systems

Open Elective-II:

1. Battery Management Systems and Charging Stations
2. Fundamentals of utilization of Electrical Energy
3. Indian Electricity Act

Open Elective-III:

1. Concepts of Microprocessors and Microcontrollers
2. Fundamentals of Electric Vehicles
3. Concepts of Internet of Things

Open Elective-IV:

1. Concepts of Power System Engineering
2. Concepts of Smart Grid Technologies

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***For Honor's/ Minor Course Fullfillments:**

- The 20 additional Credits need to be acquired, 16/15 credits can be earned by undergoing specified courses listed as pools, with 4/5 courses, each carrying 4/3 credits. The remaining 4/5 credits must be acquired through two online MOOCs (Swayam /NPTEL), which shall be domain specific, with 2/3 credits and with a minimum duration of 8/12weeks as recommended by the Board of Studies.
- Minor Engineering subjects are offered to other branches by EEE Department (except for EEE Students).
- Honors Engineering subjects are offered to EEE Students.
- The head of the department will float the list of allowed MOOC electives in each academic year, based on the list floated by MOOCs (Swayam/NPTEL).

*Honors Engineering Courses offered EEE Branch students

II B.Tech II Semester:

1. Communication Systems
2. Electrical Wiring, Estimation and Costing
3. Electrical Distribution Systems

III B.Tech I Semester:

1. Advanced Computer Networks
2. Power Quality
3. Special Electrical Machines

III B.Tech II Semester:

1. Digital Control Systems
2. Analysis of Power Electronic Converters
3. HVDC Transmission

IV B.Tech I Semester:

1. EHV AC Transmission
2. Smart Grid Technologies
3. Power Electronic Control of Electrical Drives

*Minor Engineering Courses offered by EEE Department for Other Branches (Except EEE Branch)

II B.Tech II Semester:

1. Fundamentals of Electrical Circuits
2. Concepts of Electrical Measurements

III B.Tech I Semester:

1. Analysis of Linear Systems
2. Energy Auditing, Conservation and Management

III B.Tech II Semester:

1. Evolutionary Algorithms
2. Fundamentals of Power Electronics

IV B.Tech I Semester:

1. Neural Networks and Fuzzy Logic
2. Concepts of Electric Drives and Its Applications

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
POWER SYSTEMS–II					

Preamble:
This course is an extension of power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transients in power system and effects of corona are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, insulators. These aspects are also covered in detail in this course.

Course Objectives:
- To understand the concepts of GMD/GMR and to compute inductance/capacitance of transmission lines.
- To distinguish the short and medium length transmission lines, their models and performance.
- To understand the performance and modeling of long transmission lines.
- To learn the effect of travelling waves on transmission lines.
- To learn the concepts of corona and the factors effecting corona..
- To understand sag and tension computation of transmission lines as well as to learn the performance of overhead insulators.

UNIT–I
Transmission Line Parameters
Conductor materials – Types of conductors – Calculation of resistance for solid conductors – Skin and Proximity effects – Calculation of inductance for Single-phase and Three-phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors – Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and Three-phase–Single and double circuit lines without and with Bundled conductors.

UNIT–II
Performance Analysis of Transmission Lines
Classification of Transmission Lines – Short, medium, long lines and their model representation – Nominal-T, Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks.
Rigorous Solution for long line equations –Representation of Long lines – Equivalent T and Equivalent Pie network models - Surge Impedance and Surge Impedance Loading (SIL) of Long Lines - Regulation and efficiency for all types of lines – Ferranti effect.

UNIT – III
Power System Transients
Types of System Transients – Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients.

Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction – Lumped Reactive Junctions.

UNIT–IV
Corona
Description of the phenomenon – Types of Corona - critical voltages and power loss – Advantages and Disadvantages of Corona - Factors affecting corona - Radio Interference.

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UNIT–V

Sag and Tension Calculations and Overhead Line Insulators:

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications

Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.

Course Outcomes:

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

- Calculate parameters of transmission lines for different circuit configurations.
- Determine the performance of short, medium and long transmission lines.
- Analyse the effect of travelling waves on transmission lines.
- Analyse the various voltage control methods and effect of corona.
- Calculate sag/tension of transmission lines and performance of line insulators.

Text Books:

1. Electrical Power Systems – by C.L.Wadhwa, New Age International (P) Limited, 1998.
2. Power System Engineering by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 3rd Edition.

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai Co Pvt. Ltd.2016
4. Electrical Power Systems by P.S.R. Murthy, B.S. Publications, 2017.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
POWER ELECTRONICS					

Preamble:
The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all power electronic converters. This course covers characteristics of semiconductor devices and operation of ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

Course Objectives:
- To know the characteristics of various power semiconductor devices.
- To learn the operation of single phase full–wave converters and perform harmonic analysis of input current.
- To learn the operation of three phase full–wave converters and AC/AC converters.
- To learn the operation of different types of DC-DC converters.
- To learn the operation of PWM inverters for voltage control and harmonic mitigation.

UNIT – I
Power Semi-Conductor Devices
Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design.
Static and Dynamic Characteristics of Power MOSFET and Power IGBT– Gate Driver Circuits for Power MOSFET and IGBT - Numerical problems.

UNIT – II
Single-phase AC-DC Converters
Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load – Continuous and Discontinuous conduction - Harmonic Analysis – Dual converter and its mode of operation - Numerical Problems.

UNIT – III
Three-phase AC-DC Converters & AC – AC Converters
Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three-phase Dual Converters - Numerical Problems.
Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage – Single-phase step down and step up Cycloconverter - Numerical Problems.

UNIT – IV
DC–DC Converters
Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control -Numerical Problems.

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UNIT – V
DC–AC Converters

Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Course Outcomes:

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

- Illustrate the static and dynamic characteristics of SCR, Power-MOSFET and Power-IGBT.
- Analyse the operation of phase-controlled rectifiers.
- Analyse the operation of three-phase full–wave converters, AC Voltage Controllers and Cycloconverters.
- Examine the operation and design of different types of DC-DC converters.
- Analyse the operation of PWM inverters for voltage control and harmonic mitigation.

Text Books:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics–Philip T.Krein. Oxford University Press; Second edition
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics: by Daniel W.Hart, Mc Graw Hill.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
CONTROL SYSTEMS					

Preamble:
This course covers mathematical modeling, time response, frequency response, stability analysis of Linear Time Invariant (LTI) control systems and their analysis. State space analysis of LTI systems and design of compensator using Bode diagrams is also discussed in this course.

Course Objectives:
- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers. To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To understand basic aspects of design and compensation of LTI systems using Bode diagrams.
- To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
- To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

UNIT – I
Mathematical Modelling of Control Systems
Classification of control systems - open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networks-translational and rotational mechanical systems - transfer function of Armature voltage controlled DC servo motor - block diagram algebra - signal flow graph – reduction using Mason's gain formula.

UNIT-II
Time Response Analysis and Controllers
Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) - proportional integral derivative (PID) systems.
Stability Assessment Techniques
The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function.

UNIT–III
Frequency Response Analysis
Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion- stability analysis using Bode plots (phase margin and gain margin).

UNIT–IV
Classical Control Design Techniques
Lag, lead, lag-lead compensators - physical realisation - design of compensators using Bode plots.

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UNIT–V

State Space Analysis of Linear Time Invariant (LTI) Systems

Concepts of state - state variables and state model - state space representation of transfer function - diagonalization using linear transformation - solving the time invariant state equations - State Transition Matrix and its properties- concepts of controllability and observability.

Course Outcome:

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

- Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- Determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
- Analyze the stability of LTI systems using frequency response methods.
- Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode diagrams.
- Represent physical systems as state models and determine the response. Understand the concepts of controllability and observability.

Text Books:

1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
2. Control Systems Engineering by Norman S. Nise, Wiley Publications, 7th edition
3. Control Systems by Manik Dhanesh N, Cengage publications.
4. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.

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III Year –I SEMESTER		L	T	P	C
		3	0	0	3
RENEWABLE ENERGY SOURCES (OPEN ELECTIVE-I)					

Preamble:
This course presents the various sources of renewable energy such as solar, wind, geothermal energy, biomass & other potential energy and contribution towards energy profile of the nation.

Course Objectives:
- To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
- To understand the concept of Wind Energy Conversion & its applications.
- To study the principles of biomass and geothermal energy.
- To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it.
- To study the various chemical energy sources such as fuell cell and hydrogen energy along with their operation and equivalent circuit.

UNIT–I
Solar Energy: Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT–II
Wind Energy: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT–III
Biomass and Geothermal Energy:
Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant
Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

UNIT–IV
Energy From oceans, Waves & Tides:
Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.
Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.
Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT–V
Chemical Energy Sources:
Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.
Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications
Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

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Course Outcomes:

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

- Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.
- Illustrate the components of wind energy systems.
- Illustrate the working of biomass, digesters and Geothermal plants.
- Demonstrate the principle of Energy production from OTEC, Tidal and Waves.
- Evaluate the concept and working of Fuel cells & MHD power generation.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3

CONCEPTS OF OPTIMIZATION TECHNIQUES
(OPEN ELECTIVE-I)

Preamble:

The applications of optimization techniques have expanded in all fields including design aspects of electrical machines. It is pertinent to link these concepts with that of programming skills. This course covers basic features of linear & nonlinear programming problems. Concept of dynamic programming and transportation problem are also taught.

Course Objectives:

- To know the importance of adopting optimization techniques in day to day life.
- To analyse the importance of various types of constraints at various stages.
- To learn more on linear & nonlinear programming concepts.
- To analyse the significance of transportation problem.
- To learn the concepts of dynamic programming.

UNIT – I

Introduction to Optimization Techniques

Statement of an Optimization problem – design vector – design constraints – objective function – classification of Optimization problems.

Classical Optimization Techniques

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers.

UNIT – II

Linear Programming

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

UNIT – III

Nonlinear Programming

Unconstrained cases - One – dimensional minimization methods: Classification - Fibonacci method and Quadratic interpolation method - Univariate method - Powell's method.

Constrained cases - Characteristics of a constrained problem - Classification - Basic approach of Penalty Function method.

UNIT – IV

Transportation Problem

Finding initial basic feasible solution by north – west corner rule - least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem.

UNIT – V

Dynamic Programming

Dynamic programming - Multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution.

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Course Outcomes:

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

- State and formulate the optimization problem without and with constraints, also apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Formulate a mathematical model and apply non-linear programming techniques for unconstrained and constrained case studies.
- Solve transportation and assignment problem by using Linear programming Simplex method.
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao- New Age International (P) Limited - 3rd edition - 1998.
2. "Introductory Operations Research" by H.S. Kasene& K.D. Kumar - Springer (India) 2013.

Reference Books:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan - New Age International (P) Limited - Publishers - 3rd edition - 1996.
2. Operations Research – by Dr. S.D.Sharma- Kedarnath - Ramnath& Co - 2012.
3. "Operations Research: An Introduction" – by H.A.Taha - PHI pvt. Ltd. - 6th edition
4. Linear Programming–by G.Hadley.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
CONCEPTS OF CONTROL SYSTEMS (OPEN ELECTIVE-I)					

Preamble:
This course covers mathematical modeling, time response, frequency response, stability analysis of Linear Time Invariant (LTI) control systems and their analysis. State space analysis of LTI systems and design of compensator using Bode diagrams is also discussed in this course.

Course Objectives:
- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers.
- To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
- To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

UNIT – I
Mathematical Modelling of Control Systems
Classification of control systems - open loop and closed loop control systems and their differences - transfer function of linear system - differential equations of electrical networks - translational and rotational mechanical systems – block diagram algebra – Feedback characteristics.

UNIT-II
Time Response Analysis
Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - P - PI & PID Controllers.

UNIT–III
Stability and Root Locus Technique
The concept of stability – Routh-Hurwitz Criteria – limitations of Routh-Hurwitz criterion-.Root locus concept – construction of root loci (simple problems).

UNIT–IV
Frequency Response Analysis
Introduction to frequency domain specifications – Bode diagrams – Transfer function from the Bode diagram – phase margin and gain margin.

UNIT–V
State Space Analysis of Linear Time Invariant (LTI) Systems
Concepts of state - state variables and state model - state space representation of transfer function - State Transition Matrix and it's properties - concepts of controllability and observability.

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Course Outcomes:

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

- Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- Determine time response specifications of second order systems and to determine error constants.
- Analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
- Analyze the stability of LTI systems using frequency response methods.
- Represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:

1. Modern Control Engineering by Kotsuhiko Ogata - Prentice Hall of India.
2. Automatic control systems by Benjamin C.Kuo - Prentice Hall of India - 2nd Edition.

Reference Books:

1. Control Systems principles and design by M.Gopal - Tata Mc Graw Hill education Pvt Ltd. - 4th Edition.
2. Control Systems by Manik Dhanesh N - Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal - Newage International Publications - 5th Edition.
4. Control Systems Engineering by S.Palani - Tata Mc Graw Hill Publications.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
LINEAR IC APPLICATIONS (PROFESSIONAL ELECTIVE – I)					

Unit – I

OP-Amp Block Diagram (Symbolic Representation), Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, DC and AC Characteristics, Definitions of Input and Output Off-set voltage and currents slow rate, CMRR, PSRR. Measurements of Op-Amp Parameters, Three-Terminal Voltage Regulators 78xx& 79xx Series, current Booster, adjustable voltage, DualPowerSupplywith78xx&79xx

Unit – II

OP-AMPS Applications: Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

Unit – III

Active Filters:

Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters.

Unit – IV

Timers: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger.

Phase Locked Loops: Introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566)

Unit – V

Digital To Analog And Analog To Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications.

Course Outcomes:

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

- Describe the Op-Amp and internal Circuitry: 555 Timer, PLL
- Discuss the Applications of Operational amplifier: 555 Timer, PLL
- Design the Active filters using Operational Amplifier
- Use the Op-Amp in A to D & D to A Converters

Text Books:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition 2003.
2. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma; SK Kataria & Sons; 2nd Edition, 2010

References:

1. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1993.
2. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition.

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III Year –I SEMESTER		L	T	P	C
		3	0	0	3

UTILIZATION OF ELECTRICAL ENERGY
(PROFESSIONAL ELECTIVE – I)

Preamble:
This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Energy Storage Systems concepts are also introduced as a part of this course.

Course Objectives:
- To study the basic principles of illumination and its measurements and to design the different types lighting systems.
- To acquaint with the different types of heating and welding techniques.
- To understand the operating principles and characteristics of various motors with respect to speed, temperature and loading conditions.
- To understand the basic principles of electric traction including speed–time curves of different traction services and calculation of braking, acceleration and other related parameters.
- To Introduce the concepts of various types of energy storage systems.

UNIT – I
Illumination fundamentals
Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light.
Various Illumination Methods
Discharge lamps - MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT – II
Selection of Motors
Choice of Motor - Type of Electric Drives - Starting And Running Characteristics – Speed Control–Temperature Rise – Applications of Electric Drives–Types of Industrial Loads–Continuous–Intermittent And Variable Loads–Load Equalization - Introduction To Energy Efficient Motors.

UNIT – III
Electric Heating
Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding
Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding.

UNIT – IV
Electric Traction
System of electric traction and track electrification– Review of existing electric traction systems in India–Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves. Calculations of tractive effort– power – Specific energy consumption for given run–Effect of varying acceleration and braking retardation–

Adhesive weight and braking retardation adhesive weight and coefficient of adhesion-Numerical problems.

UNIT – V

Introduction to Energy Storage Systems

Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic And Chemical Storage Systems - Comparison of Energy Storage Technologies-Applications.

Course Outcomes:

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

- Identify various illumination methods produced by different illuminating sources.
- Identify a suitable motor for electric drives and industrial applications
- Identify most appropriate heating and welding techniques for suitable applications.
- Distinguish various traction system and determine the tractive effort and specific energy consumption.
- Validate the necessity and usage of different energy storage schemes for different applications and comparisons.

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor - Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab - Dhanpat Rai& Sons.
3. “Thermal energy storage systems and applications”-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons 2002.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana - New Age International (P) Limited - Publishers - 1996.
2. Generation - Distribution and Utilization of electrical Energy – by C.L. Wadhwa - New Age International (P) Limited - Publishers - 1997.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3

COMPUTER ARCHITECTURE AND ORGANIZATION
(PROFESSIONAL ELECTIVE – I)

Preamble:
This course aims to give an overall idea about the architecture and working of a computer. This course covers various operations of a computers and discusses the memory organization of a digital computer. This course will be very useful to the students to improve their computer programming skills and to find job opportunities in hardware/software industry.

Course Objectives:
- To explain the basic working of a digital computer.
- To understand the register transfer language and micro operators.
- To learn various addressing modes supported by the processors.
- To be familiar with peripheral interfacing with processors.
- To understand memory hierarchy in computers.

UNIT-I
Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

UNIT-II
Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit. Micro programmed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

UNIT-III
Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC) Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISK Pipeline, Vector Processing, Array Processors.

UNIT-IV
Input/output Organization: Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

UNIT-V
Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

Course Outcomes:
At the end of this course, student will be able to:
- Explain the instruction cycle of a computer.
- Understand various micro operations and register transfer language.
- Describe parallel processing and pipelining.
- Interface different peripherals with processors.
- Know the advantages of cache and virtual memory.

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Text Books:

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., 3rd Edition, Sept. 2008.

References Books:

1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003.
2. Computer Organization and Architecture, Linda Null, Julia Lobur, Narosa Publications ISBN 81-7319-609-5
3. Computer System Organization by John. P. Hayes.

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		3	0	0	3

OPTIMIZATION TECHNIQUES
(PROFESSIONAL ELECTIVE – I)

Preamble:

The applications of optimization techniques have expanded in all fields including design aspects of electrical machines. It is pertinent to link these concepts with that of programming skills. This course covers basic features of linear & nonlinear programming problems. Concept of dynamic programming and transportation problem are also taught.

Course Objectives:

- To know the importance of adopting optimization techniques in day to day life.
- To analyse the importance of various types of constraints at various stages.
- To learn more on linear & nonlinear programming concepts.
- To analyse the significance of transportation problem.
- To learn the concepts of dynamic programming.

UNIT – I

Introduction to Optimization Techniques

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II

Linear Programming

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

UNIT – III

Nonlinear Programming

Unconstrained cases - One – dimensional minimization methods: Classification - Fibonacci method and Quadratic interpolation method - Univariate method - Powell's method and steepest descent method.

Constrained cases - Characteristics of a constrained problem - Classification - Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.

UNIT – IV

Transportation Problem

Finding initial basic feasible solution by north – west corner rule - least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem.

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UNIT - V

Dynamic Programming

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Course Outcomes:

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

- State and formulate the optimization problem without and with constraints, also apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Formulate a mathematical model and apply non-linear programming techniques for unconstrained and constrained case studies.
- Solve transportation and assignment problem by using Linear programming Simplex method.
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Text Books:

2. "Engineering optimization: Theory and practice"-by S. S.Rao- New Age International (P) Limited - 3rd edition - 1998.
1. "Introductory Operations Research" by H.S. Kasene& K.D. Kumar - Springer (India) 2013.

Reference Books:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan - New Age International (P) Limited - Publishers - 3rd edition - 1996.
3. Operations Research – by Dr. S.D.Sharma- Kedarnath - Ramnath& Co - 2012.
3. "Operations Research: An Introduction" – by H.A.Taha - PHI pvt. Ltd. - 6th edition
4. Linear Programming–by G.Hadley.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
OBJECT ORIENTED PROGRAMMING THROUGH JAVA (PROFESSIONAL ELECTIVE – I)					

Course Objective: Implementing programs for user interface and application development using core java principles

UNIT-I
Focus on object oriented concepts and java program structure and its installation, Introduction to OOP Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features.

UNIT-II
Comprehension of java programming constructs, control structures in Java Programming Constructs Variables , Primitive Datatypes, Identifiers- Naming Conventions, Keywords, Literals, Operators-Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control Branching, Conditional, loops.,

UNIT-III
Classes and Objects- classes, Objects, Creating Objects, Methods, constructors, Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments **Interfaces and exception handling Inheritance:** Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class Interfaces,

UNIT-IV
Understanding of Thread concepts and I/O in Java MultiThreading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading- Using isAlive() and join(), Syncronization, suspending and Resuming threads, Communication between Threads.

UNIT-V
Being able to build dynamic user interfaces using applets and Event handling in java Swing: Introduction, javax.swing package , JFrame, JApplet, JPanel, Components in swings, Layout Managers, JList and JScroll Pane, Split Pane, JTabbedPane, Dialog Box.

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

- Discuss and understand java programming constructs, Control structures
- Illustrate and experiment Object Oriented Concepts like classes, objects
- Apply Object Oriented Constructs such as Inheritance, interfaces, and exception handling
- Construct applications using multithreading and I/O
- Develop Dynamic User Interfaces using applets and Event Handling in java

Text Books:

1. The Complete Refernce Java, 8ed, Herbert Schildt, TMH
4. Programming in JAVA, Sachin Malhotra, Saurabh choudhary, Oxford.

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Reference Books:

1. JAVA Programming, K.Rajkumar.Pearson
2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech
3. JAVA for Beginners, 4e, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning.
4. Object oriented programming with JAVA, Essentials and Applications, Raj Kumar Bhuyya, Selvi, Chu TMH
5. Introduction to Java programming, 7th ed, Y Daniel Liang, Pearson Core JAVA for Beginners, Rashmi Kanta Das, Vikas.
6. Object Oriented Programming through JAVA , P Radha Krishna , University Press

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III Year – I SEMESTER		L	T	P	C
		0	0	3	1.5
CONTROL SYSTEMS LABORATORY					

Course Objectives:

- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchros.
- To understand time and frequency responses of control system with and without controllers and compensators.

Any 10 of the following experiments are to be conducted:

1. Time response of Second order system
2. Characteristics of Synchros
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5^{th} order using MATLAB.
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. To study and verify the truth table of logic gates and simple Boolean expressions using PLC.

Course Outcomes:

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

- Analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchros.
- Design P,PI,PD and PID controllers
- Design lag, lead and lag–lead compensators
- Evaluate temperature control of an oven using PID controller
- Determine the transfer function of D.C Motor
- Analyze the performance of D.C and A.C Servo Motor.
- Test the controllability and observability.
- Judge the stability in time and frequency domain.
- To examine different logic gates and Boolean expressions using PLC.

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III Year –I SEMESTER		L	T	P	C
		0	0	3	1.5
POWER ELECTRONICS LABORATORY					

Course objectives:

- To learn the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter and Boost converter.
- To understand the working of single-phase & three-phase inverters.

Any 10 of the Following Experiments are to be conducted

1. Characteristics of SCR - Power MOSFET & Power IGBT.
2. R - RC & UJT firing circuits for SCR.
3. Single -Phase semi-converter with R & RL loads.
4. Single -Phase full-converter with R & RL loads.
5. Three- Phase full-converter with R & RL loads.
6. Single-phase dual converter in circulating current & non circulating current mode of operation.
7. Single-Phase AC Voltage Regulator with R & RL Loads.
8. Single-phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.
13. Three-phase bridge inverter with 120^0 and 180^0 conduction mode
14. SPWM control of Three-phase bridge inverter

Course outcomes:

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

- Analyse characteristics of various power electronic devices and design firing circuits for SCR.
- Analyse the performance of single–phase dual, three–phase full–wave bridge converters and dual converter with both resistive and inductive loads.
- Examine the operation of Single-phase AC voltage regulator and Cycloconverter with resistive and inductive loads.
- Differentiate the working and control of Buck converter and Boost converter.
- Differentiate the working & control of Square wave inverter and PWM inverter.

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III Year –I SEMESTER		L	T	P	C
		2	0	0	2

SOFT SKILL COURSE
EMPLOYABILITY SKILLS

Preamble: The aim of this course is to enhance learner's knowledge of both soft skills and IT related skills so as to develop attributes that enhances interpersonal communication, earning power and job performance.

Course objectives:

- To enhance the Numerical ability skills such as addition, subtraction, multiplication, division, calculation of percentages, average etc.
- To develop the problem solving skills on time, distance and speed calculations, to improve the basic mathematical skills on arithmetic ability.
- To analyze a candidate's ability to relate a certain given group of items and illustrate it diagrammatically.
- To develop interpersonal skills and adopt good leadership behavior for empowerment of self and others.by managing stress and time effectively.
- To prepare good resume, prepare for interviews and group discussions, and to explore desired career opportunities.

UNIT - I
Numerical ability
Number system, HCF & LCM, Average, Simplification, Problems on numbers Ratio & Proportion, Partnership, Percentages, Profit & Loss

UNIT - II
Arithmetical ability
Problems on ages, Time & Distance, Problems on boats &Steams, Problems on Trains, Time & Work, Pipes & Cistern, Chain Rule.
Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock.

UNIT - III
Logical ability: Permutations and Combination and Probability.
Mensuration: Geometry, Areas, Volumes,
Data interpretation: Tabulation, Bar graphs, Pie charts, line graphs

UNIT - IV
Self-Management Skills
Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities
Etiquette
Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT - V
Job-Oriented Skills
Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

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Course outcomes:

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

- Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems
- Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
- Analyze, summarize and present information in quantitative forms including table, graphs and formulas
- Understand the core competencies to succeed in professional and personal life
- Learn and demonstrate a set of practical skills such as time management, self-management, handling conflicts, team leadership, etc.

Text Books:

1. R. S. Aggarwal "Quantitative Aptitude", Revised ed., S Chand publication, 2017 ISBN:8121924987
2. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
3. Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

Reference Books:

1. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

E-resources and other digital material:

1. https://blog.feedspot.com/aptitude_youtube_channels/
2. https://www.tutorialspoint.com/quantitative_aptitude/
3. https://www.careerbless.com/aptitude/qa/home.php
4. https://www.Indiabix.com
5. https://www.freshersworld.com

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III Year –I SEMESTER		L	T	P	C
		2	0	0	0
ENVIRONMENTAL SCIENCE					

Course Objectives:

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due tounplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

UNIT I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information technology in environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT II

Natural Resources: Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT III

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT IV

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT V

Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness. Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. ManjulaRani; Pearson Education, Chennai

Reference Books:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, CengageLearning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New AgeInternational Publishers, 2014

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III Year –I SEMESTER		L	T	P	C
		0	0	0	1.5
Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester					

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
ADVANCED COMPUTER NETWORKS **(Honors Engineering Course)**					

Preamble:
This course aim to provide a board coverage of new advanced topics in the fields of computer networks such as wireless networks, mobile networks, VPN networks, transport layer and application layers protocols.

Course Objectives:
- To know the various networks layers and protocols.
- To represents the IPv6 Addressing and Transition from IPv4 to IPv6 protocols.
- To discuss unicast and multicasting routing protocols.
- To know the different transport layer protocols-UDP, TCP & SCTP services.
- To understand the application layer protocols like WWW, HTTP, FTP etc.

UNIT – I
Network Layer and Protocols
IP Addressing: Address Space – Notations – Addressing – Networking – Network Address Translation (NAT).
Internet Protocol (IP): Datagram Format – Fragmentation – Options.
ICMPv4: Messages – Debugging Tools – ICMP Checksum.
Mobile IP: Addressing – Agents – Three Phases – Inefficiency in Mobile IP.
Virtual Private Network: VPN Technology.

UNIT – II
Next Generation IP
IPv6 Addressing: Representation – Address space – Allocation – Auto configuration – Renumbering.
Transition from IPv4 to IPv6: Dual Stack – Tunneling – Header Translation.
IPv6 Protocol: Packet Format – Extension Header.

UNIT – III
Unicast and Multicast Routing Protocols
Introduction: Inter-domain – Intra-domain Routing**.**
Routing Algorithms: Distance Vector Routing – Bellman-Ford Algorithm – Link State Routing – Path Vector Routing.
Unicast Routing Protocols: Internet Structure – Routing Information Protocol (RIP) – Open Shortest Path First (OSPF) – Border Gateway Protocol Version 4 (BGP4).
Introduction: Unicast – Multicast and Broadcast.
Intradomain Multicast Protocols: Multicast Distance Vector (DVMRP) – Multicast Link State (MOSPF) – Protocol Independent Multicast (PIM).

UNIT – IV
Transport Layer Protocols
User Datagram Protocol: User Datagram – UDP Services – UDP Applications.
Transmission Control Protocol: TCP Services – TCP features – Segment – A TCP Connection – State Transition Diagram – Windows in TCP – Flow Control – Error Control – TCP Congestion Control – TCP Timers – Options.
SCTP: SCTP Services – SCTP Features – Packet Format – An SCTP Association – Flow Control – Error Control.

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UNIT – V
Application Layer Protocols
World Wide Web and HTTP **– File Transfer:** FTP and TFTP **– Electronic mail:** Architecture – Web-Based Mail – Email Security – SMTP – POP – IMAP and MIME – SNMP. **DNS:** Concept of Domain name space – DNS operation. **DHCP:** Static and Dynamic Allocation – DHCP operation. **Remote Login:** TELNET and SSH.

Course Outcomes:
After the completion of the course the student should be able to:
- Implement various networks layers protocols.
- Configure TPV6 protocol.
- Apply the concepts of unicast and multicast routing protocol.
- Configure the transport layers protocols like UDP, TCP, SCTP Services.
- Determine application layer services working with the client server para diagrams like WWW, HTTP, FTP, e-mail, SNMP, DHCP.

Text Book:
1. "Data Communication and Networking" by Forouzan Behrouz.A, McGraw Hill Education, New Delhi, 2005.
2. "Internetworking with TCP/IP, Volume-I", 4th Edition by Comer Douglas E., Prentice Hall of India Private Limited, New Delhi, 2014.
3. "Computer Networks, 4th Edition" by Tanenbaum Andrew .S, PHI Learning, New Delhi, 2014.
4. "Advanced Computer Network" by B.M. Harwani and DT Editorial services, Dreamtech New Delhi, 2014.
5. "Computer Networks-Principles, Technologies and Protocols for Network Design" by Natalia Olifer, Victor Olifer, Wiley Publishers.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
POWER QUALITY **(Honors Engineering Course)**					

Preamble:
Power quality is a major problem for utilities and customers. Customers using sensitive critical loads need quality power for proper operation of the electrical equipment. It is important for the student to learn the power quality issues and improvement measures provided by the utility companies. This course covers the topics on voltage and current imperfections, harmonics, voltage regulation, power factor improvement, distributed generation, power quality monitoring and measurement equipment.

Course Objectives:
- To learn different types of power quality phenomena.
- To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- To describe power quality terms and know the power quality standards.
- To learn the principle of voltage regulation and power factor improvement methods.
- To explain the relationship between distributed generation and power quality.
- To understand the power quality monitoring concepts and the usage of measuring instruments.

UNIT - I
Introduction - Terms & Definitions
Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations – Voltage Sags – Voltage Swell.

UNIT - II
Transient Over Voltages
Sources of Transient Over voltages - Principles of Over voltage protection- Devices for Over voltage protection – Utility Capacitor Switching Transients - Utility System Lightning Protection – Managing Ferro resonance – Switching Transient Problems with Loads.

UNIT - III
Long – Duration Voltage Variations
Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker

UNIT - IV
Harmonic distortion and solutions
Voltage distortion vs. Current distortion –Harmonic indices: THD - TDD and True Power Factor– Sources of harmonics – Effect of harmonic distortion – Impact on capacitors, transformers, motors and meters – Concept of Point of common coupling – Passive and active filtering – Numerical problems.

UNIT - V
Distributed Generation and Monitoring
Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

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Monitoring
Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data.

Course Outcomes:
After the completion of the course the student should be able to:

- Differentiate between different types of power quality problems.
- Explain the sources of voltage sag - voltage swell - interruptions - transients - long duration over voltages and harmonics in a power system.
- Explain the principle of voltage regulation and improvement methods.
- Analyse voltage distortion and current distortion and their indices.
- Know the concepts of distributed generation technologies and power quality monitoring.

Textbooks:

1. Electrical Power Systems Quality - Dugan R C - McGranaghan M F - Santoso S - and Beaty H W - Second Edition - McGraw–Hill - 2012 - 3rd edition.
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley india publications - 2011.
3. Power Quality Primer - Kennedy B W - First Edition - McGraw–Hill - 2000.

Reference Books:

1. Understanding Power Quality Problems: Voltage Sags and Interruptions - Bollen M HJ - First Edition - IEEE Press; 2000.
2. Power System Harmonics - Arrillaga J and Watson N R - Second Edition - John Wiley & Sons - 2003.
3. Electric Power Quality control Techniques - W. E. Kazibwe and M. H. Sendaula - Van Nostrad Reinhold - New York.
4. Power Quality C.Shankaran - CRC Press - 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
6. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs - Mohammad A.S.Masoum–Elsevier.

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SPECIAL ELECTRICAL MACHINES **(Honors Engineering Course)**					

Preamble:
This is an advanced course on electrical machines. Students will be exposed to various special machines which are gaining importance in industry. This course covers topics related to principles, performance and applications of these special machines including switched reluctance motors, stepper motors, permanent magnet dc motors and linear motors.

Course Objective:
- To explain operation and control of switched reluctance motor.
- To understand the performance and control of stepper motors, and their applications.
- To describe the operation and characteristics of permanent magnet dc motor.
- To distinguish between brush dc motor and brush less dc motor**.**
- To explain the theory of travelling magnetic field and applications of linear motors.

UNIT - I
Permanent Magnet Materials and PMDC motors
Introduction - classification of permanent magnet materials used in electrical machines - minor hysteresis loop and recoil line - Stator frames of conventional dc machines - Development of electronically commutated dc motor from conventional dc motor – Permanent magnet materials and characteristics - B-H loop and demagnetization characteristics-high temperature effects-reversible losses - Irreversible losses - Mechanical properties - handling and magnetization - Application of permanent magnets in motors - power density - operating temperature range - severity of operation duty- Hysteresis - Eddy current Motors.

UNIT - II
Stepper Motors
Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two phase hybrid stepping motor.

UNIT - III
Switched Reluctance Motors
Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs.
Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

UNIT - IV
Permanent Magnet Brushless DC Motor
Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet DC Motors - Torque and EMF equations for Square wave & Sine wave for PMBLDC Motor – Torque - Speed characteristics of Square wave & Sine wave for PMBLDC Motor - Merits & demerits of Square wave & Sine wave for PMBLDC Motor - Performance and efficiency – Applications.

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UNIT - V

Linear Induction Motors (LIM)

Construction– principle of operation – Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one sided LIM with back iron - equivalent circuit of LIM.

Course Outcomes:

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

- Learn merits of PMDC motor
- Choose best control scheme for stepper motor
- Construct the various converter circuits for Switched Reluctance Motors.
- Analyse the characteristics of Brushless dc Motor.
- Understand the operation of Linear Induction Motors.

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
ANALYSIS OF LINEAR SYSTEMS **(Minors Engineering Course)**					

Preamble:
This course introduces the basics of Electrical Networks, state space analysis, applications of Laplace, Fourier series and Fourier transform. It also deals with Z-Transforms and testing of polynomial and network synthesis.

Course Objectives: formulate

- To formulate state equation for electrical networks and analysis simple networks with state variable approach.
- To analyze the signals applied to electrical networks and theorems.
- To examine the applications of Fourier series, Fourier transform to simple circuits.
- To know the distinction between Laplace, Fourier and Z-Transforms.
- To evaluate testing of polynomials and network synthesis of LC, RC and RL networks.

UNIT - I
State Variable Analysis
Choice of state variables in Electrical networks-Formulation of state equations for Electrical networks-Equivalent source method. Network topological method - Solution of state equations-Analysis of simple networks with state variable approach.

UNIT - II
Laplace Transform Applications
Application of Laplace transform methods of analysis:
Response of RL, RC and RLC networks to step, ramp, pulse and impulse functions, shifting and scaling theorems-Laplace transform of periodic functions-Convolution theorem-Convolution integral-Applications.

UNIT - III
Application of Fourier Series and Fourier Transform
Fourier Series: RMS, average value of a non-sinusoidal periodic wave form-Expression for power with non sinusoidal voltage and current-Power factor-Effect of harmonics-Analysis of simple circuits with non-sinusoidal inputs.
Fourier Transform: Representation of non-periodic functions-Fourier integral-Fourier transform-Graphical Representation-Properties of Fourier transforms-Parseval's theorem-Fourier transform of constant, unit step, unit impulse, unit ramp signals and exponential functions-relationship with Laplace transform.

UNIT - IV
Z-Transforms
Fundamental difference between continuous and discrete time signals, discrete time complex, exponential and sinusoidal signals, periodicity of discrete time complex exponential, concept of Z-Transform of a discrete sequence. Distinction between Laplace, Fourier and Z-Transforms. Region of convergence in Z-Transforms, constraints on ROC for various classes of signals, Inverse Z-Transform properties of Z-Transforms.

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UNIT - V

Testing of Polynomials and Network synthesis:

Elements of realisability-Hurwitz polynomials-positive real functions-Properties-Testing-Sturm's Test, examples.

Network synthesis:

Synthesis of one port LC networks-Foster and Cauer methods-Synthesis of RL and RC one port networks-Foster and Cauer methods.

Course Outcomes:

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

- Solve problems involving continuous time signals and linear systems.
- Use the Laplace transform to analyse signals, linear circuits and systems.
- Use the Fourier series and transform to analyse signals.
- Solve problems involving discrete time signals and linear systems.
- Illustrate testing of polynomials and network synthesis of LC, RC and RL networks.

Text Books:

1. Signals, Systems and Communications by B.P. Lathi, BS Publications 2003.
2. Network Analysis and Synthesis – B C Kuo
3. Network Analysis and Synthesis – Umesh Sinha- Satya Prakashan Publications

Reference Books:

1. Linear System Analysis – A N Sripathi, New Age International
2. Network and Systems – D Roy Chowdhary, New Age International
3. Engineering Network Analysis and Filter Desgin- Gopal G Bhise & Umesh

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III Year – I SEMESTER		L	T	P	C
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ENERGY AUDITING, CONSERVATION AND MANAGEMENT **(Minors Engineering Course)**					

Preamble:

This course is developed to cater the current needs of the industry. This course covers topics on Energy Audit, methodology, energy efficient lighting system, Energy Instruments and Economic Analysis. The student will learn various improvement techniques, energy efficiency in HVAC systems.

Course Objectives:

- To understand basic concepts of Energy Audit & various Energy conservation schemes.
- To design energy an energy management program.
- To understand concept of Energy Efficient Motors and lighting control efficiencies.
- To estimate/calculate power factor of systems and propose suitable compensation techniques.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit–I
Basic Principles of Energy Audit
Energy audit- definitions - concept - types of audit - energy index - cost index - pie charts - Sankey diagrams and load profiles - Energy conservation schemes- Energy audit of industries- energy saving potential - energy audit of process industry - thermal power station - building energy audit - Conservation of Energy Building Codes (ECBC-2017) -

Unit–II:
Energy Management
Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring - reporting. Energy manager - qualities and functions - language - Questionnaire – check list for top management.

Unit–III:
Energy Efficient Motors and Lighting
Energy efficient motors - factors affecting efficiency - loss distribution - constructional details - characteristics – variable speed - RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice - lighting control - lighting energy audit.

Unit–IV
Power Factor Improvement And Energy Instruments
Power factor – methods of improvement - location of capacitors - Power factor with non-linear loads - effect of harmonics on p.f - p.f motor controllers – Energy Instruments- watt meter - data loggers - thermocouples - pyrometers - lux meters - tongue testers.

Unit–V
Economic Aspects and Their Computation
Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method- Power factor correction - lighting – Applications of life cycle costing analysis - return on investment.

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Course Outcomes:

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

- Understand the principles of energy audit along with various Energy related terminologies.
- Asses the role of Energy Manager and Energy Management program.
- Design a energy efficient motors and good lighting system.
- Analyse the methods to improve the power factor and identify the energy instruments for various real time applications.
- Evaluate the computational techniques with regard to economic aspects.

Text Books:

1. Energy management by W.R.Murphy&G.Mckay Butter worth - Heinemann publications - 1982.
2. Energy management hand book by W.CTurner - John wiley and sons - 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas - Marcel Dekker Inc Ltd-2nd edition - 1995
2. Energy management by Paul o' Callaghan - Mc-graw Hill Book company-1st edition - 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO